PROCEEDINGS OF 9TH ASIAN CONFERENCE ON OCCUPATIONAL HEALTH

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ON

OCCUPATIONAL HEALTH

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PREFACE

The 9th Asian Conference on Occupational Health was held from 22 to 28 October 1979 at Hotel Shilla, Seoul, Korea. The Asian Association of Occupational Health was inaugurated in 1956 in Tokyo. The Conference has been held every three years by host countries in Calcutta, India(1958), Manila, Philippines(1961), Jakarta, Indonesia(1964), Bombay, India(1968), Manila, Philippines (1971), Jakarta, Indonesia(1973) and Tokyo, Japan(1976).

The Korean Organizing Committee established the Conference headquarters at the Korean Industrial Health Association, headed by Prof. Young Tae Choi, President of the Association.

Numerous professionals in the field of occupational safety and health in Korea joined the organizing and scientific committees to make the Conference successful. The Administration of Labour Affairs also strongly supported the Conference.

The number of member countries that participated in the Conference was 10 – Australia and New Zealand, India, Indonesia, Iran, Japan, Korea, the Philippines, Singapore, Sri Lanka and Thailand, and the number of individual participants from non-member countries reached 6 – Canada, Kuwait, Saudi Arabia, the Republic of China, Sweden and the United States.

The number of participants who attended the Conference reached 447 including accompanying persons. The number of participants in the Conference as classified by nationality is as follows:

Number of Participants in the 9th Asian Conference on Occupational Health by Nationality

Nationality	Number of Participants	Nationality	Number of Participants
Australia & New Zealand	6	Saudi Arabia	1
Canada	1	Singapore	1
Republic of China	4	Sri Lanka	1
India	1	Sweden	1
Indonesia	36	Thailand	7
Iran	1	U. S. A.	2
Japan	62	I. L. O.	2
Korea	289	W. H. O.	2
Kuwait	1	Accompanying persons	24
Philippines	5	**Total**	**447**

Representatives of the World Health Organization and International Labour Organization also attended as honorary guests.

A deeply touching event at the opening session was the presentation of plaques of gratitude to those who have rendered distinguished contribution to the improvement of occupational health in Asia and the development of Asian Association of Occupational Health. Those who received plaques were the late Dr. K.M. Bhansali of India, the late Prof. Gregorio D. Dizon of the Philippines, Dr. Suma'mur P.K. from Indonesia, Prof. Juko Kubota from Japan and Dr. M.A. El Batawi from WHO.

During the scientific sessions, under the conference theme of "Health Begets Work, Work Begets Wealth" seventy-five papers were presented, two symposia were held, and fruitful debates were conducted throughout the entire period of the Conference.

Ladies programs for accompanying persons and a study tour were arranged by the Organizing

Committee in cooperation with the Global Tourist Services for sight-seeings and visits to historical places.

An exhibition of medical equipments and protective devices for occupational safety and health was held during the period of the Conference in the lobby of the Conference hall. Eight companies including Chest Corporation, Nihon Kohden Kogyo Company, Ltd., Hirayama Manufacturing Corporation, Kubota Medical Appliance Supply Corporation, Sagami Denki Company, Ltd., Sibata Chemical Apparatus Manufacturing Company, Ltd., Sanwa Kagaku Kenkyusho Company, Ltd., from Japan and Du Pont De Nemours & Company from the U.S.A., participated in the exhibition, which was greatly successful.

In conclusion as Secretary General — Treasurer, I would like to express my deep thanks to all of the committee members and participants for their cooperation which led the fruitful success of the Conference.

December 25, 1979

Kyu Sang CHO
Chairman of Scientific Committe,
9th Asian Conference on Occupational Health

OPENING SESSION

OPENING ADDRESS

Young Tai CHOI
President,
Asian Association of Occupational Health

Honorable Administrator of Labour Affairs Mr. Sang Yul Park, Chairman of the Organizing Committee Mr. Wan Sun Tae, distinguished guest from WHO and ILO, and many other institutes fellow members and participants, and ladies and gentlemen:

It is my real pleasure to hold the 9th Asian Conference on Occupational Health here in Seoul with the attendance of more than 400 participants from sixteen countries.

As we are all well aware, since 1956, the Asian Conference of Occupational Health has been held every three years in various Asian countries and has achieved steady growth with its member countries and delegates increasing every year. Now this Conference has grown to a recognized festival for all occupational health people in Asia, providing on opportunity for exchange of professional knowledge and promotion of friendly relations.

However, I would like to regard this Conference not only as a festival for occupational health people, but also as a festival for the managerial and working population of all industrial and nonindustrial fields, because I am quite sure that the success and achievements of the Conference will render great contribution to the promotion of an industrial welfare state.

I know that the governments of Asian countries are now concentrating their efforts on achieving their national prosperity, fully aware of the fact that their national prosperity depends on their sound economic development. They further know that economic development depends on the efficiency of businesses and the health of working people.

Here in the Republic of Korea, too, the Government has always shown deep interest in the discipline of occupational health, and its deep concern has recently resulted in the establishment of a national occupational health institute and related organizations and the unchanging government support to the voluntary agencies engaged in this important field. For the 9th Asian Conference on Occupational Health, our Government has been very generous, providing a good amount of subsidies and moral and administrative support. I am proud to let you know this, and in the capacity of the President of the Asian Association of Occupational Health, I would like to express my heartfelt appreciation in this regard. We are also much obliged to the Chairman of the Organizing Committee, and officers and members of the various committees and our counsellors.

On the occastion of the 9th Asian Conference of Occupational Health which is being held twenty-three years after its first meeting, I think it would be meaningful for us to turn our thought for a while to the problems related to the present and future work of the Asian Association.

It is my belief that our future depends much on vital issues such as cultivation of well-qualified occupational health personnel, a larger number of proper institutions and positions where occupational health people can work at their easy state of mind, and the financial and administrative supports from governments and enterprises which may help enable to develop and realize occupational health projects. Legislative supports may also be necessary in this regard. With a view to promoting and accomplishing our aims, I already suggested at the last General Committee Meeting held in Tokyo the establishment of a permanent secretariat to the Association and annual subscriptions by member countries for its effective operation. You may have read my proposal in the proceedings of the 8th Conference. Furthermore, I honestly believe that such an office will help the Asian Association to carry out its continued and strengthened activities.

Mean while, I would like to draw your attention to our discussions and decisions made at the last General Committee Meeting of Tokyo. At that meeting, we came to an agreement to form three working subcommittees, that is, a committee on occupational health education, a committee on international liaison with other organizations and a committee on occupational health services. Although some topics will be submitted to this Conference and sincerely be discussed, I regret to say that our discussions on these subjects have not been so active and far from satisfactory. Therefore, I hope that these matters will be taken up in more earnest under the close cooperation among all the member countries and occupational health people in this part of the world.

I hope that this Conference will reap successful results by means of exchange of academic knowledge on Occupational Health among the participating members. It is my belief that the results of the Conference will, upon your returning home, be able to hlep you to carry out your work efficiently in future.

Before closing my speech, I would like to say a few more words to you. Though my home members and officers did their best to bring about a success of the Conference, I am afraid there may be some points that escaped our attention. Therefore, please do not hesitate to let us know of any inconveniences you may find. We will help you. Thank you.

WELCOMING ADDRESS

Wan Sun TAE
President, Organizing Committee

President Choi, distinguished guests, the delegates to the 9th Asian Conference on Occupational Health.

First of all, I would like to welcome each of you to Seoul. I am happy that more than 130 delegates from overseas are participating here today at the Conference.

I would also like to take this opportunity to thank our government and the representatives from the industry who have helped us in preparing this Conference.

As you all know, the Asian Conference of Occupational Health has been meeting in every three years, and, through the exchange of professional knowledges and experiences, it has made a great contribution to the promotion of health of over one billion workers engaged in various industrial activities in this part of the world.

I have also noted with satisfaction that the organization of Occupational Health has spread its roots in many industrialized countries with recognition of its usefulness and effectiveness in improving productivity and promoting worker's welfare.

I have come to believe that the movement of the Occupational Health may play important role in Asian countries and that the workers in this field deserve high respect and recognition of their contributions. The most of Asian countries are in need of rapid economic development. The rapid industrialization often has its own drawbacks because working conditions and environments might cause an adverse influence upon the individual workers.

I think, therefore, that it bears a profound meaning that the Asian Association of Occupational Health hold periodical meetings, thus providing opportunities for delegates from member countries to discuss the matters of mutual interest.

In the Republic of Korea, there has been a considerable progress in the economic development in recent years. During this period, industrial development was particularly remarkable. Taking the last ten years for example, the number of workers increased by five times. Such a rapid growth of industries has, of course, brought about a betterment in the quality of life of the people. Unfortunately, however, we also noted that the rate of accident and sickness in industries are also increasing. We believe that a certain measure should be adopted in order to overcome the situation.

In the rural areas of Korea, "Saemaeul Un-dong," or New Village Movement, has been undertaken for the past decade with remarkable success. It is essentially a spiritual movement as symbolized in its slogan — namely, self-dependence, diligence and cooperation. The Movement was carried on successfully and has become famous worldwide as a model of rural development program. This movement has been introduced with some modification into industries in Korea. This modification is based on a family-like relations of management and workers, and the principle is being applied in all aspects of industrial activities. It is my belief that the integration of the occupational health programmes into the Factory New Village Movement will bring a favorable result in the long run.

Lastly, I sincerely hope that your stay in Korea be enjoyable, and, that this conference will bring fruitful result contributing to the prosperity of all Asian nations.

I also hope that the participants will find opportunities to travel other part of Korea to see historical sites and industrial facilities during their stay in Korea. Thank you.

ADDRESS

Sang Youl PARK
Administrator of Labor Affairs,
Republic of Korea

Dr. Chairman, distinguished participants, ladies and gentlemen.

It gives me great pleasure to speak on this auspicious occasion of the Ninth Asian Conference and Symposium on Occupational Health.

I am especially pleased to great guests in this autumn season, the most pleasant of the four seasons in this country. Just as we enjoy the many blessings of autumn, man obtains fresh air, clean water and many other treasures from untarnished nature. On the other hand, however, we know it is unavoidable to pursue industrialization at the risk of some damage to nature in order to gain what is indispensable to the wellbeing of man.

We also know that industrialization has caused misfortune to some people in the course of its fast expansion ever since the Industrial Revolution.

This nagative aspect of industrialization threatens human lives and health in the form of pollution outside factories. Inside factories, it has an adverse effect on the health of workers in the form of industrial accidents and occupational diseases, causing unhappiness to the families of those affected and posing a problem in the rehabilitation of workers.

Industrial injuries are so widespread today that there are some which could hardly be thought of at the time mankind first embarked on industrialization. And such problems are worsening quickly. Few persons can confidently deny that a time will soon come when the ill effects of industrialization threaten the very survival of mankind.

Asian countries, with a few exceptions, now ceaselessly strive to accelerate their industrialization, which they began late compared with Western countries. In a sense, this late start of industrialization rather gives us some advantages. We have, for one thing, the time to cope with the many side effects of industrialization beforehand.

Ladies and gentlemen! You are pioneers dedicated to combatting the misfortunes of workers. You have gathered here to discuss effective ways to forestall such misfortunes. The task of safeguarding the happiness of workers from industrial hazards can by no means be limited to any single country. It is a question that all Asian countries share in common. Needless to say, mutual cooperation cannot be over emphasize so far as this question is concerned.

A medical checkup held in 1978 for a total of 2.2 million Korean workers engaged in the area of mining and manufacturing revealed that a little more than 111 thousand or 4.9% of the total were infected by various diseases. Of them, 5,364 turned out to be the victim of 15 various occupational diseases. This alarming state of affairs is found to drive from a sharp increase in the number of industries handling harmful substances. It is feared that the victims of occupational diseases will swell sharply and the kinds of such diseases themselves increase in the days to come.

To control these occupational diseases, there must be effective ways to manage the production and use of harmful substances. Efforts should also be made to measure correctly the extent of workshop pollution and scientifically combat the cause of occupational diseases.

In our country, those workers engaged in areas handling harmful substances are subject to special medical checkups in addition to those routine checkups given to ordinary workers. The special medical checkups and the investigation of their harmful working environment are together conducted at those institutions equipped with sufficient facilities and staffed by qualified medical experts. A correct grasp of inter-related occupational diseases and working conditions will provide valuable in the preparation of effective measures to prevent those diseases. The question of improving working environment is being constantly studied and developed by the National Labor Science Institute which you participants are scheduled to visit on thursday afternoon.

Our government considers the issues of industrial safety and occupational health, incidental to fast economic growth and phenomental industrial expension, to be of the highest priority. In an effect to combat the problems through a long-term program, the administrative organization in this area has been drastically bolstered and growing budget amounts are set to be poured into this undertaking in the years to come. Safety devices for various machines and tools are being developed by domestic technology, as are many types of safety equipment such as dust masks. Some of this equipment has already passed the rigid state quality test.

But, there is one problem facing us in this area. A shortage of funds for compensation and insufficient facilities for training make it difficult to secure and train qualified professional workers for life-long dedication to research in this field.

We plan to concentrate our endeavors on the training of professional workers in the area of industrial safety and occupational health.

I am sure this project of manpower training is an undertaking in which all Asian countries should cooperate on a preferential basis.

Asian countries are confronted with many common problems that have arisen in the course of industrialization. Of these problems, I believe the issues of occupational health and industrial pollution deserve keener attention. Less than careful industrialization plans, indifferent entrepreneurs and ignorance and negligence on the part of workers are all factors detrimental to the execution of effective occupational health programs.

A forum like this, where experience and wisdom can be exchanged among many countries, cannot but be highly significant — especially in an age of industrial internationalization that features international cooperation on production technology and exchange of work forces.

One lesson we have gained lately is that the wide coverage of medical insurance policy begun in 1977 has also yielded considerable achievements in the area of occupational health. Since the protection of workers' health cannot be seperated from ordinary public health programme, efforts should also be made for the promotion of the health and welfare of ordinary people.

Lastly I would like to take this occasion to extend my appreciation to the Korean Industrial

Health Association which, under the leadership chairman Dr. Young Tae Choi, has contributed much to the development of industrial health programs in Korea in the past 15 years.

I hope this six-day session will bear fruit for the benefit of one billion in Korea and elsewhere in Asia. Thank you.

ADDRESS

Mustafo A. EL BATAWI
Chief, Occupational Health,
World Health Organization

Mr. President.

I have the honor to convey to you greetings from WHO's Regional Office in Manila and Headquarters and to thank you for inviting us here. We are indeed happy to see the great progress achieved by the Asian Association in Occupational Health which has increased in terms of number of members and scientific output. Many of your members have contributed pioneer work in occupational health in their countries and we are indeed happy to maintain a close cooperation with them.

In the last three years, WHO has also given more attention to occupational health with emphasis on technical cooperation with countries. Some twenty member states of WHO have been involved in this programme in 1978 and 1979. We further emphasize the development of appropriate technology and guidelines in various applied occupational health fields, and have recently embarked on a new programme on "health based exposure baits" in occupational exposure to harmful substances with a view of international harmonization of recommended standards.

We wish to call for stronger and continuing cooperation among countries and institutions in occupational health as a contribution to our goal of "health for all by the year of 2000." Recently, UNEP, ILO, and WHO have initiated a serious global exercise of coordination in workers' health.

Once again, we thank you for your kind invitation and wish you every success in this conference.

ADDRESS

Ryuji TANAKA
International Labour Office,
Regional Office for Asia and the Pacific

Mr. Chairman, distinguished participants, ladies and gentlemen.

It is an honour and pleasure for me to be invited to the 9th Asian Conference on Occupational Health. On behalf of the ILO Regional Office in Bangkok, I wish to thank the organizers of this meeting for their kind invitation.

With the rapid industrialization that is taking place in many countries of the world, the problems of industrial safety and occupational health, in particular occupational hygiene, have become more important than ever before. Especially in Asia, many developing countries have embarked on industrialization programmes, and are in the process of introducing newer technologies and newer industries. In doing so, new occupational hazards in addition to conventional ones have also come into being. These have to be given much more attention in Asia than in the industrialized West, as the workers in industry in our part of the world belong mostly to the first generation of industrial workers. Unfortunately, most developing countries in Asia are not yet sufficiently equipped to counteract such new occupational risks, let alone the old ones. Legislation and standards on the prevention of occupational accidents and diseases are in many cases too far behind to give satisfactory protection to the workers against various new hazards brought into workplaces. A large number of workers in the region — male and female, young and old, industrial or agrarian, — are obliged to toil and moil in poor working conditions and environments, which expose them to gases, fumes, dusts, noise, vibrations, toxic substances, radiation, pesticides, etc. All these hazards, in addition to tropical climatic conditions characterized by excessive heat and humidity, could have very serious and adverse health of workers.

It is in this context that the ILO launched the International Programme for the Improvement of Working Conditions and Environment (PIACT) in 1976. You may recall that Mr. D.H. Brown of the ILO Regional Office in Bangkok introduced the role of PIACT to you at the 8th Asian Conference on Occupational Health in Tokyo. Since its first step forward in Asia, PIACT has gained momentum through the holding of national tripartite meetings in Indonesia and Philippines. Similar meetings in other countries are also under consideration.

PIACT covers not only protection against physical conditions and dangers at the workplace and in its immediate environment, but also the adaptation of installations and work processes to the physical and mental aptitude of the worker through the application of ergonomic principles. The sessions of this Conference would also cover almost all the subjects which PIACT is concerned with.

Mr. Chairman, it should give us great satisfaction in a pleasure to know that we have at this Conference such a great number of colleagues who are dedicated to the ideals of PIACT. I am sure that there would be several others in this field who could not participate in the Conference but who could themselves contribute to rapid development of this field.

On the occasion of my attendance at this Conference, Mr. K.F. Yoshimura, the Assistant Director-General for ILO activities in Asia and the Pacific, suggested me that I tell you about another world-wide activity of the ILO which is closely connected with PIACT. As you know, industrial growth is still a main concern of all the countries in the world, and new technologies and chemicals are being continuously introduced into industry as well as agriculture to help the increase in productivity and growth. These technologies and chemicals might bring into workplaces "new occupational risks," of which we have had no information or experience. As you may be aware, today some 700,000 chemical substances are in daily use in production processes and only about 100,000 of these have been tested for toxicology. As technology progresses, another 10,000 substances could be added each year with or without any assurance of their safety. They could be a source of grave risk to workers' health. Noting the risks involved in new technologies, a resolution was adopted at the 1976 International Labour Conference that an international network should be established so that newly discovered occupational safety and health hazards can be communicated urgently throughout member countries. Given this mandate, the ILO has set up the "International Occupational Safety and Health Hazards Alert System" since 1976.

Under this system, when a substance is found to be toxic, or carcinogenic or is suspected of being potentially dangerous to workers, the country involved would be able to notify and request ILO Headquarters as focal point to transmit the information urgently to all others via its alert system. This would allow countries throughout the world not only to take immediate and necessary measures to guard against possible risks but also to make available to the ILO all pertinent information on national laws and practices concerning the exposure limits to the substance and its use.

The first alert was carried out on an experimental basis. Last year it was discovered that several men had become sterile while working in a California Factory which manufactured the pesticide dibromochloropropane (DBCP). Authorities in Washington signalled the ILO and asked that an alert be sent out with a request that any information on the effects of DBCP be relayed back. And so the first test case began. The ILO notified 14 countries likely to be the most concerned. Within weeks, 10 responses had been received and relevant information was sent back to Washington. The alert system has received support and a pledge of co-operation from the World Health Organization, the Commission of European Communities and the International Register of Potentially Toxic Substances of the United Nations Environment Programme.

Finally, I would like to mention some recent trends in occupational safety and health activities in certain Asian countries. In spite of financial and other constraints a number of countries in the region have established or are in the process of establishing their own institutes of occupational safety and health. As you may know, India has already set up one central and three regional institutes of occupational safety and health, which are already conducting quite a wide range of activities in the country. In addition, Indonesia and Korea have recently established similar institutes, although still to be fully staffed or equipped. The Philippines and Singapore are planning to set up institutes probably next year. Pakistan is also expected to have such an institute after 1982.

These trends denote that not only the governments but also employers and workers have begun to be fully aware of the importance of occupational safety and health. I believe, in the near future, these institutes would produce a significant contribution in the field of occupational health to the respective countries as well as to the whole Asian region.

I wish the Conference every success.

THE ACHIEVEMENTS OF MEMBERS WHO RECEIVED PLAQUES OF GRATITUDE

At the Opening session, the President of the AAOH, upon the resolutions of the General Committee meeting, presented plaques of gratitude to those who have rendered distinguished contribution to the improvement of occupational health in Asia and the development of the Asian Association of Occupational Health. The achievements of those who received plaques are as follows:

The Late Dr. K.M. Bhansali *(India)*

Dr. Bhansali had served the Asian Association of Occupational Health by taking the responsibility to organize the Conference in 1968 and by this action the Association has continued to exist. He had served as Vice-President of the Council of the AAOH from 1964 to 1968 and as President from 1968 to 1971. Through his life he had dedicated himself to occupational health in Asia as well as other countries.

The Late Prof. Gregorio D. Dizon *(Philippines)*

Prof. Dizon had founded the occupational health professional development in his country, and been continuously involved in the AAOH, since the beginning of the organization. His great leadership had been honoured by the AAOH by appointing him as the first Honorary President in 1971-1973. Until his passing-away, he had been still the honorary member of the AAOH.

Dr. Suma'mur P.K. *(Indonesia)*

Dr. Suma'mur had expanded the organization by the inclusion of more member countries and revived the Association when he had been in the service as President in 1971-1973. He had been appointed as Honorary President for 1973-1976 and is the first honorary member, and one of his great contributions had been the preparation of the Constitution of the AAOH as approved in 1973. In addition to his involvement in the Association from 1962, he is known as an occupational health leader in his country.

Prof. Juko Kubota *(Japan)*

Prof. Kubota, who is a recognized national leader in his country, had been President of the AAOH for the period of 1973-1976 and now still serves the Association as Honorary President. During his time as President, as well as Honorary President of the Association, he has indicated his outstanding leadership to promote and expand the Asian Association of Occupational Health. As an educator and scientist, he has contributed a lot to the better knowledge and practice of occupational health.

Dr. M.A. El Batawi *(WHO)*

Dr. El Batawi from WHO has since 1967 accomplished recognized efforts and successes to assist many Asian countries to develop better occupational health practices. He has contributed a good deal to the present living reality, indicating a considerable advice and progress in occupational health in Asian countries. Either as WHO official or as a person, he always gives inspiring challenge for Asian countries to step up the health programme for the working population. He has been in close cooperation with the AAOH since 1968.

SPECIAL LECTURES

OCCUPATIONAL HEALTH SERVICES IN KOREA

Kyu Sang CHO
Vice-President,
Korean Industrial Health Association

I. Present Status of Occupational Health

1. Working population and working conditions

Korea's population was 36.4 millions in 1977, of which 12.9 millions were economically active. 41.8% of them were engaged in agriculture, forestry and fishery, 22.4% in mining and manufacturing, and 35.8% in social and other services.

Until not long ago, Korea had depended mainly upon agriculture for its economy as other natural resources were scarce. After the end of the 2nd World War, Korea was divided into two parts and the Korean War which lasted for 3 years ravaged the then existing meagre industry of this nation. However, in 1962, an industialization programme was started under the three successive five-year economic development plans. The result was an average annual increase of 10.3% of gross national product with a high growth rate of 11.2% in mining and manufacturing industries. During the same period, the overall employment increased by an average of 2.7% per year: this rate of increase was larger than the population growth rate which average 1.6% per year. The Per Capita Gross National Product has now passed the level of $1,000.

With the industrial development, there has emerged a tendency of migration of the rural population to urban areas, particularly to industrial complexes, which has resulted in a social reform. Among the labour population, female and minor workers are increasing in number, and so it has become necessary to have more concern for their health.

The ratio of men to women working population is 1.7 to 1.0. The minority working population under the age of 18 years is reported to be 96 thousand. The average number of work days and work hours per month are reported 26.0 days and 230 hours respectively. The workers' average income per month last year was $202. The total number of workers in 55 thousand industrial undertakings; employing 5 persons or more, is 2.8 millions. The plants employing less than 100 workers account for 91.3% of the total undertakings and embrace 31.2% of the total workers. On the other hand, the enterprises with more than 1,000 workers account for only 0.5% of the total undertakings, embracing 28.0% of the total employees.

Viewing these figures, we, as in other countries, have many health and safety problems in these numerous small-scale industries.

2. Industrial accidents, occupational and non-occupational diseases

The increase in the number of work places and workers has resulted in the increase of industrial accidents and diseases. According to data from the Workmans' Compensation Scheme, in the duration from 1970 to 1977, the number of plants and that of workers increased 6.9 times and 3.6 times respectively. During the same period, the total number of the injured, disabled and dead due to accidents increased 3.1 times, 10.8 times and 1.8 times respectively. In 1977, out of 2,646,592 persons, 118,011(4.5%) were injured due to industrial accidents or suffered from occupational diseases, of whom, 11,336(0.4%) became disabled and 1,174 died. The average frequency rate and severity rate of industrial accidents in 1977 were 16.2 and 2.7 respectively. These figures, covering cases treated 8 days or longer, are larger than those of industrialized countries. This is attributable mainly to the poor factory facilities and insufficient technical training of workers.

With the introduction of modern industries into Korea, new occupational diseases have come to exist side by side with the conventional diseases. Some of these industries have brought in health hazards for workers from developed countries.

According to the results of a nationwide annual physical examination reported in 1977, there were 3,821 cases(0.18%) of occupational diseases and 98,853 cases(4.8%) of non-occupational diseases out of 2,073,703 persons examined. These small figures may be attributed partly to under-detection of cases due to the poor examination technique as far as occupational diseases are concerned because sample surveys by institutions disclosed a much higher rates of diseases in hazardous work places. I am not in a position to give accurate statistical figures here; however, based upon my long experience, I am showing in a schematic presentation the general tendency of major occupational diseases the past 20 years. There are three trends of occupational diseases; first, the diseases due to heat, noise, heavy work loading and radiation coming from welding, and benzen, CS_2 are gradually decreasing as the results of the improvement of working facilities and the prohibition of use of toxic chemicals. Second, the diseases caused by chemical agents, such as, lead, mercury, chrome, cadmium, organic solvents, P.V.C. and ionizing radiation, are on the increase with the growth of the modern industries and the application of new tools. Third, the diseases due to dust do not show any change, because, in spite of the improvement of the work environments in coal mines and other fields, the dust producing industries are increasing.

Our workers, as in other Asian countries, are still suffering from infectious diseases, parasitic infections and under-nutrition, in addition to occupational injuries and diseases. Public health services for workers are needed as much as occupational health services.

3. Occupational health services

The Labour Standard Law, passed in 1953 with the corresponding enforcement regulations, deals with the workers' health and safety. The law requires enterprises of 50 or more workers to employ physicians as health officers to carry out, with their assistants, occupational health practices, ranging from environmental measurements to first aid and health education.

In 1977, the registered industrial health officers, their assistants and the industrial safety officers in plants numbered 6,247, 6,794 and 5,824 respectively. Among the health officers, only 174 physicians were full-time employees and the rest were part-time physicians having their private clinics.

Enforcement of the law is carried out by the Administration of Labour Affairs that has 269 labour inspectors, of whom 10 are engaged in health and safety activities which, in fact, require a far greater number. The Workman's Compensation Scheme was started in 1963 and its 34 provincial field offices with an organized system have contributed greatly to the development of occupational health and safety practice.

Academic study of the occupational health in Korea was started in mining areas after the Korean War which devasted the whole country. At that time, explosion accidents occurred frequently in mining areas, and cases of occupational diseases, including silicosis, were found numerously. The members of these research teams organized the Korean Industrial Health Association which was established in 1964. The Association has much contributed to the improvement of occupational health services through its seven provincial branches and service centers which are closely supported by medical schools.

In 1962, the Catholic Institute of Industrial Medicine was inaugurated as the first research institute of its kind in this country and the Industrial Accident Hospital followed. Recently, similar new institutes have been established in medical schools, and the National Institute for Science of Labour was opened last spring. Few years ago, the government inaugurated the Labourers' Welfare Cooperation which was founded with the Industrial Accident

Compensation Insurance funds. The Cooperation has three hospitals in industrial complexes. The new Medical Insurance Act was started in 1977, now covering workers serving in enterprises employing more than three hundred persons. The insurance will be extended to all workers in the future.

There are 18 medical schools, eight dental schools and 52 nursing schools in this country. Some of them have been newly established in answer to the demand of the medical insurance system recently started. The teaching of occupational health is included in the undergraduate curriculum of the medical school. A post-graduate course for occupational health is offered for both medical and para-medical students.

Training for industrial health officers and their assistants is required by law. Training for physicians is a refreshment course and that for their assistants is designed to confer a certificate.

II. Prevailing Constraints in the Delivery of Health Care Services to Workers

There are several constraints in the delivery of health care to workers; these difficulties act adversely on the health care and its efficiency. The major problems of them are as follows.

1. Legal aspects

Factories employing less than five persons are not yet covered by legislation, and those employing less than 16 workers are excluded from the existing Industrial Accident Compensation Insurance Scheme. The law also requires factories of 50 or more workers to employ health officers. Needless to say, the workers excluded from the protection of the law have more problems of health and safety in their work. It is expected that, in this country which is now in the process of rapid industrial progress, all workers will be covered by health and safety legislation in the near future, regardless of the number of workers and size of industries.

2. Labour inspectors

The government has the responsibility for inspection and guidance services; however, the limited number of inspectors can not cover the large number of factories which are scattered widely. In such a situation, an inspector can inspect only a limited number of factories conveniently situated near his office or turn to the efficient inspection of a large factory with the same number of workers. Sometimes an inspector first visits the factory only after an accident happened.

3. Industrial health officers and their assistants

Most of the industrial health officers are part-time physicians who operate private clinics located near their factories. They spend most of their time for their patients and show less interest in health care services for their workers even though their duties of occupational health services are stipulated by law. There are many factory physicians who do not even conduct periodic physical examinations for their workers. In such cases, examinations are carried out by a physical examination team from outside the factory.

The assistants to health officers are mainly classified into three types; nurses, hygienists, laboratory technicians and other certificated personnel. Their certification training is of a short term and insufficient, moreover, most of them have dual job in the factory and frequently move from position to position. Under this situation, except large enterprises, most of the factories carry out very limited activities of occupational health.

4. Research institutes and medical schools

Research institutes and medical schools which have specialists in the field of occupational health are engaged in special surveys or researches such as study of pneumoconiosis, chemical intoxications, heat or noise problems, ergonomics, and so on. They are not much interested in studying health care delivery systems for workers. Some staff members in medical schools think that this problem belongs to the government only. Occupational health lectures and practice offered in medical schools are designed to teach mainly occupational diseases. So, the students do not have ability to solve the problems of how to evaluate the workers' health and how to carry out the delivery of health care for workers. The Korean Medical Educational Association is now seriously considering curriculums by which community medicine and primary care in undergraduate education will be more intensified.

Physical examination which is one of the most important occupational health services are carried out mainly by occupational health centers or medical group teams. They are not financially supported by the government or other foundations. They are operated only with incomes from physical examination fees paid by factories. Consequently, from the mass examinations result only less academic achievements.

5. Workers and labour unions

In many instances, workers in industries, especially in small industries, are apathetic to conditions related to the providing of health and safety facilities. Trade unions are more interested in the wages of workers than their health and safety. Still now, many workers, even the old and the skillful, do not alway realize the importance of their physical examination and fail to actively participate in it. Health education programmes for workers are very important.

6. Small factories

Financial constraints in small-scale industries are directly reflect on the workers' health. Moreover, the employers are not oriented in occupational health and safety. Economic constraints in industrial progress tend to be more pronounced in small industries. In small-scale industries they cannot obtain their personnel by proper selection, and so tend to engage any available workers. Thus, they turn to cheap labour, employing vulnerable groups, such as women, young persons or hadicapped. This situation created a further constraint on the health and safety services.

III. Solution of the Problems and Recommendations

1. Desirable occupational health services

There are a number of impediments to the delivery of health care to industries; such as (a) lack of economic resources to pay for health services, (b) lack of facilities and trained personnel such as industrial physicians, hygienists, nurses and inspectors, (c) the vast number of small factories which are widely scattered, (d) the lack of legislative coverage for very small establishments.

Depending on the situation of countries, certain patterns of the organizations of health care for industries have emerged.

The community health center is insufficient as an organization for occupational health services because it carries out part of general public health services.

The industrial health center is controlled by the government in socialist countries.

Large factories which have their own institutions are not in a position to take care of small factories.

Group medical practice for occupational health services is mainly for treatment rather than for prevention.

Industrial group occupational health center is the most recommendable. It is based on the cooperative principle where a number of factories pool their financial resources together to organize group occupational health services. This type of service is suitable particularly to concentrations of factories such as industrial estates and newly developed complexes located in one geographical area.

2. Support from Government, institutions and medical schools

It is desirable that the government, in consideration of defects which may occur in the enforcement of the Labour Law, provide legal and administrative support so that the business owners, under joint investment, can jointly establish and operate in each industrial area, an occupational health service organization, in the form of a body corporate. This system will serve as a useful network for the solution of various important problems by the government.

At present, there is a great shortage of occupational health personnel, particularly specialists. For these personnel to be able to work effectively in the field organizations, they must form close ties with and receive support from research institutes and colleges. Furthermore, it is recommended that the colleges have their staff members dispatched to the field organizations for the study of various problems occurring there and, at the same time, utilize them as their fields for student practice.

3. International cooperation

Each country has its own occupational health problems. Industrialized nations have their old and incorrigible problems while there is a pile of unsolved problems in developing countries. It is earnestly hoped that we make frank discussion on problems of common interest at the international level and make joint efforts in developing and improving the work of this field for the benefit of our countries and society.

INTERNATIONAL TRENDS IN OCCUPATIONAL HEALTH

Mustafo A. EL BATAWI
Chief, Occupational Health,
World Health Organization

A. Present Situation

In recent years Occupational Health has witnessed rapid development probably in view of industrialization in developing countries and the increasing awareness of workers to their rights in health protection. Despite progress on various fronts the situational analyses show the following problems.

1. Extensive losses are encountered from occupational and work-related diseases and injuries in many countries, far exceeding any imaginable cost of prevention. This situation seems to continue unabated in many countries with new many work hazards requiring a more vigorous intervention and a well-coordinated international effort.

2. There is evidence that rapid industrialization with little attention to environmental control measures in the developing countries is bringing with it several types of new health problems which are added to the already existing diseases and aggravate various conditions of ill health.

3. Work automation, mechanization and stressful conditions at work have been associated with many health problems, including alcoholism and psychosomatic conditions. These conditions are now on the increase in many developing countries where the speed of socioeconomic change renders more people susceptible.

4. The number of toxic chemicals produced and handled by workers is rapidly increasing. There is a special need for action to protect workers who are daily exposed to toxic chemicals that might endanger their health or even survival.

5. National health services in many countries have relied totally on medical clinics in the private sector of industry for the delivery of health services to workers. The large number of underserved workers in the developing countries have the right to receive good health care, and the national health services have a definite role to play. At the same time, there may be a possibility of improving the services of the medical clinics by introducing preventive health measures and increasing their coverage of the population.

6. There is a need for better coordination and cooperation between various governmental bodies concerned with the health of workers including labour, health and industry.

7. There is great shortage of trained personnel in various fields of occupational health. At present, very few qualified specialists in occupational health and hygiene are available as compared to the needs in developing countries.

B. Advantages and Trends

Work is a key element to progress and achievement. It is the human being's main identification with a productive life. It is a human objective as well as means of earning a living. When it is a well adjusted and productive activity, work can be an important factor in health promotion, an aspect that not as yet been exploited to the advantage of workers' health. Present knowledge of work physiology and ergonomics needs to be further developed and applied.

In the developing countries work is becoming increasingly mechanized. A number of working processes have been developed that treat man as one of the tools in production, with little regard to human needs and aspirations and there is a wide variety of risks threatening workers' health and lives. The lessons learned during the industrial revolution should now be borne in mind in planning for health and economic development in developing countries.

Psychosocial factors in the working environment influence workers' health in a number of ways. Negative influences can result from inappropriate organization of work, automation, poor working relations, job tenure policies, the degree of responsibility, repetitiveness, speed, alternating shifts, overload and underload. There is increasing evidence of the role of work stress in causing overt disturbances such as the excessive use of alcohol or drugs, psychophysiological symptoms, and heightened susceptibility to physical illness. At the same time, it appears that much larger numbers of people are suffering from dissatisfaction in their work, fatigue and low motivation. Extensive research is needed in these areas, which so far have received only limited attention. Yet effective preventive measures could be taken through occupational health work at the plant level. In collaboration with work management, the health services at the plant level are in a good position to identify causes of disturbances at an early stage. Once the causative factors have been identified, preventive measures can be introduced and a considerable amount of ill health can be avoided. Adverse psychosocial factors in the place of employment are more susceptible to control than those in the general environment, which are more complex and less easily identifiable.

The delivery of preventive health services to people in their work places has the advantage of easier access and facilitates environmental and health monitoring. It also makes it possible to control at source various environmental pollutants originating from industry.

C. Required Action

1. At the national level, the underserved sectors of working populations, e.g., in agriculture, small industry, construction and mines where specialized health services are not available must be provided with primary health care by the health services or other systems.

2. Resources available in industry should be used to the greatest possible extent for the development of preventive health care for workers and wherever possible their families and medical care units in work establishments might be required to follow a preventive health approach. It may be necessary to develop appropriate health legislation in this respect.

3. National occupational health institutes serve a wide variety of important functions including preventive measures to control hazards at work places, standard setting, research and training.

International cooperation and coordination among these institutes are essential to develop their national capacity and help exchange of information.

4. There is a fundamental need for systematic epidemiological studies of the health problems of workers in different occupations and the introduction of an epidemiological approach in workers' health services. The benefits are obvious in terms of recognition of health trends and the overall improvement of knowledge.

D. Occupational Health Service Research

The present gaps in our knowledge will have to be covered by the coordination and conduct of applied research. Some of the priority areas calling for international efforts are listed below.

1. The study of the relationship between workers' health and productivity.

2. The investigation of work and human factors influencing occupational psychosocial health.

3. The epidemiological evaluation of toxicity of new chemicals in industry, with a view

to recommending permissible levels of exposure in the working environment.

4. Studies on methods for the detection and analysis of pollution in work places and on criteria for the early detection of health impairment in occupational exposure to various health hazards.

5. Research on the health effects of various low-level occupational exposures on normal individuals and on vulnerable groups.

6. The study of work-related diseases which may partly be caused by the working environment and processes, and which are susceptible to control within the work setting (e.g. hypertension and cardiovascular diseases).

7. The investigation of important synergistic effects in combined exposure to various hazards in work places.

8. The study of work as a factor in health promotion, and applied research on work physiology and ergonomics.

These are questions of vital importance to developing and industrialized countries. Any such research should start by reviewing the knowledge available, identifying gaps and aiming at developing guidance on the various health problems of workers.

A STUDY OF THE POLICIES AND ORGANIZATIONAL PATTERNS OF OCCUPATIONAL SAFETY AND HEALTH FROM VARIOUS PARTS OF THE GLOBE BY THE WORLD SAFETY ORGANIZATION

Emiliano I. CAMARILLO
President, Director General,
World Safety Organization

On behalf of the World Safety Organization, allow me to congratulate you all for this commendable conference of experts and enthusiasts in the disciplines of occupational safety and health, the ultimate goal of which is the welfare and benefit of the thousands of millions of workers throughout the world.

My associate in the World Safety Organization, Professor Wai On Phoon, of Singapore, who is currently our Executive Vice President and Regional Director for Asia in his paper during the WSO Second World Safety and Accident Prevention Congress (1978 WOSAPCON) in Singapore, stated and I quote: "Occupational health is a subject which concerns itself with all aspects of the health of the working populations. Occupational health has made great strides and received increasing attention just as its allied discipline, Occupational Safety. These two areas are so closely intertwined that it is scarcely possible to talk of one without mentioning the other." Allow me, therefore, on this occasion to address you in the context of both disciplines — occupational safety and occupational health as these are practised in various parts of the world.

Occupational safety and health must be the primary concern of government and all establishments employing people. People are the most important resources of production. People, therefore, must be afforded maximum care and protection in their health, safety and well-being.

The constitution of most countries guarantee the rights of the citizens to life, liberty and the pursuit of happiness. A great number of workers consider that working under dirty, dangerous and unhealthful conditions is a great infringement of their fundamental and basic rights to health and welfare. All countries must develop, organize, and maintain sound, effective, and efficient occupational safety and health programs for all their workers and employees. Let me cite some outstanding programs implementing these disciplines in safety and health in various countries.

A piece of legislation considered by millions around the world as a milestone in occupational safety and health is the Occupational Safety and Health Act of the United States passed in 1970. The main objective of this Act was to *"assure insofar as possible every working man and woman in America safe and healthful working conditions".* The Act ensures these benefits to fifty seven million workers and employees and more than four million American business establishments.

Under the OSH *A*ct of 1970, which many countries around the world have duly taken notice of in view of its outstanding features for the welfare of the working population, the prime responsibility of administering and enforcing the provisions and regulations of the Act rests with the Secretary of Labor of the United States.

From the other side of the glo e, A. Semenov, Head of the Labour Protection Department and Chief Labour Inspector of the All-Union Central Council of Trade Unions in Russia, stated in his paper sent to the World Safety Organization that "the basic directives for the development of the USSR national economy in 1976 to 1980 envisage further development of labour protection, large scale utilization of scientific and technical achievements, development engineering and machinery to provide safe working conditions". He continued, "it is planned to devise new methods and means of air pollution prevention, control of transport noise, industrial noise, and other kinds of noises, vibration control, methods and means of protection against harmful electric and magnetic fields and radiation protection". Mr. Semenov further stated that "continuous efforts will be made towards further mechanization and automation of manufacturing processes, gradual elimination of manual labour especially hard and disagreeable operations".

We have noted in the aforementioned reports the occupational safety and health organizational philosophies and patterns of two major countries — Russia and the United States. Let's take a quick look at the others.

Dr. Alan Bell, Vice President-Director of the WSO Division for United Nations and International Bodies Relations, briefly enumerated before the Second World Safety and Accident Prevention Congress some highlights of the occupational safety and health programs of some countries, to wit:

1) Denmark's Working Act states that the "safe and sound working environment shall anytime be in accordance with the technical and social development of society, and the basis on which undertakings themselves will be able to solve questions relating to safety and health".

2) In Canada, a comprehensive act respecting the occupational health and occupational safety workers was passed in 1976.

3) The United Kingdom Act of 1974 incorporates several provisions aimed at the workers; and the requirements that they must be informed as to the hazards they are exposed to, so that they are no longer "Helpless ignorant pieces of jetsam". It also contains provisions aimed at the promotion of self-regulation by employer and work people jointly; namely, "it is the duty of every employer to consult with employees' representatives to prepare a written statement of general policy with, respect to the health and safety at work and the arrangements for carrying it out and to bring the statement to the notice of all his employees". These last provisions are taken into consideration in various countries, which ensures that self-regulation by employer and the working people are featured in their respective occupational safety and health programs.

4) In the Philippines, the major task of eliminating unsafe and unhealthful work conditions affecting the workers' productive efficiency, and preventing the useless drain of capital is given to the Ministry of Labor that is empowered to set and enforce mandatory standards to eliminate or reduce occupational hazards. The promulgation of these standards are in the province of the Bureau of Labor Standards within the Ministry of Labor. To carry out the fullest scope these standards, tripartite participation and cooperation among government, management and labor is carried regularly. Soon, an Occupational Health and Safety Institute will be established by the government of the Philippines.

In presenting the philosophies and organizational patterns for occupational safety and occupational health, the following must serve as parameters by those in power to achieve for every working man and woman safe and healthful working conditions and to preserve the human resources:

1) encouraging employers and employees in their efforts to reduce the number of occupational safety and health hazards;

2) providing that employers and employees have separate but dependent responsibilities and rights;

3) setting mandatory occupational safety and health standards and creating occupational safety and health review procedures;

4) building upon advances already made;

5) providing for research;

6) exploring ways to discover latent diseases;

7) providing medical criteria;

8) providing for training programs;

9) providing for the development and promulgation of occupational safety and health standards;

10) providing an effective enforcement program;

11) encouraging joint labor-management efforts to reduce injuries and diseases arising out of employment; and,

12) ensuring the widest dissemination of these programs and projects and their implementation by informing all concerned.

I now, therefore, strongly recommend that your Association align itself and give full support to the following;

1) each and every country without any tangible piece of legislation on occupational safety and health must introduce and adopt in their respective constitution and/or major acts a statement on the rights of all persons to safe and healthful working conditions;

2) introduce and implement the concept of establishing National Advisory Committees on Occupational Safety and Health and that the proceedings of their meetings be opened to the public;

3) urged governments to support the ILO, ISSA, WHO, WSO and other international bodies concerned with safety and health in their current activities aimed at humanizing work; and,

4) pass and adopt a resolution that all Occupational Safety and Health legislations be preferably administered by a senior autonomous organization whose functions are primarily to humanize the workplace and which does not have other responsibilities unrelated to health and safety.

Government full support is needed if such advances in the fields of occupational safety and health were to include the control of work hazards. The role of governments in these vital disciplines is absolutely essential. Safety Superintendent, E. W. Tobin of Australia, in his paper presented at Singapore, underscored this point when he said, "it must first be recognized that a major responsibility of any government is to legislate and control the total environment to ensure the safety, health and welfare of the people."

This leads us to the question which Tobin asked: "How many governments have fully developed laws controlling fire prevention and escape, electricity-gas-water-oil supply, industrial-commercial-residential building codes, dangerous emissions of fumes gas-radiation-noise, consumer products safety, the transport of workers and people, and so on?" Tobin's ultimate inquiry was: "Are you truly researching and developing these laws and ordinances, and finally are you enforcing them?"

These questions were posed to the participants and delegates of the WSO 1978 WOSAPCON. I am now presenting these to you in the spirit of cooperation and support that occupational safety and health be a way of life among our employers, employees and the working men and women throughout the world. In line with E. W. Tobin's thinking that possibly a Department of Community Safety be established by all countries, and in the context of Dr. Bell's paper which partly stated that "all occupational safety and health legislations be preferably administered by a senior autonomous organization which does not have other functions unrelated to health and safety, I ventured in one of my newsletters to all WSO worldwide members and non-members alike a proposition that possibly, all nations and their governments must establish a separate and independent Ministry of Safety which shall administer, implement and manage all safety requirements of any one country.

One wrote that "a sense of unhealthy rivalry has occurred in some countries between different departments or ministries to the advantage of no one, least of all the man and woman at the job exposed day by day to hazards while the debate continues who really is or are to handle to its exclusiveness the functions of safety". This is an issue which must be settled, the soonest the better. Your conference today should be able to help in getting the proper support for the resolution of this issue in the future.

In expressing the above opinion, I do not express here any official stand that any country may be taking on the above issue now or in the future. However, from the replies the WSO has been receiving, the initial reactions seem to be in favor of an independent autonomous and separate Ministry of Safety which shall handled all related areas of disciplines including occupational safety and health.

Whatever the outcome of this particular point, this could redound well to the further strengthening of the occupational safety and health which we all are working for.

In conclusion, let's all keep on our forward thrust in our determination to ensure the best favorable condition of the working population through effective occupational safety and health program. A wise man once said centuries ago that "to move forward is difficult enough... but moving backward is the most difficult indeed." I would say it differently — moving backward has all its hazards — moving forward is certainly safe enough. Onward we go therefore in our monumental tasks. Thank you.

Session 1.

Organization of Occupational Health Services

OCCUPATIONAL HEALTH SERVICES IN THE PHILIPPINES

Benito R. REVERENTE Jr., *Philippines*

History

Occupational health in the Philippines had its beginning in the early years of the American occupation (1900-1925) when company dispensaries were organized in the fledging industrial concerns. Medical service however was confined to treatment of illness and injuries. After some physician-scholars returned from training abroad, the Section of Industrial Hygiene of the Bureau of Health and the School of Hygiene and Public Health of the University of the Philippines were established in 1927. Shortly thereafter, the first legislation on health services in industry was enacted with the passage of the Workmen's Compensation Act and the Emergency Medical and Dental Services Act. The latter prescribed compulsory health services in industrial establishments based on the number of workers and the hazardous nature of work.

After World War II, through the efforts of Dr. Gregorio D. Dizon, occupational health really took off. He founded the Philippine Association of Occupational Medicine in 1952 and started a series of post-graduate seminars in Industrial Hygiene and Occupational Health. Other organizations were formed, and these were the following:

1. Philippine Association of Compensation Medicine (PACOM) in 1959
2. Safety Organization of the Philippines (SOPI) in 1959
3. Occupational Health Nurses Association of the Philippines (OHNAP) in 1969
4. Industrial Medical Association of the Philippines (IMAP) in 1970
5. World Health Foundation of the Philippines in 1971
6. The merger of the PAOM, PACOM and IMAP into one umbrella organization, the Philippine Occupational and Industrial Medical Association (POIMA) in 1975.

All these associations conducted periodic scientific meetings and annual conferences on occupational health.

In 1975, a law with far-reaching implications on occupational health was enacted in the form of the New Labor Code. This war followed by the Occupational Health and Safety Code of the Philippines in 1978.

Current Status

The present status of occupational health in the Philippines is mainly the result of the two laws which I had just mentioned. They prescribe the minimum standards for occupational health and safety services in industry. The salient features of the relevant provisions are as follows:

1. Compulsory provision of occupational nursing, medical and dental services either on full-time or part-time basis depending on the hazardous nature of the workplace and the number of workers employed.
2. Compulsory post-graduate training of all occupational health personnel in occupational health and safety and the requirement for attend-

* (By a different estimate, 30% of all persons in the age range 16-74 years are not in the labour force.)

ance at Refresher Courses at least once a year thereafter.

3. Beside providing curative medical services, the requirement for occupational preventive health care by the physician including pre-placement and periodic physical examinations, health maintenance, environmental monitoring and control of health hazards, etc.

4. Compulsory free family planning services for all employees and their spouses.

5. Formation of health and safety committees in all establishments and provisions for reporting of all work-connected injuries and illness to the Ministry of Labor.

6. Establishment of threshold limit values for all airborne contaminants and prescription for permissible environmental standards for noise, lighting, ventilation, humidity, etc.

7. Rules and regulations for the proper handling of agricultural chemicals (pesticides and fertilizers).

8. Establishment of the State Insurance Fund and the Employees Compensation Commission to provide compensation and medical services for all work-incurred illnesses and injuries.

9. Rules and regulations for inspection of factories and establishments to ensure compliance with health and safety standards.

With the requirements prescribed by these new labor laws, compliance by industrial establishments gradually followed. To provide opportunities for post-graduate training, the Institute of Public Health and the World Health Foundation of the Philippines with the support of the Philippine Occupationla and Industrial Medical Association, organized a quarterly post-graduate course on Occupational Health and Safety. Since 1975, a total of about 450 doctors, nurses and dentists have taken the course. In addition, the POIMA has organized intensive crash courses on occupational health in the provinces based on the same course content as the one given in Manila. So far about 200 have finished this course.

In addition to the Bureau of Labor Standards of the Ministry of Labor which is the regulatory arm of the government on occupational health services, the Ministry of Health has also occupational health activities conducted by its Division of Industrial Hygiene. This division conducts research and factory inspections but has no police powers. It also gives training seminars on occupational health to its municipal health officers.

Research in occupational health is mainly conducted by the Institute of Public Health of the University of the Philippines. The other medical institutes hardly contribute to the local literature on the subject. Occasionally the medical officers of the Employment Compensation Commission and some company physicians employed in private industry undertake some research work. The volume, however, is at best minimal. There is therefore a need for stimulating research through grants, incentives and other promotional activities.

I have earlier mentioned the merger of the three occupational health associations into the POIMA which occurred in 1975. Previous to this event, efforts and resources spent on improvement of occupational health in our country were dissipated due to rivalries and duplication of functions. Through the initiatives of the late Dr. Gregorio Dizon, the merger was realized and the present POIMA was organized with yours truly as the first president.

Our very first campaign was to attract all occupational medical practitioners to become members. We carried this campaign to the provinces and today we have six provincial chapters and a total nationwide membership of over 600.

Our next step is to have our association recognized as a specialty society and occupational medicine as a distinct specialty by the Philippine Medical Association. Two requirements were needed, namely (1) the formation of a certifying board which will conduct certification examinations for occupational medical specialists, and (2) establishment of a residency training program in occupational medicine.

In compliance with these requirements the POIMA has formed its Specialty Board and initially certified 200 physicians as diplomates in occupational medicine. By the end of this year, it will give a certification examination to applicants for the specialty. The POIMA in cooperation with the Institute of Public Health will start offering a 2-year residency training program in occupational medicine

The third and most important drive the association is undertaking is the continuing medical education program for its present and prospective members. The Philippine Medical Association, as you know, and the Ministry of Labor as well, requires a certain minimum number of hours of attendance in post-graduate courses and scientific meetings per year. In the case of the PMA the requirement is 50 CME units. The POIMA conducts quarterly scientific meetings and annual conferences for this purpose in addition to the post-graduate courses it offers throughout the year.

Two other significant events are contributing toward improving occupational health services in the country. A year ago a National Tripartite Conference on the Improvement of Working Conditions was held in Manila under the auspices of the ILO. An offshoot of this conference was the formation of a National Tripartite Committee for the improvement of working conditions. Appointed as members of this committee by the Labor Minister were various representatives from management groups, labor, government, occupational health and safety associations as well as from the academe.

Though the objectives of this committee encompass the whole range of working conditions, its main thrust is on occupational health and safety. It has conducted so called "awareness seminars" for managers and labor leaders to arouse interest in occupational health among them and to persuade the decision-makers of business to allocate more of its resources for occupational health and safety. It is also extending material help toward research work on occupational health problems. Another sub-committee is in charge of studying working conditions of occupational health workers and making recommendations to the Ministry of Labor for better pay and fringe benefits.

The other occurrence was the election of an occupational medical practitioner as president of the Philippine Medical Association. After he took his oath, he immediately formed a Committee on Industrial Medical Practice whose main objective was the improvement of occupational health services. The committee's work plan includes the following:

1. to influence the deans of the various medical schools to increase the number of hours alloted to under-graduate teaching of occupational health.

2. to support the residency training program initiated by the POIMA and provide incentives to new medical graduates to take up careers in occupational health.

3. to work out an intensive publicity campaign in mass media on occupational health.

4. to review renumeration packages of physicians employed in industry and work out equitable salary standards for them.

5. to work for the establishment of local medical standards for occupational health programs.

Lastly, President Marcos has just signed a bill establishing the Occupational Health and Safety Institute of the Philippines. Hopefully when it becomes operational next year, it will help stimulate research, establish occupational health standards in industry and assist occupational health practitioners in environmental monitoring of the workplaces as well as in the medical surveillance of workers in their respective establishments.

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THE SITUATION OF ACTIVITIES OF JAPAN FEDERATION OF OCCUPATIONAL HEALTH SERVICE ORGANIZATION (ZENEIREN)

Akira HARADA, *Japan*

Japan Federation of Occupational Health Service Organization (Zeneiren) was established in 1969 by combining nationwide twenty occupational health service organizations (which had mainly been doing occupational health services), and at present (August, 1979) has grown to a large scale of construction nationwide and capable 62 organizations (50 members and 12 associate members) together with the development of the occupational health in Japan.

Each organization belonging to Zeneiren is doing occupational services such as several health examinations and environmental measurement of workshops concerning occupational health control, and in addition, some of them are doing health care services for school children or general population, and measurement related to environmental pollution.

Most of the large companies in Japan are doing occupational health control survey by themselves, but small companies cannot do it by themselves because of the lack of money and man power. Therefore, activities of such occupational health service organizations belonging to Zeneiren are expected and requested.

During 1977, 19,363,885 workers and 40,993 workshops received the health examination and environmental measurement by all organizations belonging to Zeneiren, and 23,474,302 workers and 42,263 workshops in 1978.

Number of workers for health examination has been gradually increased, and hereafter is expected to increase more. On the other hand, number of workshops for environmental measurement was very few, but hereafter is expected to increase according to the popularization of the environmental measurement. Among the organizations belonging to Zeneiren, every

Table 1. Number of workers received health examination and number of workshops done environmental measurement.

		1977	1978
Health examination	Number of industrial workers	5,444,007	5,974,892
	1 General health examination	4,622,233	5,053,150
	2 Health examination to detect occupational hazards	821,774	921,742
	Total (include school children and general population)	19,363,885	23,474,302
Environmental measurement		40,993	42,263

organization cannot carry out the environmental measurement thoroughly, but is in a hurry to equip for carrying out it.

For the health examination and environmental measurement, after-cares for them are very important, and carried out by each company in its responsibility in Japan. Our organizations belonging to Zeneiren are doing positively advices and guidances for each companies so that these after-cares are carried out without fail. But it is regretable that each organization belonging to Zeneiren is not doing advices and guidances sufficiently, but is trying to do them.

Many organizations belonging to Zeneiren make long-term contructs with companies, and are doing health services continuously.

In order to perform smoothly the business of Zeneiren as above mentioned, each organization is imposed the most important task to maintain doctors who are the nucleuses of it. Even in Japan there are few doctors who are specialized in the occupational medicine. Therefore, in case that the doctors specialized in the occupational medicine cannot be maintained, it is decided that no less than one occupational health consultant who has passed the national examination should be kept in each organization. In addition, a matter of course, each organization is trying to maintain the other man powers (medical technologists, radiologic technologists, working environment measurement experts, industrial nurses etc.). And some organizations have the specialists related to occupational health engineering and physical science to meet the demand.

Every organization of Zeneiren has a motto "The aim of the occupational health service is not to get a profit," but is trying to establish a economical basis by getting a reasonable fee. Thus, Management Committee has been organized for above mentioned purpose.

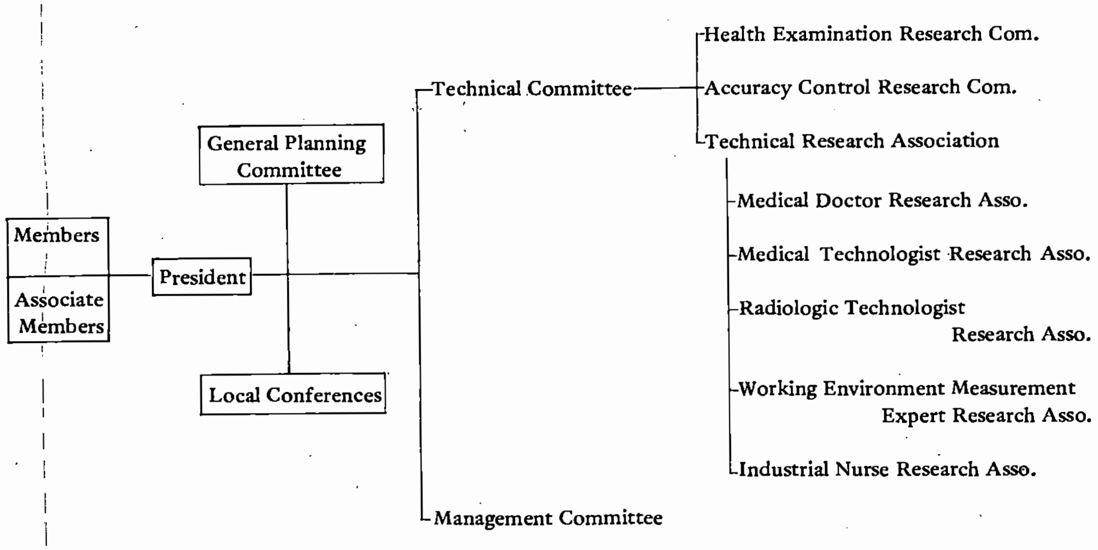
On the other hand, Zeneiren is doing the following businesses for the purpose that each organization belonging to Zeneiren can do the above mentioned services smoothly and certainly. The one is to improve the techniques of the health examination and inspection and to establish the accuracy of them. Therefore, Zeneiren has organized Technical Committee, and is doing introduction of new techniques, research and development, and popularization of them, besides, opening the technical training meetings and cross-checking for maintaining the accuracy of examination etc.

Zeneiren has been carried out the cross-check regarding the measurement of erythrocyte count, leucocyte count, hemoglobin count, hematcrit value, specific gravity of whole blood; lead, cadmium, chrome and manganese concentrations in the blood; and lead and cadmium concentrations in the urine.

The cross-check of blood cell count was necessary for investigation of the normal values of the blood picture of Japanese which is one of the businesses of Zeneiren. The normal values of the blood picture of Japanese have been investigated since 1965. Later, because the nutritious conditions and physique etc. of Japanese were much improved, the normal values of the blood picture are considered to have changed accordingly. But at present, there is no large-scale investigation for them in Japan. Because the organizations belonging to Zeneiren are scattered all over Japan and are doing blood examination daily, they are the best organizations for investigation of the normal values. Therefore, Zeneiren has come to do this investigation. As the blood cell count is presently carried out by counting machine, the important points for it are arrangement and right handling of the machine and right correction of the numeral values. Although it took three years to repeat cross-check five times regarding this point, coefficient of variance (CV) of the counting values gotten by each of 24 organizations in charge of the investigation has come to distribute within 5% range. Then, Zeneiren started the investigation from winter 1978. This investigation has been planned for the purpose to clarify the normal values of the blood picture of 30-40 thousand Japanese labour population during three years, and is now scheduled to carry out the investigation by cross-check twice a year. It is not certain whether organizations which do not participate in this investigation are doing the blood cell count properly, therefore, hereafter strong recommendation for participating in the cross-check should be considered.

The cross-check of the measurement of lead concentration in the blood etc. were carried out

The Construction of Japan Federation of Occupational Health Service Organization (Zeneiren)



four times, and 39 organizations participated in it. As the result of it, it was clarified which organizations can carry out proper measurement. At present, only 10% of all organizations can carry out proper measurement without problem. Hereafter, then, mastering of techniques and cross-check are needed continuously. But Zeneiren is embarrassed by organizations which do not participate in it, and is required to recommend participation in it strongly.

During this year, the cross-checks of lead concentration in the blood, lead, coproporphyrin, δ-aminolevulinic acid and hippuric acid concentrations in the urine etc. are planning to carry out.

On the other hand, for the purpose to improve the techniques and the faculties of doctors, medical technologists, radiologic technologists, working environment measurement experts, industrial nurses etc., technical training meetings and research conferences separated by each occupational function are being held in occasion. In addition, research conferences and training meetings consisted of all members of the organizations belonging to Zeneiren are also being held. Original studies by each organization are being carried out actively, and the results of those studies have been reported not only at the domestic academic meetings but also at many kinds of international congresses, therefore, these are of great help to improve the techniques and faculties of Zeneiren.

All organizations belonging to Zeneiren were divided into six district groups covering all over Japan, local conferences were made for each district, and then, they are not only helping each other to settle many kinds of problems but also trying to strengthen the communication among them.

Presently in Japan, reconsideration of all kinds of health examinations has been requested, and the Ministry of Labour announced the reconsideration plan, then Zeneiren has made Health Examination Research Committee and is discussing regarding how health examination should be.

Zeneiren is carrying out the business under the direct guidance and supervision of the Ministry of Labour, and is maintaining friendly relation with Japan Medical Association, Japan Industrial Safety Association and its Occupational Health Service Centre, medical universities and colleges, research organizations for occupational health, workmen's accident compensation hospitals etc.

Finally, the construction of Zeneiren is shown briefly in the following chart.

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A STUDY ON OCCUPATIONAL HEALTH PROGRAM AND DEVELOPMENT OF EVALUATING CRITERIA FOR OCCUPATIONAL HEALTH

Young Soo LEE, Young Hahn MOON,
Young Ki KIM and Ho Kun CHUNG, *Korea*

Introduction

Since 1960's, Korea accomplished rapid industrial growth under initiative and promotion of the government's economic development plans. There are not a few problems faced with us in implementing the analysis of general trends of health service management when there are no established criteria of objectivity and ratioality yet. Accordingly, we surveyed and assessed Korean industrial status in terms of health service management by citing Webb model (1975).

Material and Method

The study was carried out for 101 establishment in Kyong-In area to evaluate the industrial health management status utilizing the scoring method by the model of Webb, from September 1 to October 30, 1977.

To compare the results, re-evaluation was made with the 45 questions' model prepared by 6 Korean professionals who were specialized in industrial health fields.

As Webb model is provided for a method of objective evaluation of respective establishment's capability on operation of occupational health management.

The contents of occupational health program are classified into four components and the scoring systems is as follows:

Guiding philosophy and policy	10 points
Organizational structure	10 points
Resources	20 points
Health services program	60 points

Results

According to a survey on 101 establishments, most of them are metal and eléctricity industries, and some of them are manned with less than 200 workers.

The affirmative answer for questionnaire shows 51.6% among the establishments.

Philosophy shows 67.5% of "Yés" response, which is interpreted as reasonable familiarization of philosophy and objectives but occupational health service is 44.2%, which expose some weakness in this area.

There are a gap of about 10% in affirmative answer between the large scale establishments of more and less than 500 employees. The former shows affirmative response of 56.5%, the latter 47.7%.

Six persons of occupational health experts chose 45 items out of 86 items of the Webb model in order to accommodate the differentiation of practical occupational health management between the United Stated and Korea.

The result indicated that 67.1% of affirmative answer related to extracted 45 questions compared with 51.6% to the Webb model.

Looking into the extracted 45 questions, we recognized low ratio in all components other than philosophy and treatment. And we realized that the occupational health basic concept and treatment of disease were well recognized, but action due to be taken on preventive medicine, pose as a pressing problem to be tackled.

As for status of 45 items by size of establishments the large establishment is known more satisfactory in occupational health management than small sized one, and it shows high percentage in metal and electricity, and low in chemical fields as could be seen in the Webb model.

Conclusion

1. The mean rate of affirmative answers for

101 establishments was 51.6%. The mean weighted score rate of affirmative answers was 52.3%.

2. The mean rate of affirmative answers on components of the philosophy and facility resource for 101 establishments was higher than that of average rate. The mean rate of affirmative answers on components of the health evaluation and health management among the health service program was lower than that of average rate.

3. The mean rate of affirmative answers on 45 questions' model for 101 establishments were 67.1%. The mean weighted score rate of affirmative answers was 70.0%.

4. The mean rate of affirmative answers on components was higher among the establishments with more than 500 employees. The mean rate of affirmative answers of chemical establishment was lower than that of others.

5. In case of 45 questions' model, the mean rate of affirmative answers on components of philosophy and treatment was higher than that of average rate and the mean rate of affirmative answers on components of the facility resource and the health evaluation was lower than that of average rate.

6. The mean rate of affirmative answers of the 45 questions' model was higher than that of Webb's model in size and class of 101 establishments.

Author concluded that Webb's model must be suitable for evaluating higher conditions of occupational health management than is presently used in Korean establishments. According to the results, however, there were no significant differences between Webb's model and the 45 questions' model. So it could be used to evaluate occupational health program. For this objective, in Korean occupational situations, further study also must be made comprehensively thereafter.

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INDUSTRIAL AND FLIGHT NURSE ACTIVITIES IN KOREAN AIRLINES

Young Hee KIM and Mi Sook HONG, *Korea*

Although the principles of providing medical service in the air transport industry are similar to those in other types of industry, there are some important aspects to be considered in determining the scope and priority of medical programs in air lines (table 1).

The most important factor is the flying environment. The problems created by altitude, speed and motion require special medical attention to protect both air crew and passengers from those hostile enviroment.

Staffing and Organization of Medical Department

Medical director(table 2), the vice president for aviation health has a major role in the development, interpretation and implementation of medical policy and is directly responsible to the president of Korean Air lines. It is the fortunate to us to carry out medical mission effectively that the medical director is ranked at the policy making level of the company and has ample opportunity to discuss medical problems with top management. Then office is divided into two divisions, Aeromedical Service and Industrial Dispensary. The former is responsible for the missions concerned aviation and occupational medicine problems and the other mainly for clinical services including physical examination and primary care of the sick wounded during work hours.

Table 1. Objectives, air line medical services

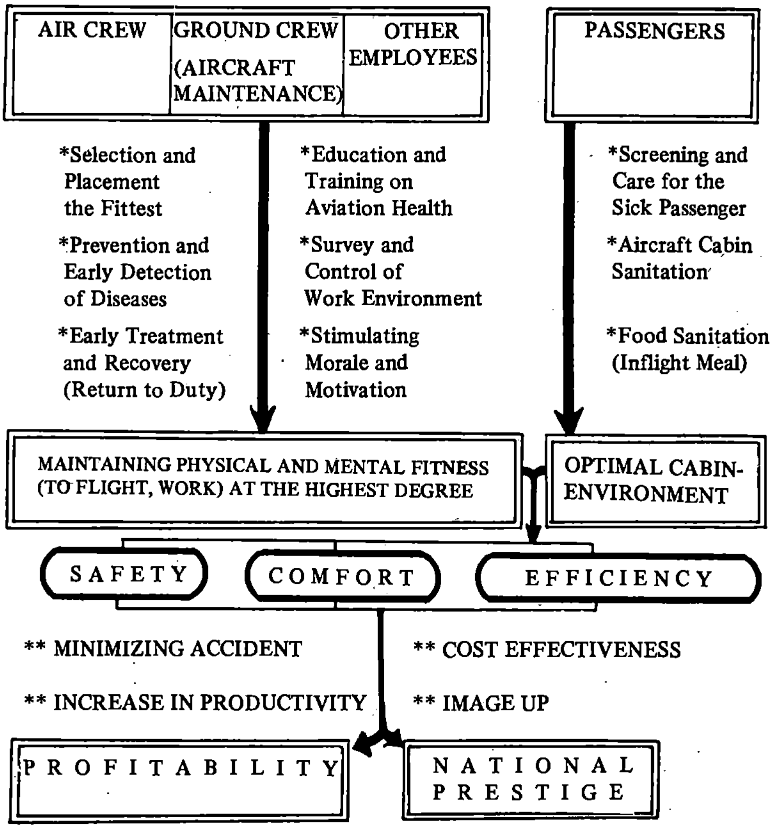
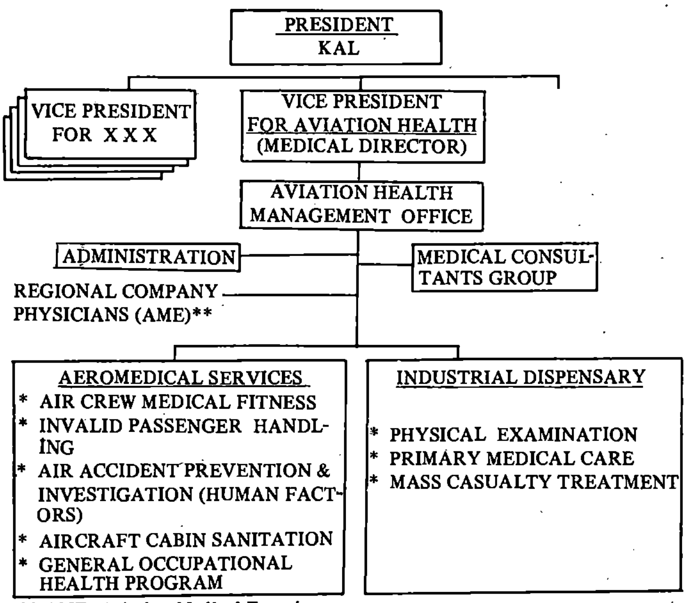


Table 2. Organization, KAL medical department



** AME: Aviation Medical Examiner

Table 3. Staffing, medical department

PERMANENT		PART TIME	
PHYSICIANS	2	CONSULANTS	5 - 10
OCCUPATIONAL HEALTH NURSES	14	Board certified in	
TECHNICIANS	3	Aviation Medicine;	
(Environmental Hygiene,		Clinical Medicine (Cardiology,	
X-ray, Laboratory)		Neurology, Psychiatry, ENT,	
ADMINISTRATIVE	3	Ophthalmology, Radiology etc.)	
TOTAL	22		

Among the permanent staffs (table 3), there are two physicans, the vice president and his deputy, the chief of Aviation Health Management Office; both of them are specialists in aviation medicine and clinical medicine. The main force of the department consists of 14 registered nurses and the senior nurses are designed as the acting chiefs of the two devisions.

They are carrying out most missions of the department under the supervision of staff physicans. Our consultants, specialists of aviation medicine and its related medical fields, help and advise us to perform missions and to evaluate the result. Besides, we have company designated physicans at the overseas areas where our scheduled flights go. They are practising medicine in those areas, experienced in aviation medicine and serve us either on a retainer bases or fee-for service basis. Their missions include care of our aircrew and passengers sick or wounded enroute, and occupational health services for company personnel stationed in the areas.

In 1969, when Korean Air Lines made a start as the first national flag carrier in Korea, only 3 medical personnel were authorized for this department, 10 years later its manpower has increased by seven times.

The augmentation was especially remarkable in occupational health nurse group not only in the number of personnel but also in their responsibilities and range of activities. Our medical budget has also expanded by thirty times but the rate to total company budget has been kept around 0.04%.

Functions of Medical Department

The functions of the medical department are divided into 3 categories (table 4). The first consists of direct support to air line operation itself and is the most important and vital portion of air line medical missions. The second is general occupational health services common to all other industries. The third category is the training of medical personnel, especially occupational health nurses.

1) Air Crew Effectiveness Program

Aircrew health maintenance is naturally a part of the company occupational health program but is particularly stressed because of the reasons shown on Table 5. Throughout their flight missions aircrew members are constantly exposed to enviromental conditions predisposing fatigue and tensions from handling the complicated mechanics of modern aircrafts. The aircrew has tremendous responsibilities for the safety of flight, lives of hundreds of passengers on board and it always required to be an elite both in skill and physical capability so that he can perform his missions successfully even at any critical moment of flight. The company invests large sums in the training costs and salaries of these men. Medical disqualification of any pilot inflicts a great loss upon company and his family.

Main objectives of aircrew effectiveness program are protecting air crews against the stress of their environment, maintaining the health of flight personnel and the prolongation of their effective flying careers.

The content of the program is shown on Table 4.

2) Medical Services for Transportation of Sick Passengers

Ordinarily one does not think of air lines as transporting many patient passengers. However, a suprisingly large number are carried, some known by the traffic officials and others un-

Table 4. Functions, medical department

I. DIRECT SUPPORT TO AIR LINE OPERATION

A. Air Crew Effectiveness Program

1. Physical Standards
*2. Health Maintenance, Medical Fitness
*3. Health Examinations; Preplacement, Periodic, Special
*4. Medical Clearance; Suspension from/ return to flight duty
*5. Health Education ; Aviation physiology, Personal hygiene, First aid,
*6. Health Counseling
7. Aircraft Accident Investigation

B. Medical Services for Invalid Passengers

*1. Screening (Authorization) for Air Travel
*2. Inflight Medical Care
*3. Meeting/Assisting the Sick at Airport

C. Air Line Sanitation

Recommendation, Advice and Survey for:

1. Environmental Sanitation of Passenger Cabin
2. Food Sanitation of Inflight Meal, Drinking Water
*3. Life Support Equipment, First Aid Kit and Company Medical Kit

II. OCCUPATIONAL HEALTH PROGRAM, GENERAL

1. Survey and Measurement of Work Environment
*2. Health Examination : Preplacement Periodic, Executive for special assignment
*3. First Aid
*4. Primary Medical Care for Minor Injuries and Sicknesses
5. Early Detection, Care for and Evaluation of Occupational Injuries and Diseases
*6. Immunization
*7. Health Education and Counseling
*8. Medical Records and Statistics
*9. Participation in Accident Prevention

III. ON THE JOB TRAINING FOR OCCUPATIONAL HEALTH NURSES

Phase I.	General Orientational Course for Company Process and Operation – Provided by the Company – ...... 1 wk	
*Phase II.	OJT for Aviation Health Management – by Medical Dept. 8WKS	
	Aviation physiology	Occupational health
	Aircrew effectiveness program	Health examination procedure
	Health administration & communication	
	Flight nurse activities	Primary medical care
	Trip to work places especially where the health hazards exist	
*Phase III.	1) Attending Refresher Courses for Occupational Health Services – Provided by KIHA, KNA	
	2) Orientational Flight and Visit to Company Physician's Offices Overseas	
	3) Nurse Conferences and Seminars – KAL Med. Dept.	

* Areas in which OHN assumes a leading role.

known to the carrier unless some special need of passenger is brought to the attention of the cabin attendants during flight. (Table 6). The reasons why an ill passenger should not fly in the modern scheduled airline are few in number but there should be some basic criteria of selection for the safety of the patient himself and the safety and comfort of other passengers as well (table 6).

Authorization for accepting sick passengers is based upon these criteria and medical certificate issued by the passenger's private physicians. If accepted, upon reviewing the contents of certificate or interviewing the patient, medical

Table 5. Significance of crew health maintenance in civil air transport

1.	THE WORK(FLIGHT) ENVIRONMENT is generally HOSTILE to HUMAN LIVES.	
	Speed ; acceleration, deceleration Altitude ; change in pressure, decrease air density Noise and Vibration Extreme Changes in Temperature Disturbed Life Rhythm	
2.	Extraordinary Physical and Mental Effectiveness of Air Crew is AN ESSENTIAL FACTOR OF FLYING SAFETY.	
3.	Training of Pilots requires ENORMOUS MONEY & TIME.	
4.	AGING of Air Crew	; Increase in Skill and Experience, Decrease in Physical and Mental Efficiency.

Table 6. Guiding principles in selecting sick passengers for air travel

I.	Any PATHOLOGIC CONDITIONS which may be unfavorably influenced by CABIN ENVIRONMENT in flight is not accepted.		
	e.g.	Coronary Insufficiency, Pneumothrax, Anemia, The New Born Within 14 Days of Birth, Pregnancy beyond 32 weeks	Cardiac Decompensation, Recent Surgical Operation, Wired Jaws,
II.	Possibility of sudden change in patient's condition which may jeopardize FLIGHT SAFETY or cause IRREGULARITY of flight must be excluded.		
	e.g.	Possibility of Death Enroute, Uncontrolable Pain,	Severe Pain, Diabetic Coma ......
III.	Any condition which may interfere with the COMFORT OF OTHER PASSENGERS is not accepted.		
	e.g.	Mentally disturbed patient, Any behavior, appearance, odor or noise OFFENSIVE to Other Persons.......	Communicable Diseases,

department advises traffic and cabin service officials prepare special meals (liquid diet, low salt, low carbohydrate, etc.) wheel chair, aero-stretcher, special loading devices (lift) or any other service items as necessary.

At times when the passenger's condition requires a medical attendant during flight and the passenger requests it, KAL nurses will escort the patient to his destination giving inflight medical/nursing care as directed by the physican. On very few occasions, a physican accompanies the patient.

3) Air Lines Sanitation

Aircraft sanitation is performed, according to International Sanitary Regulations (ISR) of WHO and is important to prevent global dissemination of communicable disease and for the good health of passengers (Table 4).

While airport service personnel takes primary responsibility for this business, the medical department is also concerned in supervision, survey of the environment, and giving advice and recommendation when needed. Nurses also check life support systems of the aircraft, such as oxygen, seat belts and first aid kits aboard and teach air crew how to use them.

First aid kits are furnished in every aircraft according to Civil Aviation Regulations and to be used by cabin attendant or any other lay individuals for injuries sustained during flight. On the contrary, a Medical Kit is provided by the company for long range flights only. It will be used by qualified physicans who happen to be on board.

4) General Occupational Health Program

The occupational health program for the

ground employee is essentially the same as that in other light industry, and is largely preventive in scope (Table 4). It includes the preplacement and periodic physical examination, the detection of defects and referal to his or her private physician. But occupational health nurses offer care and department for most minor injuries or illnesses sustained during work hours under the most supervision of staff physicians. This primary medical care system serves the employee not only for saving time to and from the hospitals located off the airport but for providing early treatment to prevent aggravation of the disease or its complications.

Particular attention is paid to the selection of individuals for foreign assignment. Since the branches of the company distributed worldwide and some employee must work in extreme environmental changes, both in climate, language and custom, only physically and mentally qualified personnel are sent overseas.

Hearing conservation program is of major importance for the employee working at the airport. This program includes periodic audiometric examination, and use of ear plugs and muffs to reduce the noise from aircraft engines or various ground equipments.

5) OJT for Occupational Health Nurses

In Korea, occupational health nursing still is scarce field and the absence of special preparation for this type of practice creates a serious problem.

The basic requirement for nurses before entering KAL includes the general qualification of registered nurse plus clinical experience of one year at the minimum. But to speak honestly the reason why they apply for this post is mostly a matter of curiosity and when they first join us, they have little knowledge or experience in occupational health and naturally even less in aviation medicine. The immediate solution therefore, is a concentrated effort evolving toward motivation, on the job training and short, frequent courses for training in occupational health nursing. Our OJT program consists of three phases as shown on Table 4.

Conclusion

While many people talk about the necessity of upgrading and expanding roles of occupational health nurses in industry, there are continuing controversies, biases and many obstacles which prevent those ideas from being realized.

Here I have introduced the activity of nurses in an airline industry, a new challenging field, where they are playing major role in occupational health practices and in carring out medical missions directly supporting company operatiosns.

One may point out the following facts which could persuade the management to transfer more responsibilities to our occupational health nurses.

1) Shortage of physicians experienced in occupational (especially aviation medicine) medicine field

2) Nurses are apparently more effective in care of the sick passengers inflight, health counseling and education and some other routine activities within the medical department.

3) Nurses have proved their effectiveness in providing first aid and treatment of minor injuries and illnesses to minimize the loss of man power.

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OCCUPATIONAL HEALTH SERVICES IN SWEDEN

Robert G. OLIN, *Sweden*

Sweden, one of the Scandinavian countries, had a population of 8,300,000 inhabitants in 1978, of whom about 50% belonged to the actively working stratum. To these 50% another

5.5% can be added, consisting of the unemployed, persons employed in emergency public works or being trained by the labour market authorities and persons in the age group 16-65 years with early retirement pensions, i.e. disablement and sickness pensions.*

During the last 100 years Sweden has reached a high level of industrilization. In Table 1, some data are presented concerning the labour force and the national economy. The main trades are wood and paper products, iron and steel, metal products, machinery and transport equipment and chemical materials and products.

Table 2 contains information regarding the number of doctors in Sweden and some other professions employed in the occupational health services.

The occupational health services in Sweden were first established already in the 16th century, when some medical facilities were set up in remote places with mining or similar heavy industries. Since then various industries with major potential risks for serious accidents have found it necessary to incorporate a health service unit in the company.

At that time the competence required was surgery. Some companies also engaged safety engineers, who were mainly employed in order to prevent accidents and to supervise the safety conditions on the premises.

By the beginning this century, – but generally not until the beginning of the fifties, – the objectives for and the organization of the occupational health services changed due to two reasons: increasing awareness of the complexity of physical and psychological risk factors in the work environment and the growing demand for employee codetermination when making decisions on the basic features of the work environment. The increasing awareness of the risk panorama in the working environment is of universal concern and thus the objective of this important conference.

The demand for employee participation in matters concerning work environment varies from country to country. In Sweden there is a tradition for collective bargaining agreements between the parties on the labour market and thus legislation only establishes the general guide lines. By the Occupational Safety and

Table 1. Economically active population by industry in Sweden 1975. Gross domestic production and average hourly earnings in 1978

Industry	Relative distribution	Time trend
Agriculture	6.4	↘
Manufacturing etc.	29.9	–
Construction	8.0	–
Commerce	19.9	–
Transport, storage, communication	7.2	–
Services	29.4	↗
Average hourly earnings 1978	U.S.$ 6.5	
Average taxation expenditure	35 – 45%	
Gross domestic production (at market prices)	U.S.$ 75,000,000,000	
Per capita	U.S.$ 9,000	

Table 2. Total number of doctors, industrial doctors, nurses and safety engineers in Sweden 1977

Total number of doctors in Sweden	15,000
Density (population/doctor)	550
Doctors occupied in industrial medicine	750 (= 5%)
(thereof part time	400)
Industrial nurses	1,170
(thereof part time	570)
Safety engineers	450
Total number of persons employed in occupational health services	4,000
(thereof part time	1,800)

Health Act of 1976, the local safety committee is given a central role for all questions relating to the working environment. The safety committee, which has an employees' majority, is given the authority to discuss and determine all matters in production, including planning for the future, that have implications on the working environment. This legislation, which historically is founded on a joint agreement between the employees and the employers organizations, makes the local safety committee an important body in each Swedish company, big or small.

The local safety committee is also the organ responsible for the company occupational health services. In short, it can be said that the occupational health services shall function in an advisory capacity to the highest organ responsible for health and safety, the safety committee. In general we have in Sweden three models for the organization of these services:

1. In bigger companies (with more than 1500-2000 employees), the company is big enough to carry its own company health service unit, which is integrated in the health and safety organization in the company.

2. Small and medium sized companies can own and administrate jointly an occupational health service centre. We have about 200 such centres in operation and each of these is controlled by a common board, which has responsibilities similar to the safety committee. This can be a very practical form of health service, even for very small companies.

3. A branch-wide solution has been established for branches with highly decentralized or mobile activities, such as construction, transportation, forestry industry and agriculture.

For the company the gross costs for establishing or joining an occupational health service unit are between 75-300 US$ per employee and year. But, due to the National Medical Health Legislation, a substantial part of this amount is refunded and the level of the net costs for the company is 50-200 US$. This expenditure covers the costs for an industrial hygiene and a medical component in the health service unit. A full-time industrial doctor has in average responsibility for 2000 employees.

The industrial hygiene component is of increasing importance, particularly in those many industries that use chemical products or inorganic materials, but also for industries that use heavy or technically complicated machines. It was just mentioned that the industrial hygiene activities, like the medical component, were formerly focused on investigating and taking care of serious accidents or obvious risks for acute adverse effects. Since the earlier part of this century, the industrial hygienist also became more and more occupied with ergonomic problems and with the techniques of sampling procedures. These objectives remain, but the modern industrial hygienist has become more and more involved in preventive tasks, such as substitution of products, incapsulation of processes, ventilation, etc. This means that the industrial hygienist is obliged to participate in all planning activities that have technical implications.

The medical part of the health service unit in Sweden has traditionally been oriented towards the injured and the sick person. The possibility to consult a company doctor has been a benefit for the employed, as the general health and sick care facilities in our country have had an insufficient manpower.

Formerly, this deficit gave a certain imbalance to the activities within a medical health service unit. Most of the time was spent on the care of the sick person. But the effects of this efforts on the constellation man and his working environment was little or none. Therefore, for the twenty years it has been postulated — in a joint agreement between the employer and the employees organizations — that the medical component of the occupational health services should direct at least 50% of its resources towards preventive activities.

The most common form of medical preventive activity is health check-ups. Today there is a tendency, particularly in contaminated industries, to diminish the time consuming and somewhat dubious efficiency of agebound health check-ups. Instead, directed health check-ups should have priority. These check-ups are oriented towards known or suspected occupational hazards, such as noise, dust, metals, solvents or other organic substances etc. But, it is of importance to stress that these check-ups in many industries also should be directed towards possible psychological side-effects due to, for example, flaws in the organizational system of the company. In fact the effects of mental health ill in the labour force is an area of increasing importance have lead to the reinforcement of the medical component in the unit by experts with psychological or behaviour professional training. This kind of expertise can also be useful in dealing with various adjustment problems that exist in modern organizations, particularly in medium-sized or big companies. Here, in analogy with what has been said about the need for a positive balance between preventive activities visavis the traditional care duties of a doctor, it is important that this "psychosocial" component has such priority that preventive activities do not get pushed in the background by the supporting, postfactum activities.

In the capacity of an advisory expert working for the local safety committee, the medical part of the unit has various other obligations, such as investigation and advice about toxicological agents and ergonomic problems etc.

To sum up, a modern Swedish occupational health unit contains relatively little of its historical predecessor, which was originally designed by those companies with heavy risks with the objective to take care of serious accidents. The modern occupational health services have had a rapid development in Sweden during the last twenty years and they are evenly distributed between all trades. Thus, not only physical but also possible psychological hazards are the objectives for these services and preventive technical and medical – and psychosocial – activities are given priority. By joint agreement between the parties on the labour market and then inforced by legislation, the local safety committee is responsible for each occupational health service unit.

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INTRODUCTION OF FAMILY WELFARE ACTIVITIES IN OCCUPATIONAL HEALTH UNITS IN INDUSTRIES AND PLANTATION

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Many of the major problems currently affecting the World and more particularly Asia, such as the rapid depletion of the Earth's resources, the pollution of the environment, the recurring shortages of food and the over crowding of the cities, with their slums and shanty towns, all stem from the same basic source – that of excessive population. At national level, the need to provide ever increasing quantities of food, housing, educational facilities, employment opportunities and health and social welfare services, makes the task of Governments well nigh impossible, as hard won gains on the economic front are overwhelmed by the rapid growth of the country's population. It is therefore of vital importance that the developing countries try to halt this rapid population growth, if they are to make any significant progress towards improving the standard of living of their people. In this situation, time is of the essence.

In these countries the drive towards the provision of population education and motivation, as well as family planning service facilities, has to be concentrated on the lower income groups. Convincing people of the need for smaller families and the advantages it can bring them is a slow process, particularly as the target groups are less well educated and quite often illiterate. The conservative outlook of rural folk, resulting from their upbringing and way of life, makes them reluctant to accept the basic changes needed to bring about a reduction in the size of their families. However difficult it might be, it is of vital importance to get the message across by all possible means, in the shortest possible time.

In such circumstances, the workers in the organized sector can be most useful as agents of living as reflected in the desire for better of change. They are young, better educated, accustomed to modern technology and therefore conditioned to the acceptance of changes of life style. Their aspirations for a better standard of living as reflected in the desire for better housing, more consumer goods and entertain-ment opportunities, induce them to readily accept the need to have smaller families provided they are adequately informed and the necessary services are readily available. Particularly in the developing countries, most urban and semi-urban workers maintain close links with their families, left behind in the rural communities from which they come and to which they return from time to time. On these visits, they are looked up to as arbiters of modern fashion, thought and behaviour and as such exert a powerful influence on rural thinking and customs. Their advocacy, therefore, of the value and importance of adopting family planning practices for the spacing of children or the limitation of families, can make a vital contribution towards the success of a National Family Planning Programme, in an area where it counts most but is generally hard to reach. Education and motivation of the organized sector workers can therefore, serve a dual purpose – directly influencing those living in urban and semi-urban areas and indirectly, the rural people.

Industry can therefore make a most valuable contribution to a country's family planning programme by actively promoting population education and family planning programmes in those establishments which are under their control. Most industries including the plantations, are legally required to provide some form of health service for their workers and the addition of a population education and family planning component to these occupational health units requires little extra input, as far as space or funds are concerned. What is needed is the will to actively promote and support these programmes. Quite apart from the satisfaction of providing a service, which will eventually have a national as well as global impact, the resulting benefit of increased productivity from a healthy and satisfied work force and a consequent reduction of labour turnover, absenteeism and accidents at work will be the reward of the enterprising employer. The worker and his family too will benefit from the relief obtained from the over crowding, malnutrition and frequent illness which is the lot of far too many workers of today.

Plant or unit level population education programmes afford a good neutral ground for cooperation between employers and unions. Working together for a common purpose, can be of benefit to both parties and will eventually lead to greater cooperation in other sectors of labour-management relations, as has been shown to be the case with so many ILO/UNFPA sponsored family welfare projects in the region.

It is the duty of the occupational health specialist to foster the health, safety and welfare of the workers, both at their places of work and in and outside their home environments. One of the most important measures for enhancing the quality of life of the workers is that of ensuring a happy and healthy family through the adoption of family spacing or family limitation, as the case may be. Most employers are aware of the problems caused by the population explosion though they often do not relate this situation to their own business undertakings. The one person in an industrial establishment who is or should be well versed in all aspects of health and welfare, and the includes population education and family planning in a big way, is the Plant Medical Officer. As such, it is plainly his duty to orient and persuade both top and middle management into starting an effective family welfare programme in the plant. If he is worth his salt, the medical officer is looked up to and enjoys the trust of the workers and their organizations. He can therefore, be the link between the workers organizations and the employers and influence both into active support of the plant family welfare programme.

In this context, if any advice and help is needed in setting up such programmes, the services of the ILO Labour and Population Team for Asia and the South Pacific, based at the Regional Office of ILO in Bangkok, is readily available to any country or organization, which is interested in setting up effective plant level family welfare programmes. This team has already been instrumental in helping many governmental, employer and workers organizations, to set up population education and family planning service programmes, with funds from the United National Fund for population activities. During the course of this conference, I shall be only too happy to provide any further information on these programmes to any interested participant and to discuss the possibilities of setting up new population education and family welfare projects for the organized sector in any country in the south east asia and pacific region.

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STRESS AND OCCUPATIONAL HAZARDS IN CORPORATE EXECUTIVES IN INDIAN INDUSTRIES

Ashok SAHNI, *India*

Introduction

The subject of my talk is "Stress and Occupational Hazards in Corporate Executives in Indian Industries". Before I share my thoughts and results of my studies on the subject, I shall like to congratulate all of you for your interest in occupational health in Asian countries, particularly the developing countries. I want to thank, very sincerely, Prof. K. S. Cho, Secretary General for inviting me to participate in the Ninth Asian Conference on Occupational Health.

Even though India is still basically agrarian, the movement toward development of industrial complexes is over 300 years old. Today, India is the ninth largest industrial nation. And, it is the third largest nation in terms of qualified technical, scientific, and managerial resources. We have today over 400 major industries in the public and private sector employing over 10,000 senior executives. Occupational and mental health of these executives should be of great importance and concern to all of us, engaged in the health care delivery systems, since upon their health and well-being depends the industrial and economic development of the country as well as health and well-being of the 130 million adult workers.

In this paper, I would like to outline the problems confronting the Indian executives, some research data on their occupational and mental health and suggest preventive, maintenance and promotional measures for the effectiveness of the executives. Apart from the empirical research study, most of the data presented in the paper has been gathered from my interactions with the senior executives participating in my several training programmes.

Problems Confronting the Indian Executives

The question arises as to the definition of an executive. Generally, the top men in any organization or corporation are referred to as 'executives'. Fortune magazine (1950) asked a large group of 'top men' to define what they mean by an 'executive'. From these men emerged this composite self-portrait:

"An executive is a person paid for a full-time job in which he/she: (1) directly helps to set the company's objectives and overall policies; (2) is required to make or approve decisions that significantly affect profits and future plans; (3) coordinates several major corporate functions, or those of a major division or department; (4) maintains and develops an organization of trained subordinates to achieve the company's objectives; and (5) delegates responsibility and authority to the organization and controls performance and results through at least one level of supervision".

Executives in India, compared with their counterparts in western countries have to play more demanding and challenging roles. Due to the civil service, managing agency and propriety systems which have influenced the managerial approaches to our industries and business organizations, the executives and professionals experience many constraints. These constraints are further increased by the aims and objectives of our socialistic pattern of society. Some of the major problems that the executives experience are:

1. Coping up with Information

In the last 10-15 years, the information relating to various aspects with which the executives have to deal has been increasing at a very rapid pace. Most of the executives find extreme difficulty in assimilating this information which results in alienation, obsolescence and ineffective decision-making to rapid change in technology and processes. Since independence, particularly in the last 10 years, the technology is being introduced at a very rapid rate which results in changes in processes to perform various functions of the organizations. Effective adaptation to the changing processes requires continuous human adjustment which creates problems of disequilibrium, and maladjustment.

2. Problems of Travels and Transfers

Managing multiunit and sometimes multinational organizations require constant travels and resultantly the executives face the risk of life, apart from family crisis and family adjustment problems. Executives in public sector companies, to a lesser degree in private sector companies, are constantly transferred, without their willingness, from one location to another location which results in mental, emotional, and family adjustment problems apart from lack of commitment and low feelings of achievement.

3. Social Leadership

The business executives are vested with tremendous social and economic power in the sense that they must know how to solve the community problems. However, most of the executives are not skilled agents of social change. This is particularly true of young executives who are required to be innovative and creative yet they have to wait for years since they lack the delegation of authority to make decisions and initiate programmes.

4. Problem of Obsolescence

Due to the rapid change in technology and increased information, the executives are under constant pressure to change their roles, increase their knowledge and competency. Failingly, they become obsolete, develop defensive mechanisms and psychosomatic disorders. Obsolete executives show indecisiveness, ineffectiveness in decision-making resultingly low performance and neurotic environment in the organization.

5. Living with Uncertainty

The political and economic environment in India has caused great degree of uncertainty for the executives resultingly making it difficult for them to predict the future course of events and utilize the resources of the organization effectively. On the other hand, the executives are required to produce results. This results in tremendous anxiety and stress.

6. Conflict in Organizations

Over the last 10 years, conflicts between labour-management and various professional groups have increased tremendously which has resulted in demanding roles for the executives to become specialized in conflict resolution.

The above problems result in a difficult and demanding role for the executives.

Occupational Hazards and Mental Health

No major survey or study on the occupational hazards and mental health of Indian executives has been made so far. Tatas and Hindustan Lever have made some sporadic attempts in this direction. From the limited data available, the following observations can be concluded.

1. The business executives are subject to same hazards of health as other professional such as doctors, lawyers and civil servants. There is no significant difference in the executives compared with the other employees with regard to diseases such as TB, anaemia, ailments like cold, dysentry, diarrhoea, and infections like bronchitis and pneumonia. There is no significant difference also in the incidence of peptic ulcers, heart diseases and high blood pressures.

2. The executives are likely to be more prone to suffer from diabetes, obesity, piles, pain in the joints, low backache, migrant headaches, and frequent variation in blood pressure.

3. There is very little information on the alcoholism and suicide in the executives.

Stress in Managers

Besides the above occupational hazards, I would like to share results of research study on stress in executives.

For definition purposes, those individuals who are motivated, and correspondingly find opportunities on the job for their need satisfaction and continuing growth in a favourably perceived environment are likely to experience low stress. On the other hand, individuals who are highly motivated and committed to their profession but do not find growth opportunities on the job and perceive the organizational climate and the leadership style not conducive for work are likely to experience, as a result, high degree of stress, conflict and problems of maladjustment.

A total of 307 professional administrators, engineers and scientists participated in this study. These executives represented several public and private sector industries and had participated in my training programmes. Out of 307, 196 were technical and 111 were non-technical managers and administrators. On the basis of the above criteria, high stress experiencing and low stress experiencing groups were formed. The major differences in the two groups are as follows:

1. The low-stressed group compared with the high-stressed group tends to be significantly higher in their commitment toward their chosen profession.

2. The low-stressed group compared with the high-stressed group tends to be significantly lower in their neurotic orientation. In other words, they experience less anxiety, indecisiveness and worries on the job.

3. The low-stressed group compared with the high-stressed group tends to be significantly higher with respect to their satisfaction with the work which they do. In other words, they perceive that the work which they do is in line with their training, they have responsibility on the job, achievement and advancement on the job and opportunities for self-recognition.

4. The low-stressed group compared with the high-stressed group also tends to be significantly higher in the satisfaction of their maintenance needs. In other words, they perceive that the organizational policies are fair, the working environment is adequate, their salary and job security on the job is also adequate and they have good relationship with their peers, superiors and subordinates.

5. The low-stressed group compared with the high-stressed group tends to perceive the organizational climate much more favourably. In other words, they feel that there is a lot of respect for each other; they have opportunities for participation in decision-making, there is adequate communication about what is going on in the organization, the conflicts are resolved constructively, and their superiors consult with the subordinates in decision-making.

6. The low-stressed group compared with the high-stressed group tends to be significantly high in respect of their growth on the job. In other words, they are continually growing on the job, advancing in their knowledge about their profession and the damands on the job.

7. The low-stressed group compared with the high-stressed group tends to be more competent with respect to utilization of their time. In other words, they live in the present rather than in the past or future and are able to function according to the realities of life.

8. The low-stressed group compared with the high-stressed group tends to be significantly higher with respect to their needs for socializing and good human relations.

9. The low-stressed group compared with the high-stressed group tends to be significantly higher with respect to their being flexible in their attitudes and values. In other words, they have an existentialistic orientation. They are less rigid in their behaviours.

10. The low-stressed group compared with the high-stressed group tends to be more humane with respect to their being sensitive to their own needs and feelings as well as other people's needs and feelings.

11. The low-stressed group compared with the high-stressed group tends to be significantly higher with respect to their self-esteem. In other words, they have a positive regard for themselves, they accept themselves whatever way they are, and they also accept others and have also regard for others.

12. The low-stressed group compared with the high-stressed group tends to accept aggression as natural part of human behaviour and have the ability to deal with aggression in a positive and constructive manner.

13. The low-stressed group compared with the high-stressed group tends to be also significantly higher with respect to their capacity for maintaining contact and relationship with other people.

14. The low-stressed group compared with the high-stressed group tends to be significantly higher with respect to their need for being independent. In other words, they are inner-directed and feel comfortable in working long hours by themselves.

15. The low-stressed group compared with the high-stressed group tends to be significantly higher with respect to their perception of their supervisor's leadership style. In other words, they perceive their supervisor's leadership style more favourably and respect their superior's decision-making and judgement.

16. The low-stressed group compared with the high-stressed group experience lesser conflict with their superiors.

From the above, it is clear that favourably perceived management and organizational climates tend to influence higher motivation, commitment to the organization, satisfaction with the job content and context and opportunities for learning and growth on the job. Effective leadership in the organization, enriching job opportunities, fair and equitable personnel policies of the organization influence commitment to the professionals toward the goals and objectives of the organization as well as employee job satisfaction.

Prevention Programmes

The question which the organizational leaders and the managers are likely to ask is: What can the management do to minimize stressful situations and occupational hazards in their organizations? As indicated in the beginning of this paper, almost every social system has inherent potentials for stress and occupational hazards. However, some of the following measures could be initiated in an organization for prevention of stressful situations in the organizations.

1. The organizational leaders should have clear objectives for the organization and the various members of the top management must wholeheartedly accept those objectives and commit themselves to achieving those objectives. This will minimize the climate of ambiguity at the top which usually filters down the organization in the form of neurosis.

2. In the light of the above objective, the organization must clearly and sincerely establish policies and practices for the effectiveness of the organization. The effectiveness of the organization is not only the result of achievment of its goals but basically the result of effective utilization of its human resources. The organization must be sincerely committed to the development and utilization of its human resources.

3. Keeping in view its objective of maximum utilization of human resources, the organization must create meaningful jobs for its employees on a continuing basis. This requires that the organization must have an organizational development department separate from the personnel administration department. The organizational development department's responsibilities are to create meaningful and enriching jobs for its employees and ensure that there is a maximum match between the jobs and the job holders.

4. The organization must be adaptable to the changing social, economical, political and technological developments. Thus the organizational structure must be flexible so as to accommodate internal and external resources as well as constraints. Flexible and adaptable organizational structure brings innovation, creativity and involvement of the people toward achievement of the goals and objectives.

5. The organization must select employees who are growth-oriented and later provide conditions and opportunities for continuing growth and development of its employees at various levels. Besides organizational responsibility, however, the individuals must make sincere efforts toward their personal and professional development.

6. To promote a mentally health organization, the employees at various levels must have a positive attitude toward themselves as well as others in the organization. Favourable interpersonnel relationships, commitment and goal-directed behaviours will result in creation of a healthy environment in the organization.

7. The organization must ensure that their executives get a regular general health check

up, take precautions regarding their eating habits and less engage in social drinks.

References

Ajit Singh. The Lonely Manager, Lok Udyog. April 1972, 977-80.

Buck, V.E. Working Under Pressure. Staples Press, 1972.

Davis, F. Uncertainty in Medical Prognosis, Clinical and Functional in E. Freidson and J. Lorber (eds.) Medical Men and Their Work, Aldine-Atherton, Chicago, 1972.

Dwivedi, R.S. A Psychological Attempt to Diagnose Personality Difficulties among Indian Managers. Indian Management, May, 1969.

Dunn, James, P., and Cobb, Sidney, "Frequency of Peptic Ulcer among Executives", Journal of Occupational Medicine, 4:7, 343-348, July 1962.

Fortune (Editors), The Executive Life, Garden City: Double Day & Co., 1956, pp. 17-19.

Gemmil, Gery R. and W.J. Heisler. "Machiavellianism as a Factor in Managerial Job Strain, Job Satisfaction and Upward Mobility" Academy of Management Journal, Vol. 15, No. 1, March 1972, pp. 51-62.

Gowler, Dan and Karen Legge (eds.) Managerial Strees, John Wiley and Sons, New York.

Hall, Doublas T. and Roger Mansfield. Organizational and Individual Response to External Stress. Administrative Science Quarterly, Vol. 16, No. 4, December 1971, pp. 533-547.

Hankle, Lawrence E. Plummer, Norman, and Whiteney, L. Holland. "The Continuity of Patterns of Illness and the Prediction of Future Health". Abstracts, Thirteenth International Congress on Occupational Health, 1960.

Jennings, E., The Mobile Manager. The University of Michigan Press. 1967.

Johnson, Harry J. Executive Life Styles. A life Extension Institute Report on Alcohol, Sex, and Health. Thomas Y. Crowell Co., New York, 1974.

Kahn, R.L. et al. Organization Stress: Studies in Role Conflict and Ambiguity, Wiley, New York, 1964.

Kornhauser, W. Scientists in Industry: Conflict and Accommodation. Berkeley, University of California Press, 1962.

Lanter, G.P. Environmental Constraints Impeding Managerial Performance in Developing Countries. Management International Review, 1970, 10(2-3), 45-52.

Levison, Harry. Executive Stress. New York. Harper & Row, 1970.

Levinson, Harry. emotional Health in the Wrold of Work. New York, Harper & Row, 1964.

Lotia, C. Managerial Problems of Public Sector in India, Bombay Menaktalas, 1967.

Narain, Laxmi. Managerial Turnover in Public Enterprises. Lok Udyog, May 1972, 11-16.

Newcomer, M. The Big Business Executive, New York, Columbia University Press, 1955.

Selye, Hans. "Stress", Psychology Today, Vol. 3, No. 4, September 1969, p. 25.

Selye, Hans. Stress Without Distress. New York. The New American Library, 1974.

Schaffer, Robert H. The Psychological Barriers to Management Effectiveness. Business Horizons, Vol. 14, No. 2, April 1971, pp. 17-25.

Steiner, Jerome. What Price Success? Harvard Business Review Vol. 50, No. 2, March-April 1972, p. 69.

Sarien, R.G. (ed.) Managerial Styles in India, Ram Prasad and Sons, Agra, 1973.

Shaffer, Lawrence F and Edward J. Shoben, Jr. The Psychology of Adjustments. New York: Houghton-Mifflin, 1956, pp. 585-590.

Schoonmaker, A. Anxiety and the Executive. American Management Association Inc., 1969, pp. 82-84.

Wright, Beric. Executive Ease and Disease. John Wiley & Sons, New York, 1975.

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Session 2.

Industrial Accident and its Prevention

INDUSTRIAL ACCIDENTS IN A NICKEL MINING INDUSTRY IN INDONESIA

A Comparison Between Figures of Exploration, Construction and Production Period (A Preliminary Report)

Agoess KIAGOES, *Indonesia*

Introduction

Indonesia became one of the major nickel producing countries in the world when early in 1977 president Suharto of the Republic of Indonesia inaugurated the PT. INCO nickel processing plant in Soroako, South-Sulawesi, Indonesia. PT. INTERNATIONAL NICKEL INDONESIA (PT. INCO), a part of INCO Metals Company, was incorporated on July 25, 1968 as a wholly owned subsidiary of INCO Limited, a major Canadian based, diversified company and the world's largest nickel producer. Mobilization of exploration and contractor personnel and equipment began immediately upon signing of contract in July 1968. Aerial photographic surveys were followed by ground traverses and sampling with portable drills. Indicated favorable areas of laterite terrain were subsequently investigated in detail by sampling with large power drills, test pits and trenches. Exploration began in the Soroako area in the spring of 1969. With the completion of the exploration period, in 1973 seven hills had been selected as phase one initial mining site and the engineering and construction of the process plant facilities commenced. After the agreement was reached with the Government on construction and operation of a hydro electric project in Larona, on 1975 the construction of the stage two project started. The Larona Hydro Electric Power Plant is designed to supply 165 megawatts at 150 kilovolt to the process plant by means of an overhead transmission line from Larona to Soroako. First production came early in 1977 from stage one plant and the first export shipment was done on April 26, 1978 whereby 1786 tons of Nickel matte was shipped to Japan. Stage one plant will have an annual production rate of 16,000 tons (35 million pounds) of nickel in a 75% nickel matte and stage two will raise the output to 45,000 tons (100 million pounds) a year, placing the Soroako nickel plant among the major nickel producing complexes of the world.

Meterial and Method

Following the Safety Law of the Government of the Republic of Indonesia, PT. INCO has been reporting all disabling injuries since the beginning of its exploration. Total lost time accidents reported during the last 10 years from 1969 until 1978 was 370 cases of which 77 cases happened during exploration period (1969-1973), 268 cases during construction period (1974-1977) and 25 cases occurred during the first production year of 9178. Besides, 21,762 first aid case injuries without working days lost were also recorded as from 1972 until 1978. In this paper the terms accident and injury are restricted to those that include occupa-

Table 1. Details of 370 disabling injuries by year of occurence

Year of Occurrence	Average number of employee	Disabling Injuries: Death	Permanent total disability	Permanent partial disability	Temporary total disability	Total	Days Charged: Actual days lost	Scheduled charges	Total days charged	Accident Rate: Frequency rate	Severity rate	Disabling injury index	Average days charged	Fatal Rate
1969	498	1	1	1	4	7	120	12.525	12.645	7.03	12.696	89.25	1806	2,00
1970	971	1	–	–	26	27	326	6.000	6.326	13.90	3.257	45.28	234	1.03
1971	1455	1	–	–	24	25	566	6.000	6.566	8.59	2.256	19.38	263	0.69
1972	974	–	–	–	8	8	678	–	678	4.11	348	1.43	85	0
1973	475	1	–	–	9	10	140	6.000	6.140	10.52	6.463	67.99	614	2.11
5 Years of Exploration	875	4	1	1	71	77	1831	30.525	32.356	8.9	3.698	32.54	420	
1974	1487	3	1	4	27	35	568	24.425	24.993	11.77	8.404	98.91	714	2.02
1975	4207	4	1	2	101	108	2307	30.755	33.062	12.83	3.929	50.40	306	0.95
1976	8767	3	1	4	63	71	1112	27.725	28.837	4.05	1.645	6.66	406	0.34
1977	9798	3	–	2	49	54	1064	19.200	20.264	2.75	1.034	2.84	376	0.31
4 Years of Construction	6065	13	3	12	240	268	5051	102.105	107.156	5.52	2.208	12.19	400	
1978	4940	4	–	1	20	25	357	27.600	27.957	2.53	2.830	7.16	1118	0.81
Total of Years		21	4	14	331	370	7239	160.230	167.469					

tional injuries only. The disabling injury frequency rate and severity rate in this paper were calculated based on the standard formula set forth in ANSI Z16.1 by use of the following formula.

Frequency rate (=F)

$$= \frac{\text{Number of disabling injuries x 1,000,000.}}{\text{Employee hours of exposure}}$$

Severity rate (=S)

$$= \frac{\text{Total days charged x 1,000,000.}}{\text{Employee hours of exposure}}$$

$$\text{Disabling injury index} = \frac{F \times S}{1{,}000}$$

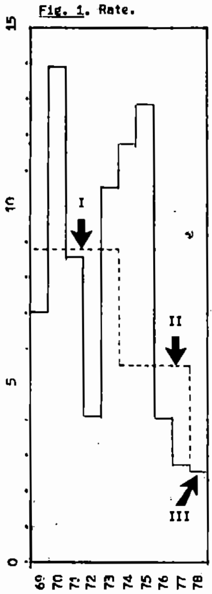
Average days charged per disabling injury

$$= \frac{S}{F}$$

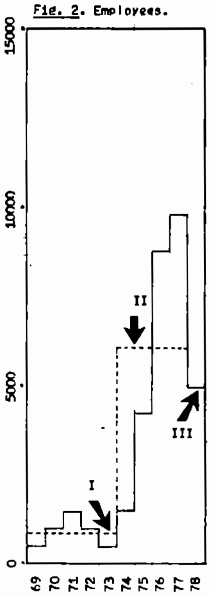
A disabling injury is an injury which results in death or permanent impairment or which renders the injured employee unable to work for a full day on any day after the day of injury. Employee hours of exposure are based on the average an employee works about 2,000 hours per year and is calculated by multiplying the average number of employees during the year by 2,000. Included in the severity rate are both actual days lost and scheduled charges. Disabling injuries are of four classes : death, permanent total disability, permanent partial disability and temporary total disability. For the three classes of injuries : death, permanent total disability, and permanent partial disability — the number of days charged is a predetermined total and is referred to as "scheduled charges". For temporary total disabilities, the number of days charged is the total number of full calendar days on which the injured employee was unable to work as a result of the injury.

Place of Accident								Type of Accident								Part of Body Affected								Nautre of Injury							
Mining	Quarrying	Processing Plant	Town/Camp construction	Hydro electric plant	Oil terminal pipe line	Wharf & Warehousing	Motor vehicle Accident.	Handling	Person falling	Machinery	Striking against	Transport	Struck by	Hand Tools	Others	Head, face, neck	Eyes	Shoulder, arm, & forearm	Hand & fingers	Body	Hip, thigh, & leg	Knees	Feet & Toes	Grazes	Bruises	Foreign body	Burns	Laceration	Sprain & strain	Fractures	Others
5	–	–	2	–	–	–	–	1	–	–	1	–	4	1	–	1	–	–	2	3	–	–	1	–	–	–	–	2	–	4	1
15	–	–	1	–	–	5	6	2	6	–	2	7	6	3	1	8	–	1	3	7	5	1	2	1	2	–	1	12	–	4	6
19	–	–	5	–	–	–	1	1	5	–	3	1	12	1	2	8	1	3	2	5	4	–	2	–	2	–	1	11	–	4	7
3	–	–	2	–	–	1	2	–	1	–	2	2	2	1	–	1	–	3	2	–	2	–	–	–	1	–	–	2	1	4	–
8	–	–	2	–	–	–	–	–	2	–	1	–	3	–	4	1	2	–	2	2	1	–	2	–	–	–	2	4	1	1	2
50	–	–	12	–	–	6	9	4	14	–	9	10	27	6	7	19	3	7	11	17	12	1	7	1	6	–	4	31	2	17	16
2	1	12	7	–	1	4	8	–	7	9	–	9	6	–	4	5	1	5	7	9	5	–	3	1	2	1	1	10	1	13	6
1	2	36	13	1	2	4	49	4	21	4	4	52	23	–	–	34	7	15	11	22	10	2	7	17	16	1	–	25	7	31	11
4	1	24	11	8	3	6	14	7	16	4	4	15	23	1	1	14	7	9	10	14	10	1	6	–	4	3	7	12	1	37	7
3	1	17	2	22	–	1	8	2	18	–	7	8	13	–	6	9	9	3	5	11	11	3	3	–	6	4	8	4	4	25	3
10	5	89	33	31	6	15	79	13	62	17	15	84	65	1	11	62	24	32	33	56	36	6	19	18	28	9	16	51	13	106	27
2	–	14	1	4	–	–	4	1	6	2	5	5	5	–	1	3	3	2	4	7	2	1	3	–	–	–	2	3	1	[illegible]	4
62	5	103	46	35	6	21	92	18	32	19	29	99	97	7	19	84	30	41	48	80	50	8	29	19	34	9	22	85	16	138	47

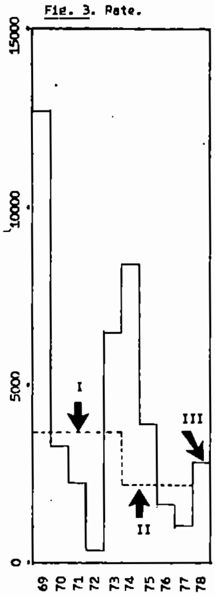
Frequency
Fig. 1. Rate.



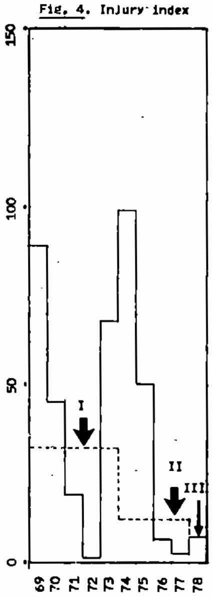
Number of
Fig. 2. Employees.



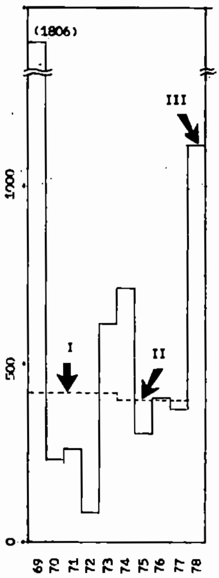
Severity
Fig. 3. Rate.



Disabling
Fig. 4. Injury index



Average
Fig. 5. days charged



(I = 5 year exploration period ; II = 4 year construction period ; III = one year production period)

Results

Of a total of 370 disabling injuries occurring during the ten year period (1969-1978), there were 21 (5.7%) fatalities; 4 cases (1.1%) permanent total disability; 14 cases (3.8%) permanent partial disability and 331 cases (89.5%) temporary total disability with total actual days lost 7,239 and total scheduled charges 160,230 or an overall total days charged 167,469 making an average days charged per disabling injury of 453. (Table 1).

1. *Frequency Rate* : In the period of 1969-1978 the frequency rate showed fluctuations from year to year but on average as shown in Fig. 1, this figure showed a reduction from 8.80 during 5 years exploration to 5.52 during construction and then dropped to 2.53 in the production year of 1978 although the average number of employees increased very sharply from 875 to 6,065 and then decreased to 4,940 during the above three periods (Fig. 2).

2. *Severity Rate* : The severity rate showed fluctuations in the 5 years of the exploration period but year by year in the construction period showed a tendency to decrease from the 1974 high of 8404 to 3929 in 1975, 1645 in 1976, and 1034 in 1977. The production year figure was 2830 in 1978. The average figure for 4 years construction was 2208, a reduction from the 5 years of exploration high of 3698.

3. *Disabling Injury Index* : This figure showed a tendency to decrease in the first 4 years of exploration from 89.25 in 1969 it went down to 45.28; 19.38 and 1.43 in the following 3 years respectively but then went up at the end of this period to 67.99 when the number of employees dropped to a number similar to the first year of exploration i.e. 475 in 1973 and 498 in 1969 (Table 1. and Fig. 4). The increased number of employees during 4 years of construction (1487 in 1974, 4207 in 1975, 8767 in 1976 and 9798 in 1977) was followed by a decrease in Disabling Injury Index from 94.91 in 1974 to 50.40 in 1975, 6.66 in 1976 and then went down to 2.84 in 1977. Comparison of the three periods showed a reduction from 32.54 in the exploration to 12.19 in the construction and 7.16 in the production year.

4. *Average days charged per disabling injury* : In the first period of exploration, the average days charged per disabling injury was 420 which then decreased to 400 in the construction period but went up to 1118 in the production year of 1978 (Fig. 5).

5. *Death* : During ten years of this study, there were 21 fatalities with a total scheduled charge of 126,000 days following the formula proposed by the American National Standard Institute where a scheduled charge of 6000 days is made for each death or permanent total disability. The cause of accident of these fatal injuries were TRANSPORT (8 cases), CAUGHT UNDER (5 cases), PERSON FALLING (4 cases), STRUCK BY FALLING OBJECT (3 cases), and one case was electrocuted.

6. *Permanent total disability* : There were 4 cases of permanent total disability with a total scheduled charge of 24,000 days. One case with incomplete paraplegia of the lower limbs because of a fracture of the lumbar vertebra, one case with loss of sight of both eyes due to severe compression fracture of the frontal bone, one case with severe intellectual impariment and one case with left sided hemiplegia plus speech defect. The two last cases were due to extensive trauma of the skull.

7. *Permanent partial disability* : There were 14 cases of permanent partial disability with a total scheduled charge of 10,230 days, or an average days charged of 731 days per case. Of 14 cases in this class of injuries, 11 cases were traumatic amputations of fingers, one case was surgical amputation of the forearm with a scheduled charge of 3600 days, one case of loss of sight of one eye and one case of loss of one eye with a scheduled charge of 1800 days for each of the last two cases.

8. *Temporary total disability* : There were 331 cases of this fourth class of injury with a total actual number days of disability of 7239 days or an average of 22 days per case.

9. *Place of accident* : During the 5 years of the exploration period 65% of accidents

occurred in the mine exploration areas, 15% in the town/camp area, 12% were motor vehicle accidents and 8% in the wharf-warehouse. During the construction years, 33% of injuries happened in the Process Plant construction, 29% motor vehicle accidents, 12% in the construction of the town, 11% in the construction of the Hydro Electric power plant, 6% in the wharf and warehouse, 4% in the mine operation area and the rest in the quarry and the construction of the oil terminal and pipe line. During one year of production most accidents (56%) occurred at the Process Plant and next were vehicle accidents. Thus during the whole period the "big five" in places of occurrence were: first (28%) Process Plant, second (25%) motor vehicle accidents, third (17%) Mining, fourth (12%) Town & Camp Construction, fifth (9%) Construction of the Hydro Electric Power Plant (Table 1).

10. Type of accident : The most common type of accident that happened during the exploration years was being STRUCK BY FALLING OBJECT (35%) followed by PERSON FALLING (18%), TRANSPORT (13%) and STRIKING AGAINST (12%), while in the construction years, number one was TRANSPORT (31%), number two was being STRUCK BY FALLING OBJECT (24%), number three was PERSON FALLING (23%) and number four was MACHINERY (6%). In one year of production, 4 groups were almost in the same percentages, PERSON FALLING was the highest (24%) and STRIKE AGAINST, TRANSPORT and STRUCK BY were of the same percentage (each 20%). The overall figure were: first, TRANSPORT (27%), second, STRUCK BY (26%), third, PERSON FALLING (22%) and fourth, STRIKE AGAINST (8%), followed by MACHINERY, HANDLING GOODS and OTHERS, 5% of each and the lowest was using HAND TOOLS (2%).

11. Parts of body affected : In both exploration and construction years the following are the order, first Head, Face & Neck; second Body; third Hip, Thigh & Legs, fourth Hand & Fingers; fifth Shoulder, Arm & Fore arm. Injuries affecting eyes were number seven in the exploration years but number six in the construction year, and in reverse number six in the exploration years was feet and toes, which was number seven in the construction year. The lowest figure in both period were injuries affected knees which was number eight.

12. Nature of injury : During the exploration years the highest percentages of injuries were lacerations (40%) followed by fractures (22%), but in reverse, number one in the construction year was fractures (40%) and lacerations (19%) was number two. Similarly the highest percentage in one year of production were fractures which were 60% of total disabling injuries in 1978.

13. First Aid case injuries : Percentage of First Aid case injuries in two exploration years varied between 84.3% and 87.8%, but in four construction years they varied between 98.1 to 98.9% or an average of 98.6%, almost similar

Table 2. Percentage of accident according to class of injuries by years.

Year	Average number of employees	First Aid injuries Number	%	Disabling injuries Number	%	All injuries Number	%	Incidence Rate
1972	974	43	84.3	8	15.7	51	100	52 °/oo
1973	475	72	87.8	10	12.2	82	100	177 °/oo
1974	1487	1789	98.1	35	1.9	1824	100	1227 °/oo
1975	4207	6611	98.4	108	1.6	6719	100	1597 °/oo
1976	8767	6588	98.9	71	1.1	6559	100	748 °/oo
1977	9798	4801	98.9	54	1.1	4855	100	495 °/oo
1978	4940	1958	98.7	25	1.3	1983	100	401 °/oo

with the one year of production, which was 98.7% (Table 2.)

14. The highest number of disabling injuries in a year during ten yeras of this study was 108 cases where 90 of them occurred during the last six months of 1975. Control chart shown in Fig. 6 demonstrated that the injury experience of August were "out of control", this is because in August 7, 1975 a dump truck being used to transfer 35 workers overturned, resulting in 2 fatalities and 33 injuries.

15. All injuries : The incidence rate of all injuries varied from year to year. There were 52 injuries per 1,000 employees in 1972, but this went up to 177°/oo in 1973 (Table 2.). When the construction started in 1974, this figure reached a high of 1.227°/oo and still went up to 1.597°/oo in 1975. It then showed a tendency to decrease until 401°/oo in 1978. This was achieved following the extension of safety and health education and training for safety supervisors and workers in more systematic and practical approach.

Summary and Discussions

1. The peak of construction period in 1977 recorded a low rate of accident (frequency rate: 2.75; severity rate: 0.34; disabling injury index: 2.84 and average days charged of 376) although the average number of employees was the highest (9798).

2. The frequency rate (2.53) and the incidence rate of all injuries (401°/00) in the first year of production were also the lowest in both construction and production periods but the severity rate (2830) was still high.

3. Motor vehicle accident in both construction and production periods were number two after the injuries occurring at the Processing Plant, besides the major cause of fatal injuries were traffic accidents. Thus in planning an accident prevention program for construction of a process plant, priority must be given to a vehicle safety program next to promoting safety in the construction and operation of the process plant itself. We are all aware that the total cost of a vehicle accident far exceeds the amount recovered from the insurance company apart from its indirect cost which is several times the direct cost.

4. The major cause of permanent total disability was head injury, apart from traumatic amputation of the fingers and loss of sight were the major causes of permanent partial disability and both caused a very high number of scheduled charges, therefore wearing hard hats, goggles and handgloves must be strictly enforced in the potential hazard area.

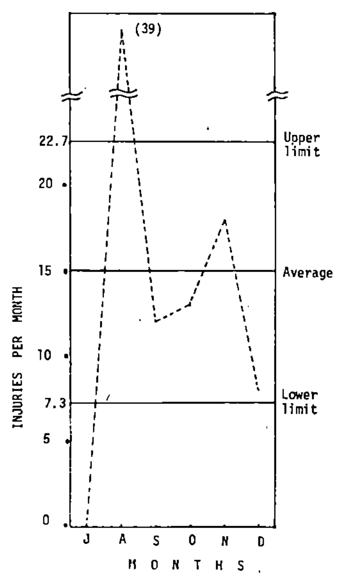


Fig. 6. Control chart of 90 cases of disabling injury occured between July and December 1975. Upper and lower control limited were based on 6 months' experience.

Conclusions

1. In the mining, smelting and refining industry where the hazard potential is high, a safety department should be well established.

2. Planning for an accident prevention program must be initiated long before the construction starts or best to be included when doing the feasibility study.

3. Motivating people to work safely is necessary and an on going part of every accident prevention program as the majority of injuries resulted from human error.

References

I.L.O. (1972): Encyclopaedia of Occupational Health and Safety (3rd impression).

Kiagoes, A. (1977): Rumah Sakit Soroako diresmikan oleh Ibu Tien Soeharto, Soroako. March 31, 1977.

National Safety Council (1974): Accident Prevention Manual for Industrial Operations (7th Edition)
PT. International Nickel Indonesia (1977): Inauguration of PT. INCO's Soroako Nickel Processing Plant by President Soeharto. March 31, 1977.
PT. International Nickel Indonesia (1978): Dedication of the Larona Hydro Electric Power Plant 1978 by the Minister of Mines and Energy. November 15, 1978.

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A STUDY ON SAFETY CONTROL TECHNIQUE AND SITUATION JUDGEMENT DATA

Geun Heui YI, *Korea*

Introduction

The safety control technique has been developed, side by side with the production control technique, both techniques are as closely interrelated that the technique of only production control, being the main stream technique, is apt to be conspicuously brought foreward, while the problem of safety is often neglected or gone without.

Accidents may not occur frequently, but if it does occur, it disturbs or poses an obstruction to the flow of the main stream. Therefore, if and when the safety control, which is to prevent such disturbances or abstructions, is not properly introduced, the production control may be plunged into a complete chaos.

Therefore in order to accomplish rationalization of the production, the method of analysing situation judgement data for safety control Technique should be well systematize.

However for safety control technique by this time, methodology of analysing the cause has been only proposed.

And so it is fact that the function of preventive control has not been able to be effectively accomplished.

This study is to be examine the situation judgement of safety control technique, with $\bar{P}n$ control chart(1) of the application of the safety control technique in the favor of preliminary and preventive control(2).

The Basic Technique of Safety Control

The basic technique of safety control is able to be indicated by seven way as follows:

(1) How and in which manner accidents occur.

It is the first prerequisite that the control of occurrence of an accident should be entirely grasped.

Management (production Control) can not be accomplished without the above statements. In other words, management which the cause of occurrence is not able to be grasped is compared to an locomotive to be out of rail. This locomotive is not able to be expected normal operation. As present, past and future situation can not be foreseen, the goal of management is not able to be exactly decided.

In case of necessity to know the situation of stream, in the first place, it should be measured by a gauge.

In the same manner, the situation of accident occurrence for safety control have to be exactly grasped with data on the base of management.

This matter seems to be simple thing.

But in fact, it has many complicated things. Of course, it may be easy thing an accident in case of closed production system, is possible to be grasped to a certain extent.

However, such an accident as incident having a difficult situation to grasp its occurrence, it is not able to be grasped without all worker's the right consciousness for safety, and mutual sufficient understanding and cooperation.

(2) The situation and trend of accident must exactly decide the extent of deviation about the goal or index.

Without such judgement data as the above statement, it is almost impossible to establish reasonable counterplan, and to make use of the situation of accident as good available data.

The motivation for counterplan can be achived by knowing entirely the devation.

(3) In some case it may be not reasonable that we know the trend, and accomplish the counterplan for safety control.

Eventhough we simultaneously develop many matters which are related to safety control, its results in the end are beside the point which is followed by management intention. And so it is almost impossible to achieve fruitful result for safety control.

Therefore a counterplan to be developed in priority for the technique of management should be decided in review of accident data.

The counterplan have also got to be carried out in regular sequence.

In order to obtaining the desired results, these matters should be developed on a solid basis of cooperation which all workers have appeal and understanding for a such problems,

(4) It is hard to expect a good result only with developing the policies applying to the safety control. In actual application every worker should take positive attitude toward executing the policies. It is agreed that motivation to lead them to participate in this activity is more important than anything else.

Therefore, such performance needs mutual assistance through their valuation and requires continuous stimulation producing their fulfillment. They need to be stimulated systematically to get such behavior through motivation upon basic wants for money and reputation, superiority and competition. Such stimuli are confined to respective worker that they will lose their function as stimuli if they are given too long.

Physiologically and psychologically this is the one of the natural conclusions, therefore another new stimulus is needed to abolish the mannerism. To change motivating method for the identical purpose means to give different stimuli.

(5) When control technique is being developed emphatically, it is necessary to check the effect, what the result stands for, continuously.

As pointed out in preceding paragraph, the cause of accident is not always one and, what we should be deploying emphatically is only a part of it. Therefore we always have to check the effect. Since the effect comes from the comparison between past and present occurrence and randomness is involved in accident occurrence, final judgement should be done by using statistical method, otherwise the variation become great in comparison and various problems can be arisen consequently.

(6) In order to secure effectiveness of the measures, any factor disturbing in reaching the objectives, found in the results obtained in the course of developing the measures, have to be feed-back for the purpose of eliminating it.

Human beings are basically free, unlike machines. It is, therefore, not assured of that all instructions are properly performed for long. Instructions may, even, have defects but this may not be found until actions in response to the instruction proceeds. Therefore, any defects found, either from the data of the result of actions or from the process of actions, have to be feed-back if the measure is to get effective results.

(7) The result from insufficient instructions can not be same as that from remedied with such feed-back informations. Safety control without inputs of successive data obtained either from processes or from performances may deteriorate proper functioning of its organization. And if the organization should not function properly then data may not be properly obtained.

Therefore, if a firm is to introduce proper safety control and if it is to raise it's effectiveness, the firm will have to embody such basic techniques as mentioned in the above.

Data for Judging Safety Control Status

The quality of safety control status can be judged by the following factors which are showing the realities of accident occurrence.

(1) What is the frequency rate of accident occurrence.

(2) What is severity of accidents.

Above factors can be summarized in collecting every accident record from manufacturing and working site. In other words, it is important to secure operator's assist to collect any injury during not only shutdown but non-shutdown.

It also increases reliabilities in setting up the safety control policy to collect the record of every injury even slight one treated with first aid kit. But it is very hard to keep the record of such slight injury in actual practice, therefore convincing him (or her) of accident prevention, every operator's assist should be sought.

Without this kind of help, slight one can not be detected. Furthermore, it should not be ignored that it is fundamental to keep the record of every cause of the injury even slight one.

By preparing the graph showing monthly accident occurrence, the accomplishment of safety control can be easily interpreted.

In case that the number of accident occurrence is exceptionally high, the causes of accidents could be fully investigated and the plan to decrease the accidents also should be established, using this graphic method.

To accomplish the control object, actual number of accident should be plotted on the graph together with target indicaters. With this procedure the degree of accomplishment against the object can be read at the glance.

He following formula is useful in judging the graph.

$$\bar{P}n = \frac{Pn_1 + Pn_2 + Pn_3 + \cdots Pn_k}{K} \quad \cdots\cdots\cdots\cdots (1)$$

Where P and $\bar{P}$ represent accident rate per 1,000 persons during a month and average accident rate per 1,000 persons during a year respectively, n is the number of persons of population, k equals the total number of month observed, and $Pn_1, Pn_2 - - - Pn_k$ indicates the number of accidents during first month, second month - - - and Kth month respectively.

From above formula (1) we can calculate upper control limit and lower control limit using the following formula (2).

$$\begin{aligned} U.C.L. &= Pn + 3\ \bar{P}n(1\text{-}P) \\ L.C.L. &= Pn - 3\ \bar{P}n(1\text{-}P) \end{aligned} \quad \cdots\cdots\cdots\cdots (2)$$

If, for the control purpose, the number of accident comes in the range of U.C.L. and L.C.L. each month this accident occurrence regards as expected.

If any point lies above this control limit, this indicates the state of "out of control" and should be carefully observed as accident occurs more than expected during the month.

Fig(1) illustrates the example of the accident control chart. Center line represents the number of actual average accident, and the above and the lower dotted lines over and below the centerline are upper control limit and lower control limit respectively which are generally called U.C.L. and L.C.L. Fig(1) also tells that a, b and j fell outside the U.C.L. The control chart has been drawn as Fig(1) for calender year as an example.

It illustrates that accidents of each month holding a, b and j fell outside U.C.L. and also implies that necessary countermeasure be considered to the causes of the each accident. Under this accident distribution, let's consider the plan to reduce accidents by 10 percents for the future. This results that U.C.L. became lower as Fig(2). The points of a, b, g and j beyond new U.C.L. are considered as danger signal. We should investigate the causes of and consider the countermeasure to the accidents. It also says that we could not attain the object along-with this points in the control chart.

Since U.C.L. and L.C.L. simply indicates the breadth of variation, points are expected to be plotted under U.C.L. Fig(1) and Fig(2) show the safety control by the chart including light injuries like a incident.

It is necessary to collect any incident if possible. But depending on the degree of injury, this collection can not be done without the assist of organization's member as emphasized previously. As saying before, it is more desirable to keep any accident record even during non-shutdown. Since it is very difficult to keep every detailed record in actual practice. How to draw the control chart becomes the major problem. In this case, we collect every record during shutdown more than one day. Using these data, we can consider the following formular to draw approximated control chart.

$$\begin{aligned} U.C.L. &= Pn + \bar{P}n \\ L.C.L. &= Pn + \bar{P}n \end{aligned} \quad \cdots\cdots\cdots\cdots (3)$$

As this method is very simple, it has a merit

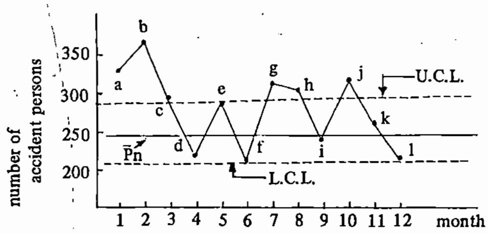

Fig. 1. Safety control of Accident chart

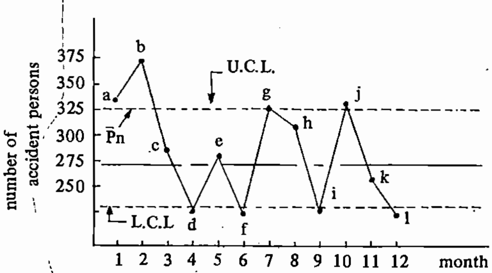

Fig. 2. Safety control of Accident chart

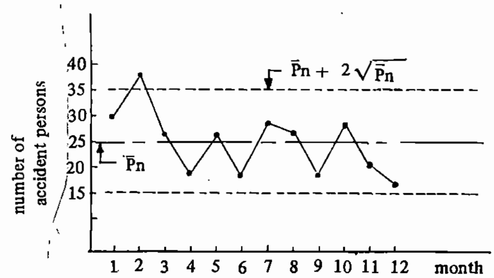

Fig. 3. Safety control of Accident chart

on collecting accident data easily. Fig(3) shows accident occurrence during more than one day like Fig(1) and Fig(2). Since simple formular(3) is used for this case, the breadth of control range is getting wider relatively. Because there is the possibility to have contingency.

In this case, if the analysis of performance for $\bar{P}n$ during long period in the past is to be dealed with, the confidence of breadth for the judgement in getting wider.

Here it is necessary to get the average value of accident data during six months, since the goal value can be changed by $\bar{P}n$ value.

Conclusion

Measures to accidents has, up to now, been nothing but to think about control technique of analyzing the causes, as presented in the above. And much efforts could not be directed to exact detection of defects or to preventive control.

This paper is to present current situations as well as past facts in a control chart concretely, and then to seek measures for scientific control. For that end, an attempted application of $\bar{P}n$ control chart is made. Safety control will have to be a preventive function. And so application of scientific preventive technique is pre-requisite in order to fullfil it's function, where $\bar{P}n$ control chart is selected for the attempted application.

References

Geun Heui, Yi: Monden quality control, 1978 (Changji-Sa, Seoul)

Geun Heui, Yi: Production system Analysis and control, 1977 (Changji-Sa, Seoul)

Geun Heui, YI: Problem of Factory safety management, 1964, Nov. (The Industrial Bank)

Geun Heui, Yi: Accident prevention and spread safety knowledge, 1970 (Administration of Labour Affairs, Rok)

Geun Heui, Yi: The general Theory of safety no error system (International Occupational Safety and Health Congress, Geneva, 1970)

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ECONOMIC EFFECT OF THE MEDICAL REHABILITATION FOR THE VICTIMS OF THE INDUSTRIAL ACCIDENT

Dong Eun Kim, *Korea*

Abstract

During one year period of 1977, the author had managed three hundreds and forty-three stiff joints of two hundreds and one patients who had been involved in industrial accidents. The initial injuries causing joint stiffnesses were fractures, dislocations, amputations, ligament injuries, tendon injuries, peripheral nerve injuries, and etc. The average duration of treatment was three and a half months. Treatment used was conventional physiotherapy including various kind of heat, hydrotherapy, and therapeutic exercises. Comparing the disabilities at the time of admission with the ones on discharge, forty-three patients (21.4%) showed complete recovery from disabilities and one hundred and sixty-nine patients (84.1%) showed marked improvement.

To prove the economic significance of medical rehabilitation, the disabilities of individual patient were evaluated in accordance with Korea Compensation Law for the victims of industrial accident before beginning the rehabilitation treatment and assumed, total expenditure from compensation fund was calculated. After finishing the rehabilitation treatment the disabilities of individual patient were evaluated again similarly and actual, total expenditure from the fund was calculated. The difference between the assumed, total expenditure before beginning rehabilitation treatment and actual, total expenditure after finishing it was 96,475,000 won.

As a result of rehabilitation treatment for two hundreds and one patients who had stiff joints, 96,475,000 won of compensation money could be cut down during one year period.

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TO PREVENT RAILWAY ACCIDENT CAUSED BY EPILEPSY

SOEHADI and UMAR SALIM, *Indonesia*

Abstract

Endeavouring to secure the social-economical position of labourers, the government has composed the appropriate principal Law which is in accordance with the aspirations of the Indonesian Nation in aiming to achieve the PANCASILA Society.

On that principle a labourer gets the freedom to choose a suitable work; developing his potency, increasing his ingenuity and skill. Beside that, in order to safeguard him in his daily work, the labourer would be protected against all sorts of problems surrounding him and on him.

Said protection, especially at the PJKA – Indonesia should be rendered to labourers, as well as to the public in general who are making use of the PJKA service, and to the environmental society.

One of those matters relevant to the above-mentioned protection consists in promoting efforts in order to prevent railway accidents

due to epilepsy of the engine-driver.

The railway security system in Indonesia has its own characteristic, i.e. among others requiring from the engine-drive his full concentrated consciousness continuously. The required concentration of consciousness for the execution of the railway's operation duty, being bound up closely with the careerdistance of braking the train, either for those with a central operated (automatic) brake-system or for those with a hand-brake system implicates the requirement of man's ability to see the signals, and with the sanction and law in view in case of tresspassings although an accident has not happened yet.

This constant consciousness is necessary to attend safety of the train-service among others the level-crossings with the public roads, the signs for obligatory reducing speed and the signals serving as a system predicting safety or unsafety of the track to be passed over.

This constant concentration of consciousness could accelerate mental exhaustion and such mental exhaustion could become one of the causes which could quicken the looming process of the epilepsy disease to someone (engine-driver) and change into latent epilepsy-disease. When several cases of railway accidents, which were caused by violating the signals or entering unsafe denoted areas, were traced and investigated, had proved to seek the source of breaking those rules merely in the direction of the engine-driver's inattention or fall asleep of the engine-driver, not investigating the possible attack of epilepsy.

Based on the assumption that epilepsy of the engine-driver may also cause railway accidents, it should therefore be required at the physical tests the prevention of epilepsy's susceptibility and at those accidents' investigations should also be assured that epilepsy suffered by the engine-driver may also be the cause of the accident; that is why it is desirable to investigate that possibility as well.

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RECENT DEVELOPMENTS IN THE PREVENTION OF OCCUPATIONAL ACCIDENTS AND DISEASES

David I. AMIR, ILO

It is commonly accepted to regard the development of safety (and Health) as a concomitant of the industrial revolution of the 18th - 19th centuries. It was prompted by the evident necessity to attempt and stem the spate of accidents and work – related diseases, that became the constant companion of industralization. This was the beginning of our mechanised age with its factories, manufacturing process lines etc. which have brought us to where we stand today in our technological progress. In the course of his development, man's ingenuity of inevention has given us a wide choice of tools and techniques, but this was coupled with a heavy toll of death, maiming and suffering of the operators.

Philosophically viewed, there is an inherent conflict between the machine and its operator. Every piece of problem created during the centuries in machine design, construction or operation – either by acts of commission or of omission – has led to injury, death or health impairment.

While, as said our modern concern with safety and health problems goes back less than 200 years, I may be permitted to quote from the Bible, Old Testament: – I refer to Deuteronomy, Chapter 22, Verse 8 which reads (in modern rendition) "When you build a new house, you shall put up a railing on your roof and prevent a serious accident (literally "And not put blood upon your house"), should somebody fall from it."

It is true that above refers to building operations only, but its message is universal and as valid today as when issued.

But let us go back to modern times. Safety, as originally conceived and developed in the then industrializing countries of Western Europe, primarily England, was only concerned with what we now term "mechanical safety" i.e. with the prevention of machinery-caused accidents by means of a physical seperation between the machine or its dangerous parts and the operator (fencing, guards, barriers, anclosures etc.). This has, on the whole, remained as the basic concept of safety well into the 1930's.

This preoccupation with machanical safety formed the core of the activities and also determind the scope of specialization of early safety inspection. As an aside, I must recall, that in most countries protection of the workers' health and the prevention of occupational diseases often developed parallelly to that of safety, the two either operating independently or, in some cases, with a certain degree of collaboration.

One must remember that, historically at least, occupational health (or industrial health as it was formerly called) preceded safety and that its foundation has been laid by the classical work of Ramazzini (1700/1717 "De morbis artificum diatriba").

This simplicit approach to safety as only covering the danger posed by machinery, underwent in the course of the Second World War and the years thereafter an almost complete change. The reasons for this were: an unprecedented development of new processes as also an ever-growing introduction of new and ofter potentially hazardous materials and substances.

The very concept of safety and health has thus changed. First of all, it became universally accepted that any worker or employee had the right to a safe place and conditions of work; and the designation "industrial safety and health" was changed to "occupational safety and health" to cover all walks of economic activity.

The various skills, techniques and procedures needed to ensure the required conditions of work call on the services of a multidisciplinary team composed of engineers, hygienists, physicians, nursing and paramedical personnel, ergonomists, ecologists, statisticians, economists and sociologists.

The area covered by them is nowadays referred to as "occupational safety and health" and is commonly abbreviated to "safety," and that is how I shall use this word.

New techniques of accident prevention had been developed, while at the same time improving and perfecting the old ones. It became soon evident however, that mechanical safety alone is unable to prevent the spate of accidents and diseases, and the concern began shifting more toward the hygiene and health fields and thus to encompass all the potential hazards facing the worker at his place of work. Another important fact came to light: world-wide statistics regularly confirmed that only some 10-12% of all accidents were caused by unsafe machinery, and the obvious question of "What to do about the remaining 90%?" forcibly came to the fore.

Detailed studies conducted by specialists in many countries came up with the same answer: The majority of accidents are caused, not by unsafe conditions of work (machines, tools or processes) but by unsafe acts of the operators, and are mainly due to:

a) the worker's physical or/and mental inability

b) lack of proper training and instruction and c) lack of supervision/guidance

But even the measures introduced to cope with this newly recognized truth as to the real causes of accidents, did not produce all of the expected results and the number of accidents continued to increase, worldwide.

Then came another, more important perhaps as to its implications, breakthrough. It dawned on those dealing with safety that, throughout the years, they might in fact have been attacking only shadows and not the real agent causing the accident. What lay behind it, was the realization that up till then their concern only went to accidents resulting in bodily injury, that is to the *effects of accidents* and that they disregarded those accidents (or incidents or dangerous occurrences as others call them) which, fortuitously, did not cause an injury.

But are not precisely the latter the actual causative factors and indications of hazards and of things being wrong? Who can, after all, predict whether, at a given moment when the accident occurs, there will be in its vicinity somebody who could get injured by it, simply be being within the radius of the effects of such an accident (f.i. a suspended load falling, a scaffold collapsing etc.). The lesson the became clear: We have to attack the real causes-i.e. all potentially hazardous conditions, some of which may be signalled by non-injury accidents, and not their effects, which are, to a great extent, governed by laws of pure chance and probabilities. Though it sounds so simple, when stated in this way, it took us some 200 years to arrive at this logical conclusion!

While the preceding overview is generally valid for all types of economies, irrespective of their level of development, the developing countries and those in the course of industrialization have to face another serious dilemma, that is: the price in money, human suffering and environmental degradation they are prepared to pay for a more rapid industrialization, required by them for their very economic development. Thus, in the first stages, social needs were often sacrificed and ecological and environmental considerations set aside, for the sake of creating employment, exports and industrial progress. In several industrializing countries, many polluting or highly hazardous industries, banned in their own home-countries, found a safe haven and a hearty welcome with little thought as to the ultimate, and often irreversible, damage.

Fortunately, the recognition that no real sustained economic progress is feasible without a parallel one in the social field became accepted worldwide and I shall not bother you with references to, or quotations from, relevant resolutions, conferences and legislation.

Suffice to say that there is nowadays no self-respecting country which would not include the social component in its overall development planning. Matters become much more serious as we descend from national levels to those of specific industries or, even more so, of individual plants.

The main reason behind this lack of recognition of the importance of safety is the still wide-spread lack of appreciation of the magnitude of the losses caused by occupational accidents and diseases.

Every accident or work connected illness amounts-besides moral implication-to a net economic loss.

These losses are sustained through work stoppages, damage to machinery, material or process flow, loss of manpower (particularly serious in cases of highly trained and often difficult to replace one), lowering of work morale and productivity and finally, to a possible interruption of production. Though I shall not go into details, I may add that the so called invisible (or hidden) costs of such accidents and diseases by far surpass (often by a factor of 4 to 6, depending on the study) the direct costs which are usually defined as the cost of medical treatment and compensation to the injured employee.

While detailed studies and research activities conducted in various industrially developed countries all tended to show that the costs of determining the causes of accidents and of subsequent preventive or remedial measures were lower than those of the accidents or diseases themselves, this fact is not always recognized or even known to management in our region.

To counter the often met with reply that these studies do not fully apply to the local conditions in Asia, the ILO is presently conducting a "Case study of the costs of occupational accidents and diseases in selected industries in the Asia Region and of appropriate preventive measures." The results will – we trust – clearly support the contention that it is cheaper to prevent than to cure and that, to put it short, "Safety pays." Let us now turn to the more recent concepts and developments in the prevention of occupational accidents and diseases.

As said, there has been a worldwide shift from the classical *accident – oriented* approach to that of a *hazard – centered* one.

The whole thrust of modern accident prevention is directed towards the elimination of possibly hazardous factors and conditions before they can cause an accident or impair the worker's health.

We can follow two basic routes to hazard recognition: the "fundamental" one or the more modern and comprehensive one, the "technical" approach better known as "Total Loss Control." The fundamental approach really amounts to a study of all possible hazards that could exist, first qualitatively (recognizing their existence), then quantitatively (to try to calculate the probability inherent in each hazard) and the overall probability of an accident.

The technical or loss control approach involves the careful recording and study of as many accidents and near-accidents (non-injury accidents) as possible in order to identify and eliminate the hazards that led to them. I wish to stress in particular the importance of investigating non-injury accidents i.e. those, involving property damage only, since experience has shown that their causes are more easily established and analysed. One of the very useful tools of total loss control is that of a "Safety audit." Derived from the traditional association with financial accounting, audit — in the safety context-designates a systematic critical examination of an operation in its entirety to identify potential hazards and levels of risk. While clearly requiring advanced technological expertise in the fields covered by OSH, the emphasis markedly shifted towards the managerial aspects of accident prevention. To put it simply and succinctly, it amounts to an attempt of "managing out" accidents and occupational diseases by the application of the usual managerial techniques, procedures and approaches, — but time prevents me from going into details at this time.

The basic premise however must always be the recognition that safety and health are as much a managerial responsibility as any other production input, be it capital, machinery, sales etc.

Another path-setting development came following the publication in the U.K. in 1972 of the Lord Roben's Report on Safety and Health at Work.

It recommended changing or even abandoning some of the hitherto followed practices in accident prevention and strongly advocated reliance on self-inspection at plant level, coupled with joint management-employees' actions and programmes.

Its other main recommendation concerned the need for continued safety training, education and recourse to the usual measures aimed at motivating and promoting cooperation among all concerned. Government only to provide guidance and enforce relevant safety legislated.

I would now like to add a few remarks on the need of planning for prevention of major hazards.

Minamata, Flixborough, Seveso — locations of the three most widely publishize disasters — have now become a byword of what can happen to workers and the surrounding population and environment in the absence of proper recognition of high potential hazards, lack of foresight and planning. Were all the clearly known inherent dangers given proper attention, and the very extreme seriousness of any mishap evaluated as to its overall results, above tragedies could clearly have been averted. Advance planning was all that was needed.

It should only be normal for me, an ILO expert, to conclude my address by stressing the benefits of closest cooperation between governments, employers and workers. This represents not only the basic ILO credo of tripartism, but in the field of OSH is clearly a precondition for any meaningful and effective programme of accident and disease prevention.

On the international scene, the closest collaboration between all bodies and persons active in the field of OSH is required for an exchange of information and expertise and our current meeting is a good example of it.

The continued close collaboration and consultation on all matters of OSH maintained by various UN organs and specialized agencies can serve as another good example; I naturally think, in the first place, of the excellent coordination and frequent joint team work between us in the ILO and our friends in the WHO, or more recently also the (UNEP) — UN Environmental Programme.

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Session 3.
Environmental Control

A CONTRIBUTION TO EPIDEMIOLOGY IN EVALUATION THE RISK OF LOW LEVEL EXPOSURE OF HAZARDOUS AGENTS

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Introductive Note

In 1977 Mancuso et al.[1] published epidemiological study on the health effects of radiation worker working for U.S. Hanford National Laboratory.

Their conclusion was: radiation workers had died with cancer significantly higher than workers who did not exposed radiation on their jobs, and therefor limit of radiation exposure should be lower than present regulated dose.

Much of critique appeared subsequently by many scientists, among these critiques Sanders[2] claimed completely opposite opinion even dealt with exact same data.

This contradictious argument developed from the difference of handling variables which characterized study subjects, and as the result led to confounding interpretation of association between frequency of death and some assumed causal factor.

Principally, longitudinal epidemiological study is all the more important to detect subtle influence of working environment. However, proceeding long term cohort study on human subjects is always not easy, so some specific idea or effective methods useful to do study efficiently have been widely expected.

The points desirable to those methods are: to be capable of eliminating spurious association not to decline precious human data and having relatively power of test.

Method

Orthodox ways used in epidemiological study to cope with spurious association are matching and stratification of data. Unfortunately, both of these methods inevitably decline volume of data. Declining volume of data also inevitably weaken the power of test used. The other method, hopefully available to fulfill desirable condition above noted should be applying to some kind of multivariate model on original data.

On of those methods, logistic function model seems quite suitable in applying to epidemiological study on human data.

Study Example of Applying Logistic Function Model

Logistic function model was applied to the absence data of two institutions of R&D of nuclear power. Both of them have close relation to Japanese major constructors of nuclear power plant and they have passed nearly 20 years after the establishment. During these 20 years, none of radiation workmen died from any kind of cancer while they were employed. From the institution A 490 cases of radiation workers and from the B 103 cases could be used for analysis.

The details of theory of logistic function and process of calculation of coefficients derived from applying the function on the data, should refer to elsewhere.[3),4)]

Items Used in Analysis

a. Age at March 1978.

b. Length of employment until March 1978.

c. Accumulated exposure does for individual worker until March 1978.

d. Record of absence longer than 5 days with doctor's certificate.

Table 1: Distribution of frequencies in each item of workers in institution A.

Absenteesm by disease*	Freq.	Age	Freq.	Lengh of employment	Freq.	Estimated exposure(mrem)	Freq.
none	458	20–24	27	0– 4	47	0– 49	200
		25–29	158	5– 9	234	50– 99	53
once or more	27	30–34	144	10–14	82	100–149	31
		35–39	73	15–19	89	150–199	24
		40–44	50	20–	38	200–299	39
		45–49	21			300–399	39
		50–54	7			400–599	36
		55–	10			600–799	18
						800–999	10
						1000–	40

Total : 490

*: Absence more than 5 days, submitted doctors certificate.

Table 2. Distribution of frequences in each item of workers in institution B.

Absenteesm by disease*	Freq.	Age	Freq.	Length of employment	Freq.	Estimated exposure(mrem)	Freq.
none	84	20–24	15	0– 4	30	0– 99	4
		25–29	37	5– 9	39	100–499	41
once or more	19	30–34	21	10–14	12	500–999	23
		35–39	9	15–19	20	1000–	35
		40–44	10	20–	2		
		45–49	6				
		50–54	2				
		55–	3				

Total : 103

*: See note of Table 1.

Table 3. Correlation coefficients, means and standard deviations of each variable with data of workers in institution A.

Variable	Correlation coefficients				Mean	S.D.
	Abs.Dis.	Age	L.Emp.	E.Exp.		
Absenteesm by diseases*	1.000	0.139	0.079	−0.006	0.055	0.288
Age at March 1978	0.139	1.000	0.756	0.098	33.1	7.5
Length of employment	.0.079	0.756	1.000	0.141	10.5	5.4
Estimated exposure	−0.006	0.098	0.141	1.000	361.0	832.0

*: Value of 1 for cases that have records of absenteesm, 0 for others.

Table 4. Correlation coefficients, means and standard deviations of each variable with data of workers in institution B.

Variables	Correlation coefficients Abs.Dis.	Age	L.Emp.	E.Exp.	Mean	S.D.
Absenteesm by diseases*	1.000	0.391	0.332	−0.102	0.185	0.390
Age at March 1978	0.391	1.000	0.747	0.200	32.1	8.6
Length of employment	0.332	0.747	1.000	0.359	8.42	5.45
Estimated exposure	−0.102	0.200	0.359	1.000	1073.0	1490.0

*: See note of Table 3.

Table 5. Result of fitting of multiple logistic function to the data of institution A.

Variable	Coefficient	S.E.[c]	S.Coef.[$]	t-Value
Age	[illegible]$\times 10^{-2}$	2.67×10^{-2}	0.489	2.44
Length of employment	-8.86×10^{-3}	46.30×10^{-3}	−0.048	−0.19
Estimated exposure	-1.05×10^{-4}	3.05×10^{-4}	−0.087	−0.34
Constant	−4.97	7.81	−	−6.37

c S.E. : Standard Error

$ S.Coef. : Standardized Coefficient

Table 6. Result of fitting of multiple logistic function to the data of institution B.

Variable	Coefficient	S.E.[c]	S.Coef.[$]	t-Value
Age	6.60×10^{-2}	4.15×10^{-2}	0.569	1.59
Length of employment	1.10×10^{-1}	0.70×10^{-1}	0.601	1.56
Estimated exposure	-4.75×10^{-4}	3.13×10^{-4}	−0.707	−1.52
Constant	−4.35	1.22	−	−3.57

c S.E. : Standard Error

$ S.Coef. : Standardized Coefficient

The upper 3 were dealt as independent variables and the last one as dependent variable. As the routine health check of radiation worker, complete blood count has been done followed government's regulation, but records of blood count varied so widely both in between individuals and population of worker as could not be used as an item of analysis.

Results

Major results of analysis are shown in Table 1-6. Owing to poorness of the quantity and quality of the data, any clear associations can not be found between the record of absence and other items. Only the fact that estimated t-value for the accumulated radiation dose are negative in the both institutions (Table 5 & 6) implies that the more healthy workers have had the more chance to be engaged radiation work.

Matters Contribute to Long Term Epidemiological Study

To do epidemiological study successfully and find out health effects of hazardous agents earlier, following matters should be recommended.

a. To establish systems available to acquire all kinds of information relating workmen's individual characters and health matter.

b. These systems should encompass their function even after workmen resign their jobs, if available until the time of their death. At least, causes of death of registered worker should be tried to acquire.

c. In an analysis of acquired data, with orthodox methods of epidemiology, applying some kind of multivariate models suitable to the nature of data should be recommended.

References

1) Mancuso T.F. et al., "Radiation Exposure of Hanford Workers Dying from Cancer Causes," *Health Physics*, 33, 369 (1977).
2) Sanders S.H., "Low-Level Radiation and Cencer Death," *Health Physics*, 34, 369 (1978).
3) Maeda K. and Hattori Y., "A Trial Application of Logistic Function to the Evaluation of Long Term Radiation Exposure," (available from authors).
4) Hattori Y. and Maeda K., "A Contribution to Epidemiological Study on Long Term and Low Level Radiation Exposure – On the Data from Two Nuclear Power Institutions in Japan," (available from authors, in Japanese).

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EVALUATION METHOD IN THE FIELD CHECKING FOR AIR POLLUTANTS

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Abstract

This investigation was carried out to develop the measuring method for the industrial environmental condition and its evaluation.

By collecting 48 consecutive 10-minute samples in every 8-hour workday, a total of 144 samples was taken for three days at an ethambutol process of a pharmaceutical industry in which hydrogen chloride gas was released.

The results obtained were as follows:

1. To evaluate the degree of atmospheric pollution in an industrial environment, the cumulative frequency distribution curve should be drawn by plotting the observed data and the geometric mean and standard deviation should be calculated.

2. For evaluation of industrial environmental condition, it is necessary to take a series of measurement for the consecutive 16 samples in an 8-hour workday with the 30-minute sampling period.

3. One-hour average concentration provides a convenient mean to evaluate daily variation of pollution level.

4. The data obtained by means of gas detector tube were found to be unsatisfactory for use of representative value of environmental condition.

5. In deciding whether the observed average concentration of an airborne contaminant exceeds a standard threshold limit value, the Bar-Shalom's graphic procedure seems to be suitable for practical use.

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PLANNING A COMPREHENSIVE INDUSTRIAL HYGIENE PROGRAM

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Introduction

The objective of an Industrial Hygiene Program is to ensure that people working in industry are not exposed to hazardous levels of chemicals or physical stresses. The program must cover a wide range of activities which include education of employees, surveillance and evaluation of exposures, control of hazards and communication of results to the employees and management. Although due consideration must be given to physical as well as chemical stresses in planning a comprehensive Industrial Hygiene Program, this paper for the most part, emphasizes the approach taken by Korea Pacific Chemical Company and Dow Chemical Korea Ltd. in implementing a program with respect to the chemical environment.

Thorough planning of an Industrial Hygiene Program is important to make sure that all of the potential hazards in a plant are defined, evaluated and controlled. The program is generally developed in four stages: preparation; inspection; surveillance; and control.

The preparation and preliminary plant inspection are very important to the success of the surveillance program. In these two stages, the plant supervisor and the industrial hygienist working together must make a judgement of the potential hazards in the plant. A hazard rating is established for each chemical and physical stress in the plant in order to determine the degree of surveillance necessary to evaluate the hazard.

After the priorities for surveillance have been set, the industrial hygienist can then develop the techniques required to measure the exposure levels. Once the exposure levels have been defined and evaluated, any necessary recommendations can be made to reduce exposures through the use of engineering and/or administrative controls. The implementation of controls must be followed-up by periodic surveillance of exposure levels to make sure the controls are working and to evaluate any major changes in the process.

Preliminary preparation

This segment of the Industrial Hygiene Program requires the input from people familiar with the engineering and chemistry of the process. The guidance of the industrial hygienist is also needed to make sure that the information is developed in a way to enhance the search for potential hazard areas.

1) *Flow Sheets:* For industrial hygiene purposes, the key element in a flow sheet should emphasize possible contact points such as sample taps, vents, manholes and drains where the operator can be exposed to the process chemicals.

The line diagram should show the progression of the raw materials, through the intermediate steps to the final product. Each piece of process equipment, including pumps, should be shown schematically.

A well prepared flow sheet will spotlight the main areas of concern and will minimize the change of a potential hazard being overlooked.

2) *Floor plans:* A floor plan drawing to locate the process equipment is very helpful. The floor plan or layout should be as detailed as possible showing pumping stations, trenches, the location of process sampling taps as well as the major process equipment.

Besides pointing out potential problem areas, the floor plan is a useful tool during an industrial hygiene survey. The layout can be used to locate sites where measurements are made during the survey. This simplifies the explanation of where the samples were taken for reporting purposes and enables other investigators to duplicate the work in subsequent surveys.

3) *Chemistry:* In industrial hygiene work, quite often the by-product or contaminants produced during a chemical reaction are more critical than the reactants or products.

In describing the chemistry of the process, the reactions and possible side reactions should be defined for each major piece of equipment. Detailed analyses of the raw materials, intermediates and products should be available, particularly when there is a change of producing a toxic by-product.

A complete understanding of the process chemistry is essential in preparing for an industrial hygiene survey. The sampling and analytical techniques are selected on the basis of what is expected to be found.

4) *Process chemicals:* A thorough understanding of the process chemistry is important in the preparation of industrial hygiene inventory records. A form should be filled out for every job classification in each plant. The list of chemicals that the employee can encounter in the performance of his job should include all raw materials; additives; intermediates; and by-products.

5) *Health hazard data sheets:* It is important that the health and safety information is available for each of the chemicals found in a plant. A typical health hazard data sheet should basically contain a summary of the toxicological information available for a particular material. This information may be presented in four sections corresponding to the four routes of exposure, namely: (1) eye contact, (2) skin contact, (3) inhalation, and (4) ingestion. It may also contain worker exposure guidelines, the chemical structure of the compound and physical properties. This type of data sheet also presents the industrial hygienists' recommendations for protective equipment based on the potential for exposure.

6) *Worker exposure guidelines:* Worker exposure guidelines or standards, often referred to as Time Weighted Average Concentrations (TWA), Threshold Limit Values (TLVS), Maximum Allowable Concentrations (MAC), or Industrial Hygiene Guides; are usually defined as the airborne concentration of a substance or the level of a physical stress that represents the conditions to which nearly all workers may be exposed day after day without adverse effect throughout a working lifetime. Normally the guideline is based on exposures for an eight hour day and a forty hour work week. The guidelines are an index of the degree of control that is needed in the occupational environment. Where a guideline has not been established, the industrial hygienist should have the responsibility for coordinating a joint effort with toxicology and medical colleagues to establish a guideline based on the best available information. If sufficient information is not available to make a proper judgement, a sample of the material should be submitted for toxicological studies.

Preliminary plant inspection

The following steps in the preliminary plant inspection require a detailed knowledge of the operating procedures and work practices used in the plant.

1. *Time distribution:* The purpose of an industrial hygiene survey is to determine the workers' maximum and time-weighted average exposure to the materials and physical stresses found in the plant. To do this, the sampling program must be organized to monitor the level of airborne contaminants in each of the work areas where the worker spends his time.

The preparation of a time distribution sheet for each job classification is necessary. This should involve both the supervisor and the operator to make sure that the estimates reflect a true average of where the operator spends his time. The time distribution should be segmented for each job classification by work area and by specific operations. With this information, the sampling program can be planned effectively to give a reliable estimate of the average exposures.

2. *Degree of exposure:* The degree of exposure is of primary importance in assessing a hazard. Several parameters may affect the degree of exposure. The physical properties of the material, type of operation and duration and frequency of exposure are factors which must be considered.

Degree of exposure for each job classification can be rated as (1) no contact, (2) minor contact, (3) occasional daily contact, (4) gross contact. The rating should be based on normal operating conditions and regular observations of the operating procedures for each job classification.

3. *Consequences of overexposure:* A brief description of the consequences of overexposure should be prepared for each of the process chemicals. Each description should summarize the available toxicology and medical data and what health effect could occur by each route of exposure.

4. *Hazard rating:* Hazard ratings are based on the expected employee exposure to a chemical (degree of exposure) and ability of the chemical to cause injury (consequences of overexposure). The ratings are a numerical ranking of chemical hazards, from 1 (high) through 5 (low). The hazard ratings are the key to the entire surveillance program. As the hazard rating increases, the need for industrial hygiene studies and control measures increases. In setting the ratings, the industrial hygienist makes a judgement as to which of the chemicals and physical stresses require measurement to evaluate the exposure levels. Just as important, he also makes a judgement as to which of the hazards are already suitably controlled so that at most only a minimal amount of monitoring is required.

5. *Setting priorities for surveillance:* Based on the hazard ratings a priority rating system can then be established as a guideline in deciding when measurements are required to evaluate a health hazard.

Exposures to chemicals or physical stresses that have received a 1 or 2 hazard rating based on ability to cause injury and a relatively high possibility of exposure, should be measured immediately and on a routine or continuous basis.

Chemicals and physical stresses that have a hazard rating of 3, based on a relatively high ability to cause injury but a low degree of exposure, should be measured at least once per year. Proper work practices, handling and storage procedures should be established and reviewed periodically by an experienced person.

Chemicals or physical stresses that have a hazard rating of 4 and 5 are likely to pose little or no health hazard so that little or no monitoring should be required.

Serveillance

In assigning the hazard ratings, a significant amount of the surveillance program has already been completed. Based on observations of operating procedures and work practices, it may be determined that some of the potential hazards in the plant are already adequately controlled. The remainder of the program is concerned with the chemicals and physical stresses that require measurement to evaluate the exposure levels.

1. *Establishing analytical and sampling parameter:* The sampling and analytical techniques have to be specific for the stresses in question. It must afford the required degree of sensitivity, be reliable and be adaptable to the production process under study. It is very likely that a survey will be conducted where more than one substance will be persent. Thus, the sampling and analytical methods will be influenced by possible interfering substances in the atmosphere. The sampling equipment must be calibrated against known standards before any sampling is done.

2. *Defining exposure levels:* The best way of checking the concentrations that an operator encounters is to have him wear a personal sampler which collects the air sample in his breathing zone. This type of sampler is normally worn over a 4 to 8 hour period as the employee goes through the regular work routine period. If worn for the entire shift, the measured concentration is a direct reading of his TWA exposure for that day. An attempt should be made to collect this type of sample for all three shifts.

Another approach for estimating TWA exposures is to monitor each of the work areas where the employee spends his time. This is called area sampling. In addition to the area samples, short term samples should be collected in the employee's breathing zone as he performs operations with a high potential for exposure. The area sampling approach requires the collection of a larger number of samples than the personal monitoring method because of a need to thoroughly characterize the concentration variations in each area. The time-weighted average exposure is determined by relating the work area concentrations to the distribution of time spent in each area.

Continuous monitoring is an extension of the area sampling method, again using the work area time distribution. Based on an area sampling survey, sampling sites are selected to give an average exposure reading for each work area. Because of the large volume of data obtained by a continuous monitor, the analyzer may be connected to a computer programmed to calculate the TWA exposures.

3. After the sampling has been carried out, the data must be interpreted. The first thing that must be done is to calculate the TWA exposures for the various plant job classifications. This is done by obtaining a weighting factor for each area or task in which a worker spends time during his work day. These are calculated by multiplying the average concentration level of the material in the air in that area by the time spent in that area for that job classification. All time-weighting factors for the various areas in which the worker spends time are added and this number is then divided by the total number of hours per day spent in that environment.

Once the time-weighted average exposures to the various materials have been determined, they can be compared against the respective exposure guideline or standard. If the exposure levels are found to be too high then a more detailed review of the operating procedures and work practices is required. The industrial hygienist then has the responsibility of recommending a short term approach for the control of the workers' exposures. This can be in the form of protective equipment, ventilation, remote operation or change of procedure.

Control of hazards

Excessive exposure levels can be reduced by engineering controls and administrative controls.

Engineering controls are the preferred approach since they generally involve process changes that reduce the escape of the material into the work areas. This type of control can be implemented by such changes as closing open systems, scrubbing vent emissions, and automating raw material feed and process sampling systems. Whenever the material cannot be contained, engineering controls such as local and general exhaust ventilation can be used to reduce work area concentrations.

Administrative controls can be implemented by using remote operations, rotating work assignments and personal protective equipment. The use of this type of control is an indication that concentrations in the process area cannot be reliably controlled within acceptable levels. Such controls should only be considered as temporary measures until the proper engineering controls can be implemented.

Periodic measurement of exposure levels is necessary to make sure that the controls are being implemented and that they provide adequate protection. At the same time, this review can be used to update the plant information and to recheck the work practices and operating procedures.

Continued reevaluation of exposure levels is important. Changes in process, personnel, and procedures may require a different approach to controlling the health hazards. Also, existing process and control equipment can become worn, plugged or in some other way less effective.

Conclusions

The objective of a sound Industrial Hygiene Program is the preservation of health through the control of the chemical and physical environment. Data and judgement must be used to ensure that each worker will operate during his industrial lifetime in a safe and healthful workplace.

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A TRIAL ON THE EVALUATION OF HAZARD LEVEL OF WORKPLACE BY SCORING METHOD

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Introduction

This study made a trial to evaluate and indicate the level of the harmful state of a factory as a whole with a simple "Harm Index" calculated out by scoring method for the purpose of realistic recognition of the state and administrative use to control the environment of factories rather than academic interesting.

Principle of Scoring

Following to surveying a number of factors inducing discomfort, fatigue and new disease and disturbing work efficiency and a number of determinants influencing the effect of the factors, "Weighted Score" which counted out regarding to the condition of the determinants observed, were multiplied each other and finally divided by number of all workers in manufacturing parts of the factory. Harm Index(H.I.) therefore would indicates a degree of harmful effect of the all factors per capita.

The factors applied were illumination, noise, heat and airborne contaminants (including dust, organic solvents, solvents, lead, metals and harmful substances). The regarding determinants were concentration (or intensity) of factors, exposure time, level of physical activity at work, accuracy of work and population of workers exposed.

The weighted scores of each factors regarding to determinants were counted out as follows;

1. Relation of airborne contaminants to corresponding determinants i.e., concentration in the air, level of physical activity, exposure time, potential hazards of chemicals and population of workers.

According to the table 1, conc.-weighted score(Wc-xi) of observed value below the permissible limit were counted as zero and that beyond the limit were counted as the rate of observed concentration to the limit. "Wc" indicates the concentration weighted score, "x" indicates the kind of factor and "i" indicates the part of unit environment.

As the inhaled amount of the air contaminants would be variable according to the respiratory tidal volume, physical activity-score(Wa-xi) was given as much as the grade on the table 2 that showing the physical activity level of worker by R.M.R.(and then tidal volume).

Weighted score for exposure time(Wt-xi) below 8 hours per day was given as 1 and for

Table 1. The permissible concentration for chemicals.

Name	Concentration	Remarks
Benzen	10 ppm	Carcinogenic
Hexan	100 ppm	–
Methylisobuthylketon	100 ppm	Skin-absorbed
Methylethylketon	200 ppm	–
Toluol	100 ppm	Skin-absorbed
Xylen	100 ppm	Skin-absorbed
Cadmium	0.05 mg/m³	–
Chromate(as Cr)	0.05 mg/m³	Carcinogenic
Lead	0.15 mg/m³	–
Dust, type 1	2.0 mg/m³	With free silica above 30%
Dust, type 2	5.0 mg/m³	With free silica below 30%
Dust, type 3	10.0 mg/m³	Other dust.

Table 2. Relationship between physical activity level and R.M.R.

Grade number	Level of activity	Range of R.M.R.
1.	Less than moderate	0 – 4
2.	Heavy	4 – 6
3.	Very heavy	6 or more

that above 8 hours, the rate of the observed time to 8 hours, was given.

When the workers handled carcinogenic or skin-absorbed chemicals without adequate protection measure, 1 point of potential-weighted score(Wp-xi) was given regardless the concentration in the air or physical activity level.

Population-weighted score(Wn-xi) was the same value as the number of workers exposed to each factor.

2. Relation of heat condition to corresponding determinants, i.e., physical activity level, exposure time and population of workers.

According to the table 3, conc.-weighted score(Wc-xi) for that condition was given as 0 when the temperature observed was not exceeds the limit and if it exceeds the limit, the score would be the same value as the number of the corresponding class intervals.

Weighted scores for the time and population were the same as for the chemicals.

Table 3. The permissible limit for heat condition.

Physical activity		Exposure condition	Temp.(°C)
Light	(RMR:0-2)	Continued	34 DB
Moderate	(RMR:2-4)	Continued	32 DB
Heavy or more	(RMR:4-)	Continued	30 DB
Light		Continued	40 GB
Light		Interrupted	50 GB

3. Relation of noise intensity to corresponding determinants, i.e., exposure time and population of workers.

When the intensity observed was below the corresponding permissible limit on the table 4, conc.-weighted score(Wc-xi) was given as 0, on the contrary, if it exceeds the limit, the score would increase as much as number of class intervals to the corresponding permissible limit.

Table 4. The permissible limit for overall noise level.

Duration per day by hrs.	Noise level by dB(A).
8	90
4	95
2	100
1	105
½	110

4. Relation of illumination to corresponding determinants, i.e., accuracy of work, exposure time and population of workers.

Conc.-weighted score for illumination was counted out from the permissible limit on the table 5. If the observed was not less than the limit, the score would be 0, and so on as the above mentioned factors.

Table 5. The permissible limit for illumination.

Grade number	Accuracy of work	Limit by Lux
1	Rough work	Above 70
2	Ordinary work	Above 150
3	Fine work	Above 300
4	Extra-fine work	Above 600

Calculation Process

1. After multiplying the corresponding weighted scores for a certain factor(x) in a certain unit part(i), a "part score"(Pxi) for the agent in the unit part of environment was obtained by adding the value that was made from multiplying the potential-weighted score(Wp-xi), if exists, by scores for time and population to the value that was made from multiplying the concentration-weighted score, time-weighted score and activity-weighted score each other.

(Wc-xi x Wt-xi x Wa-xi + Wp-xi x Wt-xi) x Wn-xi = Pxi

2. Factor-specific Harm Index(Hx) for agent "x" was obtained by dividing the "total score",

Table 6. The details of factories surveyed.

Name of factory	No. of all worker	No. of manufact. worker	Main products
A-1	1,006	966	Rubber shoes.
A-2	412	300	PVC film, Roofing board, Pipes.
A-3	207	142	Bicycle tires, tubes.

Table 7. The result of survey on the Rubber and PVC-plastic factories.

Name of factory		Unit part	No. of workers	Level of activity	Chemical contaminants (concentration)			Hrs.	Heat DB	Heat GB	Hrs.	Noise dB	Hrs.	Illumi. Lux	Acc.	Hrs.
A-1	P-1	Weighing, Compounding	18	Heavy	Dust 3(55.0)	–	–	4		–		–		450	2	4
	P-2	Masticating, Compounding	18	Heavy	Dust 2(11.5)	–	–	4		–		–		300	2	4
	P-3	Designing, Cutting	8	Light	Dust 2(18.0)	–	–	8		–		–		350	3	8
	P-4	Cutting	63	Light	–	–	–	–		–		97	3	700	3	8
	P-5	Press moulding	12	Mod.	–	–	–	–		–		90	3	70	3	8
	P-6	Mould collecting	4	Mod.	–	–	–	–		–		98	3	500	2	8
	P-7	Paste painting	5	Mod.	–	Tol(160), Hex(tr)	–	8		–		–		250	3	8
	P-8	Sewing.	250	Light	Dust 2(2.5)	–	–	8		–		90	8	230	3	8
	P-9	Shoe making - 1	335	Light	–	–	–	–		–		–		840	3	8
	P-10	Shoe making - 2	84	Light	–	Tol(70),Ben(12)	–	8		–		–		430	3	8
	P-11	Shoe making - 3	105	Light	–	–	–	–		–		–		750	3	8
	P-12	Vulcanizing	25	Mod.	–	–	–	–	25	41	8	95	1.5	150	2	8
	P-13	Inspecting	20	Light	–	–	–	–		–		–		250	3	8
	P-14	Packing	19	Light	–	–	–	–		–		–		20	3	8
			966													
A-2	P-1	Weighing, Compounding -1	84	Heavy	Dust 3(6.0)	–	Pb(0.03),Cd(tr)	8		–		–		30	2	8
	P-2	Weighing, Compounding -2	51	Heavy	Dust 3(90.0)	–	Pb(4.03),Cd(tr)	8		–		93	8	200	2	8
	P-3	Mixing	36	Heavy	Dust 2(7.6)	–	Pb(0.50),	8		–		–		150	2	8
	P-4	Masticating, Calendering	80	Heavy	–	–	–	–		–		–		60	2	8
	P-5	Printing	33	Mod.	–	MIBK(tr),MEK(500)	–	8		–		–		200	3	8
	P-6	Packing	12	Heavy	–	–	–	–		–		–		450	2	8
	P-7	Electroplating	4	Light	–	–	Cr(tr)	8		–		–		80	3	8
			300													
A-3	P-1	Weighing, Compounding	8	Heavy	Dust 3(55.0)	–	–	8		–		93	8	80	3	8
	P-2	Masticating, Calendering	14	Heavy	–	–	–	–		–		90	8	170	2	8
	P-3	Moulding	42	Mod.	–	–	–	–		–		–		70	2	8
	P-4	Extruder	4	Mod.	–	–	–	–		–		–		600	2	8
	P-5	Paste painting	8	Mod.	–	Ben(23),MEK(tr),X(7.0),Tol(130)		8		–		–		120	3	8
	P-6	Vulcanizing	58	Mod.	–	–	–	–	28	42	8	–		40	2	8
	P-7	Adhering	8	Light	–	Ben(5.0),MEK(tr),X(0.8),Tol(30)		8		–		–		250	3	8
			142													

Ben : Benzen, Tol: Toluol, Hex: n-Hexan, MEK: Methylethylketon, MIBK: Methylisobuthylketon, X: Xylene, DB: Dry bulb, GB: Globe bulb.

Table 8. Weighted scores of factors by part.

Factory/part		Dust	Solv.	Lead	Metal	Heat	Noise	Illum.	No. of worker	Si
A-1	P-1	11	–	–	–	–	–	–	18	11.0
	P-2	4.6	–	–	–	–	–	–	18	4.6
	P-3	3.6	–	–	–	–	–	–	8	3.6
	P-4	–	–	–	–	–	1	–	63	1.0
	P-5	–	–	–	–	–	–	2	12	2.0
	P-6	–	–	–	–	–	1	–	4	1.0
	P-7	–	1.6	–	–	–	–	1	5	2.6
	P-8	–	–	–	–	–	1	1	250	2.0
	P-9	–	–	–	–	–	–	–	335	0
	P-10	–	2.2	–	–	–	–	–	84	2.2
	P-11	–	–	–	–	–	–	–	105	0
	P-12	–	–	–	–	1	–	–	25	1.0
	P-13	–	–	–	–	–	–	1	20	1.0
	P-14	–	–	–	–	–	–	3	19	3.0
	Pxi	310	193	0	0	25	317	356	966	
	Hx	0.32	0.20	0	0	0.03	0.33	0.37	H.I. = 1.25	
A-2	P-1	–	–	–	–	–	–	2	84	2.0
	P-2	18	–	53.7	–	–	1	–	51	72.7
	P-3	3.0	–	6.7	–	–	–	–	36	9.7
	P-4	–	–	–	–	–	–	2	80	2.0
	P-5	–	5	–	–	–	–	1	33	6.0
	P-6	–	–	–	–	–	–	–	12	0
	P-7	–	–	–	1	–	–	2	4	3.0
	Pxi	1,026	165	2,980	4	0	51	369	300	
	Hx	3.42	0.55	9.93	0.01	0	0.17	1.23	H.I. = 15.32	
A-3	P-1	11	–	–	–	–	1	1	8	13.0
	P-2	–	–	–	–	–	1	–	14	1.0
	P-3	–	–	–	–	–	–	1	42	1.0
	P-4	–	–	–	–	–	–	–	4	0
	P-5	–	6.5	–	–	–	–	2	8	8.5
	P-6	–	–	–	–	1	–	2	58	3.0
	P-7	–	2	–	–	–	–	1	8	3.0
	Pxi	88	68	0	0	58	22	190	142	
	Hx	0.62	0.48	0	0	0.41	0.15	1.34	H.I. = 3.00	

the sum of all "part scores" of the factory ($\sum_i Pxi$), by number of all workers(N) in manufacturing parts. And the sum total of Hx was the Harm Index(H.I.).

$$\sum_i Pxi/N = Hx, \qquad \sum_x Hx = \sum_x \sum_i Pxi/N = H.I.$$

Practice of Calculation and Evaluation in a Field Survey

As shown in the table 6, 2 rubber factories and 1 PVC-plastic factory were surveyed and tried to evaluate the harmful state with Harm Index.

The result of survey and scoring were shown on the table 7 and 8, respectively.

Disscussion on the Survey.

Although the average Harm Index(H.I.) of these 3 factories was 5.02, difference among the indices of each factories was quite large, the highest was that of A-2, 15.32, the seonnd, A-3, 3.00, and the lowest, A-1, 1.25.

High level of the factory A-2 was due mainly to the large concentration-weighted score of P-2 for lead and dust. Because of powdered raw materials esp., lead stearate, one kind of stabilizers of PVC-resin, was used in operation such as weighing, mixing and transportation in bulk without adequate control measure, large amount of lead and dust contaminated the air. In addition, a large number of population(51) were working with so much high grade of physical activity(grade 2) that the "total score" would become larger and so the Harm Index too.

To evaluate the harmful state of a factory as a whole, of course, it would be necessary to analyze H.I. into Hx, Pxi and Wn-xi. In this way, even A-1 with 966 workers was less harmful than A-3 with 142 workers in a viewpoint of individuals, the former would be not less troublesome than later in a viewpoint of whole population.

Conclusion

To evaluate and indicate the harmful state of workplace environment of a factory as a whole with a simple value, Harm Index was calculated out from the "weighted scores" for the harmful factors regarding to corresponding determinants. Harmful factors are chemical contaminants (dust, lead, organic solvents, metals and other harmful substances), heat, noise and illumination. The determinants are concentration (or intensity) of the factors, exposure time, physical activity level of worker, accuracy of work, potential hazards of chemicals and population of workers exposed.

Harm Index would indicate the effect of all factors to workers per capita.

Practical application of this method was performed in 3 rubber and PVC-plastic factories and obtained Harm Index 1.25 in rubber shoes factory, 15.32 in PVC-plastic factory and 3.00 in bicycle tire factory.

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THE TOXIC SUBSTANCES OF SUSPENDED PARTICULATE IN INDUSTRIAL AREA IN SEOUL

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Introduction

During the past decade, several epidemiological studies have suggested a relationship between environmental pollution and morbidity or mortality.

Besides of indoor environment, the outdoor should be considered specially as one of working conditions in industrial area.

In a recent study on the health effect of air pollution, Levy et al. St Joseph's hospital and Mamaster University Medical Center, Hamilton Ontario, Canada showed strong correlationship between hospital admissions and air pollution due to respiratory illness in a highly industrialized Canadian city.

Dr. Larsen also suggested the mortality equation increased owing to air pollution from the past episode days.

For recent decade, Korea has exerted his utmost effort to develop the industry as well as to improve the economy.

Nevertheless it has been entirely devoted to environmental protection, the environmental pollution around industrial areas and cities has been increased to be serious.

This study was carried out to compare air pollutions among industrial, commercial and residential area in the vicinity of Seoul, Korea.

Method

The suspended particulates in the atmosphere were sampled with the high volume air sampler in industrial area(Ku Ro-dong), commercial area(Kwang Hwa Moon) and residential area (Shinchon-dong) from January to November 1977.

To determined heavy metals of the suspended particles, the samples were digested and extracted with the acidic solution by reflux-extraction technique and were measured by atomic absorption spectrometry.

Benzo(a)pyrene was extracted from samples with soxhlet apparatus by benzene, and was separated by column chromatography and thin layer chromatography. The concentration of benzo(a)pyrene were measured by fluorophotometry.

The heavy metals and benzo(a)pyrene in the atmosphere were analyzed in statistics.

Results and Analysis

The suspended particulates in Seoul atmosphere were determined as shown in Table 1.

Among the areas measured, the industrial area, Ku Ro-dong, was the highest in air pollution of suspended particulates and the residential area, Shin Chon-dong was the least.

According to Hovey and Jones' calculations, the 50 percentile frequencies of apparent concentrations were 264 ug/m^3 in Kwang Hwa Moon, 300 ug/m^3 in Ku Ro-dong and 178 ug/m^3 in Shinchon-dong respectively.

The benzene solubles of suspended particulates which are comprising benzo(a)pyrene were measured at 26.9 ug/m^3 in Kwang Hwa Moon, 22.7 ug/m^3 in Ku Ro-dong and 15.5 ug/m^3 in Shinchon which were equivalent to 9.8%, 7.0% and 8.0% as the ratio for benzene soluble matters to total suspended particulates.

The average concentrations of benzo(a)-pyrene were 8.5 ng/m^3(0.8-29.9 ng/m^3 ranged) at Kwang Hwa Moon, 10.9 ng/m^3(1.1-52.0 ng/m^3) at Ku Ro-dong and 5.8 ng/m^3(1.5-11.4 ng/m^3) at Shinchon respectively.

The heavy metals of suspended praticulates in Seoul atmosphere in 1977 were observed as shown in the following Table 3.

Among heavy metals analyzed, the iron was identified at the highest level in the suspended particulates and the chromium was the least.

Through the surveyed area, the concentration of heavy metals of the industrial area was comparatively high among others and the commercial was the second.

It was detected that lead was the most concentrated in the suspended particulate of the commercial area, that might be caused of the traffic emissions.

The seasonal variations were analyzed and the correlations among heavy metals and total suspended particulate were also calculated. Especially, the iron was highly correlated with total suspended particulate in all the surveyed areas.

References

Samuel S. Epstein, Nathan Mantel, Thomas W. Stanley., 1968. "Photodynamic Assay of Neutral Subfrac-

Table 1. The concentration of total suspended particulate in Seoul city.

(Jan. 1977~Nov. 1977) ($\mu g/m^3$)

Item \ Season \ Place	Kwang Hwa Moon				Ku Ro Dong				Sin Chon			
	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall
Sample number	7	6	7	7	7	7	6	6	7	7	6	7
Average concentration	281.2 ±65.0*	289.5 ±59.0*	249.6 ±12.3*	284.0 ±93.7*	381.0 ±173.8*	278.3 ±43.4*	312.4 ±77.4*	329.9 ±111.0*	141.1 ±51.3*	195.2 ±41.5*	195.4 ±47.9*	240.7 ±38.5*
Minimum concentration	185.3	199.2	225.9	193.3	186.6	224.3	193.4	222.1	115.4	110.7	129.0	172.8
Maximum concentration	357.1	353.6	263.6	400.4	583.1	341.0	382.1	548.6	256.4	230.5	256.9	278.7
Total average concentration	275.6 ± 65.9*				325.9 ± 116.4*				193.0 ± 54.9*			

*Mean ± S.D.

Table 2. The concentrations of benzene soluble matter and benzo(a)pyrene in Seoul city.

Item	Place / Season	Kwang Hwa Moon Winter	Spring	Summer	Fall	Ku Ro Dong Winter	Spring	Summer	Fall	Sin Chon Winter	Spring	Summer	Fall
Benzene soluble (μg/m³)	Average concentration	27.8 ±13.3*	23.3 ±5.6*	22.6 ±3.6*	32.6 ±0.4*	25.5 ±20.7*	13.9 ±4.8*	27.9 ±8.1*	23.9 ±10.1*	11.8 ±5.5*	15.6 ±1.8*	13.5 ±3.6*	20.8 ±6.3*
	Range of concentration	8.4 –43.3	13.9 –28.6	19.7 –29.1	24.2 –50.5	9.4 –49.0	8.1 –21.6	14.1 –35.5	10.7 –35.8	5.5 –22.1	12.8 –12.6	8.3 –18.0	13.9 –31.3
	Total average concentration		26.9 ± 9.2*				22.7 ± 13.1*				15.5 ± 5.5*		
Benzo(a) pyrene (μg/m³)	Average concentration	18.6	7.6	4.8	2.8	19.9	7.6	11.6	2.2	9.6	8.3	2.7	2.8
	Range of concentration	13.1 –29.9	6.4 –8.5	1.9 –10.5	0.8 –9.6	2.1 –52.0	6.3 –11.4	2.9 –23.7	1.1 –3.6	8.6 –11.4	6.4 –10.7	1.5 –3.7	2.0 –4.1
	Total average concentration		8.5 ± 8.3*				10.9 ± 15.1*				5.8 ± 3.5*		

*Mean ± S.D.

Table 3. The concentrations of heavy metals in particulate(T.S.P.) in Seoul atmosphere, 1977

(unit, = μg/m³)

Item / Place	Ku Ro Dong (Industrial)	Shin Chon (Residential)	Kwang Hwa Moon (Commercial)
T.S.P.	325.9±116.4	193.0±54.9	275.4±65.9
Cu	0.354±0.293	0.103±0.052	0.204±0.153
Fe	6.519±2.476	3.679±1.710	4.816±1.822
Mg	0.014±0.014	0.007±0.011	0.008±0.011
Mn	0.254±0.166	0.128±0.008	0.157±0.092
Cr	0.006±0.010	0.003±0.006	0.005±0.016
Pb	1.091±0.980	1.149±0.681	2.252±0.864
Cd	0.024±0.026	0.011±0.012	0.018±0.014
Ni	0.102±0.082	0.044±0.051	0.063±0.069

*Mean±S.D.

tions of Organic Extracts of Particulate Atmospheric Pollutants." Envir. Sci. and Tech., W, 132.

U.S. Dept. of HEW, 1968. "Air Quality Data, 1966." Durham, N.C.

Chi-Hung Shen, Georga S. Springer, Donald H. Stedman., 1977. "Photochemical Ozone formation in Cyclohexene-Nitrogen Dioxide Air Mixture." Envir. Sci. and Tech., H, 151-158.

Thomas W. Stanley, Myrna J. Morgan, Erhel M. Grisly. 1968. "Application of a Rapid T.L.C. Procedure to the Determination of Benzo(a)pyrene, Benz(c)-acridines, and Thbez (de) anhircen-T-one in Air Particulates from Many American cities." Envir. Sci. and Tech., W., 699-702.

Robert J. Gordon, Robert J. Bryan. 1973, "Patterns in Airbone Polynuclear Hydrocarbon Concentration at Four Los Angeless Sites." Envir. Sci. and Tech. T. 1050-1053.

Samuel, S. Epstin, E. Sawicki, T. Stanley, E.C. Tabor., 1966. "Carcinogenicity of Organic Particulate Pollutants in Urban Air Administration of Trace Quantities to Neonatal Mice" 212, 1305-1307.

J.W. Clayton Jr., 1974 "Toxicologic assessment of the health effects of Sulfur Dioxide and Sulfate Particulates. International Symposium Proceedings Recent Advances in the assessment of the health effects of environmental in the assessment of the health, effects of environmental pollution, EVR. 5350 Vol. 1 pp. 371-384.

Ralph I. Larsen, Proceeding from air quality criteria to air quality standard and emission standards. APCA. Paper 69-210.

H. Schimmel and L. Greenburg; 1972, "A study of the relation of pollution to mortality New York City

1963-1968." J. of Air Pollution Control Associ. 22 607-616.

M. J. Yun, et al.: 1967, J. Korean Modern Med. 7, 37-41.

S. P. Kwon, et al.: 1968, New Med. J. 3, 257-263.

G. M. Chung: 1971, Korean J. Pub. Health 8, 276-280.

H. H. Kwon, et al.: 1970-1975, Report of N.I.H. Vol. 7, No. 13.

M. Y. Kim, et al.: 1974, Korean J. Pub. Health 11, 130-141.

H.A. Clements, Thomas B. McMullen, Richard J. Thoson, 1972. "Reproducibility of the HI-VOL Sampling Method Under Field Conditions" of Air Pollution Control Association. 22, 955-958.

Herbert C. Mckee, Ralph E. Childers, Oscar Saenz, Jr. 1972 "Colaborative Testing of Methods to Measure Air Pollutants" J. of Air Pollution Control Association 22. 342-347.

T.W. Stanley, J.E. Meeker, M.J. Morgan: 1967 "Extraction of Organics from Airborne Particulates" Envir. Sci. and Tech. 1, 927-931.

P. Cukor, L.L. Ciaccio, E.W. Lanning, Robert L. Rubino 1972. "Some Chemical and Physical Characterics of Organic Fractions in Ariborne Particulate Matter" Envir. Sci. and Tech. 6, 633-637.

Thomas J. Porro, Robert E. Anacreon, Paul S. Flandreau. 1973. "Corrected Fluorescene Spectra of Polynuclear Materials and their Principle Applications" J. of AOAC. 56, 607-620.

B.E. Saltzman: 1972, "Simplified Methods for Statistical Interpretation of Monitoring Data." J. of Air Pollution Control Association 22, 90-95.

R.I. Larsen: 1969. "A New Mathematical Model of Air Pollutant Concentration Averaging Time and Frequency J. of Air Poll., Control Assoc., 19, 24-30.

Harney H. Hovey, Howard C. Jones, Wiliam N. Stasiuk. 1976 "Short Term Air Quality Standards for Suspended Particulate Matter in New York State," J. of Air Poll. Control Assoc. 26, 129-131.

U.S. EPA Compilation of Air Pollutant Emission Factors 2nd. 1976.

K. K. Han: 1976 "A study on the Urbanization in Korea" J. of Population Studies 20. 84-108.

Howard M. Ellis, Simon K. Mencher: 1971 "An Evaluation of the Proposed National Ambient Air Quality Standards for Particulate Matter, Sulfur Dioxide, and Nitrogen Dioxide" J. of Air Poll. Control Assoc. 21, 348-353.

H.R. Hosein, C.A. Mitchell, A. Bouhuys: 1977 "Evaluation of Outdoor Air Quality in Rural and Urban Communities" Arch. Environ. Health, 32, 4-13.

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Session 4. Environmental Control

DUST CONCENTRATIONS IN THAI TEXTILE MILLS

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Introduction

Relatively few data are available as to airborne dust concentrations in textile mills of Asian countries. Compared with European, United States and African cotton workers, for whom the prevalence of byssinosis has been well documented (British Occupational Hygiene Society, 1972; El Batawi and El-Din Shash, 1973; Imbus, 1974; Palmer et al. 1978), the incidence of byssinosis and related respiratory illnesses among corresponding Asian workers has not been made clear yet. The reports by Shima (1970) and others, however, have suggested that dust concentrations in mills processing primarily cotton in this region could be significant enough to cause chronic respiratory diseases of the workers.

In line with the joint study on health conditions of textile mill workers of Thailand, the results being reported at the present Asian Conference of Occupational Health, an attempt has been made to assess airborne dust concentrations in various workplaces of three textile mills in the Samutprakarn Province, an industrial zone south of Bangkok, Thailand. These mills were primarily processing cotton mainly imported from other regions.

The measurement was carried out by collaboration of both Thailand and Japanese occupational health institutions comprising Occupational Health Department of Mahidol University in Bangkok, Occupational Helalth Center I in Samutprakarn Province, Institute for Science of Labour in Kawasaki, Department of Hygiene of Okayama University Medical School in Okayama, Japan, and others. The emphasis of the study was palced on clarifying the relation of dust concentrations with respiratory symptoms of the workers. Detailed discussion as to the relationships will be done in the other paper presented at this Conference (S. Duangploy, M. Wongpanich, C. Pongpanich and K. Kogi: Health hazards among textile workers of Thailand). The present paper describes the levels of total and respirable dust, to discuss their implications for health.

Methods

Personal dust samplers of the common filtration type and an impaction-filtration type total-respirable dust sampler (T.R sampler) developed by K. Kimura of the Institute for Science of Labour (Kimura and Shimakage, 1977; Kimura, 1978) were used for collection and differentiation of dust in the air of workplaces of three textile mills in Samutprakarn.

The personal dust samplers which were carried by workers during a whole day-shift, had an airflow speed of 1 liter/min, dust being collected on a filter. The mean dust concentration was then estimated as the quotient of the dust weight divided by the total air volume. For calculation of the air volume, the mean of airflow measurements before and after the sampling was used. Two to several workers from each workplace were asked to serve as subjects for dust collection. The samplers did not interfere with work motions.

The T.R. sampler used was a newly devised filtration sampler equiped with an impact coarse dust sampler, adapted to simultaneous selective sampling of respirable small particles and larger particles. The sampler was set in the central area of each workplace, 1.2m in height from the floor, dust being sampled for 2 hours each time at a constant air flow rate of 20 liters/min. The diameter of a hole for impaction by inflowing air on a glass plate with silicon oil on it was arranged so as to collect on the plate particles larger than 15μm, while smaller particles were collected by a filter behind the plate. The weight of the glass plate and the filter was determined before and after the sampling, the balance in the case of the glass plate giving weight of 'non-respirable dust' collected and that in the case of the filter weight of 'respirable dust'.

Each filter used for the T.R. sampler had been pre-heated at 550°C and was heated at 550°C again after sampling and weighing, to know the amount of inflammable dust as the balance between the filter weight after sampling and that after post-heating.

Results

Figure 1 indicates all the measurements by personal dust samplers, with their means for various workplaces of the three textile mills. The dust concentration on the average of a whole shift period was generally high for blowing, carding and weaving sections, the deifference between mills being remarkable.

The mean concentration was 5.71, 3.64 and 3.08 mg/m^3 for blowing in factories I, II and III, respectively. The values in this factory order were 5.01, 3.38 and 2.01 mg/m^3 for carding, and 1.35, 2.85 and 3.78 mg/m^3 for weaving.

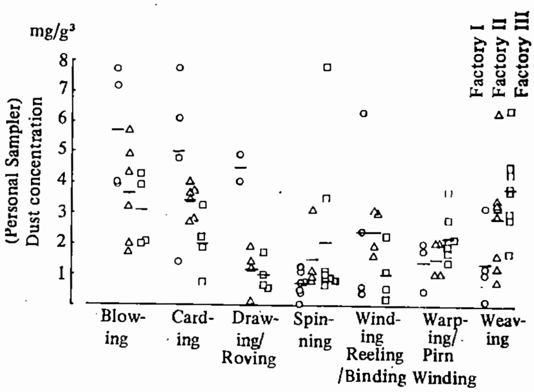

Fig. 1. Dust concentrations measured by means of personal dust samplers at various workplaces of three textile mills. Each circle indicates the mean for a whole shift period, each bar the average of these individual measurement.

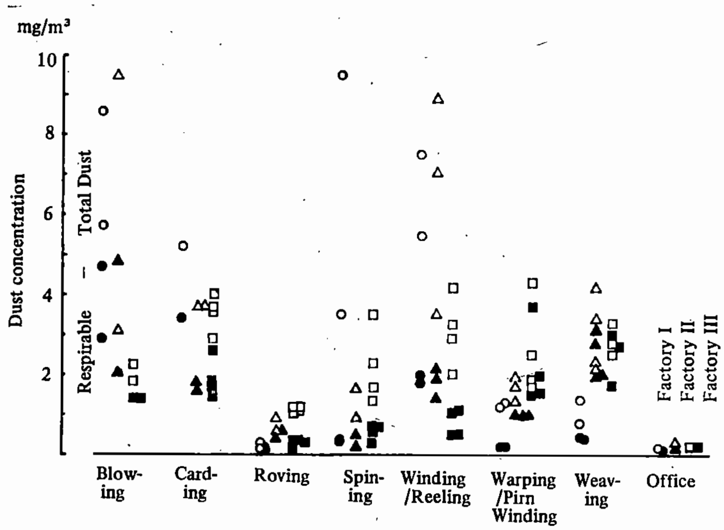

Fig. 2. Total dust and respirable dust concentrations determined by means of an impaction-filtration type total-respirable (T.R) dust sampler by Kimura (1978) at various workplaces of three textile mills. A pair of total and respirable dust concentrations always correspond to each other, being simultaneously sampled.

Among other workshops, the dust concentration was lower for drawing/roving or spinning than for winding/reeling/binding or warping/pirn winding. However, high concentrations of 3 mg/m^3 or more were also seen in these workplaces, and the mean concentration less than 1 mg/m^3 was found only in the case of spinning of factory I.

In blowing and carding sections, the dust level was the highest in factory I and the lowest in facotory III, whereas in weaving shops the dust level was the highest in factory III and the lowest in factory I. The difference between factories was much less as to other workplaces.

As illustrated in Fig. 2, similar patterns by workplace were seen in the total dust concentrations determined by the stationary T.R. sampler. The level of total dust was as high as around or more than 3 mg/m^3 for blowing, carding, winding and weaving sections of these mills, reaching 6-7 mg/m^3, except for blowing of factory III and weaving of factory I. In contrast, the total dust level was relatively lower in roving and spinning, though a very high value of nearly 10 mg/m^3 was seen in spinning.

The amount of respirable dust was likewise high in blowing (3.80, 3.45 and 1.38 mg/m^3 in factories I, II and III, respectively), carding (2.89, 1.71 and 1.91 mg/m^3, respectively), winding and reeling (1.91, 1.84 and 0.80 mg/m^3, respectively), and weaving (0.42, 2.46 and 2.77 mg/m3, respectively). Particularly high values were seen in blowing of factories I and II, in carding of factory I and in weaving of factories II and III. It should be noted that a mean respirable dust level of lower than 1 mg/m^3 was found only in roving and spinning, though less than 0.2 mg/m^3 in all offices. Thus, the country's threshold limit value for cotton dust of 1 mg/m^3, which corresponds to British standards (British Occupatiinal Hygiene Society, 1972), was far exceeded in most workplaces.

When all the measurements attained by the T.R sampler were put together, the cumulative frequency distributions showed clear differences between the three factories (Fig. 3). The majority of measurements exceeded the limit value of 1 mg/m^3 for either of the total and respirable dust conecentrations for all the three factories, except the respirable dust level in factory I. In general, factories II and III has similar cumulative curves, though factory II had some extraordinarily high levels. Factory I had a more number of low dust values than factories II and III, while in some workshops of factory I the dust level was must higher than in dusty places of other factories. This implies that the dust levels in the workshop level are more important than the between-factory differences.

Figure 4 shows the ranges of the ratio of

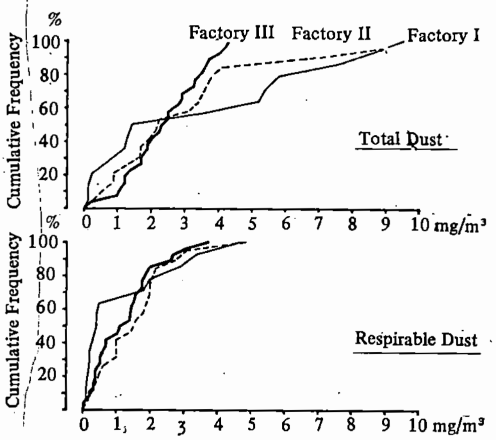

Fig. 3. Cumulative frequency distributions of total and respirable dust concentrations for all the workplaces together at three textile factories I, II and III.

total dust to respirable dust (T/R ratio) at the same spot for various workplaces. The T/R ratio was 1.8 in blowing sections, 1.5-2.2 in carding, but much higher in spinning, winding and reeling sections, being 3 or more, due to larger proportions of large fibrous dust floating in the air. The ratio was less than 2 in weaving and offices.

The proportion in the respirable dust of residues after 550°C heating, which corresponded to non-inflammable portion, is majorly inorganic. The percent residues were similar for repeated measurements in blowing and carding, but very variable in the case of winding. The relatively high values of blowing may be due to solid impurities in raw cotton materials. The comparatively low values in spinning, winding and weaving, except those of factory II, may be explained by high T/R ratio or large proportion of large organic particles. High values of factory II's blowing, winding and weaving would have been due to the uncovered earth ground of these workplaces. At any rate, variability in percentages of post-heating residues from respirable particulates must be taken into account.

Conclusions

1. Measurements of airborne dust concentrations in various workplaces of three textile mills in an industrial zone of Thailand have established that the concentrations of dust, primarily cotton, was much higher than the country's threshold limit value for cotton dust of 1 mg/m^3. The respirable dust concentration was the highest in the blowing section with 3.45-3.80 mg/m^3 in two of the three mills, the total dust reaching 6-7 mg/m^3.

2. The respirable dust level of around 2 mg/m^3 was common to all the three mills as to carding, winding and weaving, but 1 mg/m^3 or lower in roving and spinning and less than 0.2 mg/m^3 in offices.

3. It was noteworthy that the dust level in blowing or carding was the highest in factory I and the lowest in factory III, but that in weaving it was in the reverse order. Thus the cumulative frequency curve for total or respirable dust

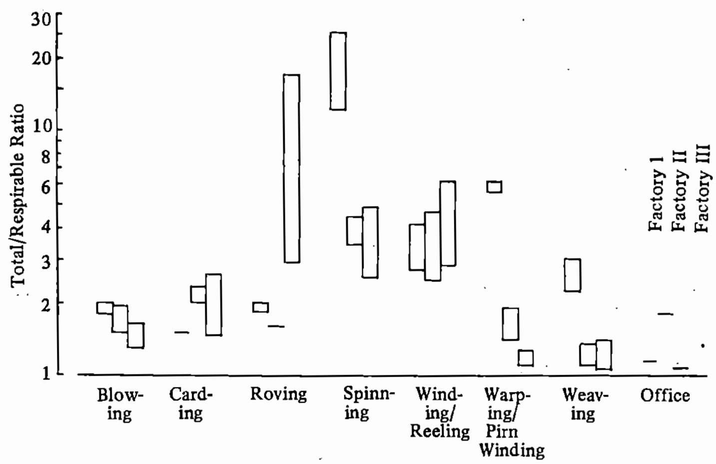

Fig. 4. Ranges of the maximum and minimum total/respirable dust ratio (T/R ratio) for various workplaces of the three textile factories I, II and III.

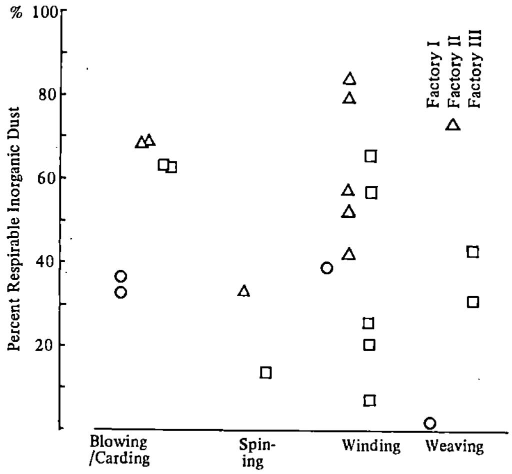

Fig. 5. The amount in weight of residues of the sampled dust after heating at 550°C in percentage of respirable dust collected on the filter of the T.R. dust sampler.

concentrations was very different between factories, implying that the dust controlling measures in the workshop are very important.

4. The radio of total/respirable dust was around 2 in blowing and carding, less than 2 for weaving and offices, but it was as high as 3 or more in spinning, roving and winding sections due to floating long fibers. Residues remaining after heating at 550°C of the filter were 30-70% in blowing and carding, lower in spinning, but variable in winding and weaving.

5. The results by personal samplers confirmed high total dust levels of 2-6 mg/m^3 in blowing and carding and of about 1-4 mg/m^3 in other sections.

6. These high levels of dust in the air of textile mills would be relevant to respiratory symptoms and lowered pulmonary function of many workers (Imbus, 1974; British Occupational Hygiene Society, 1972; Shima, 1970). The effects of the particularly high levels of dust in blowing and carding containing a variety of impurities should be countermeasured (Merchant et al., 1973; Taylor et al., 1971; Wesley et al., 1978). The results also suggest the importance of measuring both respirable and larger particles, because excessive inhalation of coarse dust can also be harzardous. Intensive hygienic measures thus seem urgent to reduce both respirable and total dust levels in textile mills.

References

British Occupational Hygiene Society Committee on Hygiene Standards, Subcommittee on Vegetative Textile Dusts (1972) *Ann. Occup. Hyg.*, 15;165-192.

El Batawi, M.A. and El-Din Shash, S. (1973) *Int. Arch. Gewerbepathol. Gewerbehyg.*, 19:393-402.

Imbus, H.R. (1974) *J. Occup. Med.*, 16:547-551.

Kimura, K. (1978) *J. Sci. Labour,* 54(7, Part II): 9-17.

Kimura, K. and Shimakage, K. (1977) *J. Sci. Labour,* 53;475-479.

Merchant, J.A. et al. (1973) *J. Occup. Med.*, 15:222-230.

Palmer, A. et al. (1978) *J. Occup. Med.*, 20:96-102.

Shima, S. (1970) *Nihon Kyobu Rinsho*, 29:602.

Taylor, G. (1970) *Brit. J. Ind. Med.*, 28:145-151.

Wesley, R.A. et al. (1978) *Am. Ind. Hyg. Assoc. J.*, 39:368-377.

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LEAD POLLUTION REFLECTED IN PIGEONS IN TOKYO METROPOLITAN AREA

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Lead pollution has been a serious problem in both work and general environment in industrialized countries. Use of lead containing gasoline was banned in Japan in 1974. Annual monitoring of lead pollution reflected in pigeons captured in the center and suburban Tokyo indicates steady decrease in lead pollution in Tokyo Metropolitan Area.

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LEAD CONTENT IN HAIRS OF SOME KOREANS BY THEIR ENVIRONMENTAL DIFFERENCES

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Introduction

It is well known that hair is an important indicator of heavy metal content in the human body and lead is normally present in hairs of all healthy subjects, but its concentration varies widely depending on diet and environment. Lead enters the human body primarily through the alimentary and respiratory tracts. Following absorption, lead is carried in the blood, deposited in many tissues including hair, and binds firmly because of its affinity to sulfhydryl groups in the follicular proteins. Thus lead cannot be seperated from hair by soaking or boiling in water, dilute acids, alcohols, soaps or detergents.

The concentration of lead in scalp hair of health persons may be from two to five times greater than in bone, about ten to fifty times higher than in blood, and from a hundred to five hundred times greater than in urine.

It has been suggested by Kopito and Petering that the hair could be utilized as a biopsy material as an index of persons' exposure to lead in the environment because it has the advantage of being readily obtained, stored, transported and analysed. In addition while the metal remains in blood only briefly it remains for a long time in hair, and in contrast with blood and urine which must be collected by qualified personnel under metriculous conditions to avoid contamination, hair may be obtained by relatively unskilled personnel.

Present writers made an effort to measure the lead concentration of scalp hair from different environments in Korea. Experiments were designed to compare lead contents of human scalp hairs from each groups according to the occupational exposure, duration of working history, working process, residence, sex and age.

Materials and Methods

1. Samples: A total of 134 samples of human scalp hairs were collected from four different groups of people. One group was from taxi-drivers, constantly exposed to lead contaminated air because of their occupation; one from printing workers exposed to the metal occupationally even more so than drivers; one from urban residents exposed to lead in their daily living condition but not occupationally; one from rural residents less exposed than the urban counterparts and also not occupationally.

All samples were collected from healthy human subjects and except for inhabitants of rural areas (from several provinces), samples were obtained from Seoulites for other groups. Table 1 shows the sample distribution by their residential areas, ages, sex and occupations. In

Table 1. Sample distributions by their residential areas, ages, sex and occupations

	Groups	Sex Age	<15	16-30	31<	Total
Occupationally	Driver	M			21	21
Exposed group	Printing worker	M		4	14	18
Occupationally	Urban	M	5	10	6	21
	Resident	F	5	10	7	22
Uninvolved group	Rural	M	7	5	10	22
	Resident	F	6	14	10	30

convenience for this study ages were divided to three groups; less than 15 years, 16-30 years, and more than 31 years.

2. *Preparation of samples and detection of metals:* Average sample weight was 0.5mg. Following Clarke's method the samples of hair were washed and rinsed repeatedly with deionized water, detergent, aceton and saturated EDTA solution in order to remove lead and other contaminated materials adherent to surface of specimen. Dried hairs were then, wet-ashed with mixture of nitric acid and hyperchloric acid, and chelated with sodiumdiethyl-dithiocarbamate. Extraction was performed with Methylisobutyl keton (MIBK) and metals were detected by means of Atomic absorption spectrophotometer(Shimadzu AA-630.11) at the wavelength of 283.3 nm.

Results

1. *Comparison of lead contents by occupational exposures:* In Table 2 are shown the concentrations of lead in human scalp hair from

Table 2. Lead concentrations of hair from urban residents compared with those of occupationally exposed men in same age groups (30 – 50 years)

Group	No.	Pb μg/g dry weight (Mean±S.D.)
Urban residents	6	7.8±7.2 (1.3 – 23.2)
Drivers	21	11.3±8.9 (2.6 – 28.6)
Printing Workers	14	*15.3±7.1 (10.2 – 28.2)

( ) : Range
* : Significant from urban residents at P<0.05

3 groups (urban residents, taxi-drivers, and printing workers), all from Seoul area. In printing workers lead was found at concentration of 15.3 μg/g which was the highest among 3 groups and 2 times higher than occupationally uninvolved group, urban residents (P<0.05).

In taxi-drivers it was 1.4 times higher than occupationally uninvolved group but not significant statistically.

2. *Comparison of lead content by residential area:* In Table 3 and Fig. 1 are shown the lead contents of hairs in 3 age groups (less than 15 years, 16-30 years and more then 31 years) from urban and rural areas.

The concentration of lead for urban area was higher than rural by 1.3-1.4 times except for rural females, less than 15 years group.

The lead was present more in female than

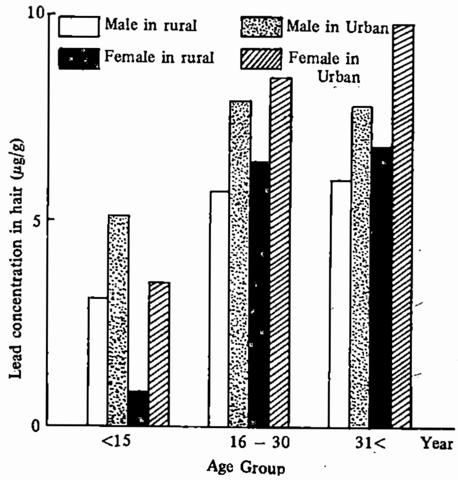

Fig. 1. Lead concentrations in hair by residents, ages, and sex

Table 3. Lead concentrations in hair from rural and urban residents

Age	Male Rural	Male Urban	Female Rural	Female Urban
	Pb μg/g dry weight, Mean±S.E.			
<15	3.1 ± 4.9 (0-13)	5.1 ± 2.0 (2.1-6.9)	0.8 ± 1.2 (0-3)	3.5 ± 5.3 (0-14)
16-30	5.7 ± 1.9 (1.5-7.6)	7.9 ± 5.6 (0-24.3)	6.4 ± 4.2 (2.0-11.8)	8.5 ± 4.5 (2.2-20.1)
31<	6.0 ± 4.1 (3.7-13)	7.8 ± 7.2 (1.3-23.2)	6.8 ± 4.6 (1.1-13.7)	9.8 ± 7.6 (4-22.8)

( ) : Range

male but the difference was slight and statistically not significant. The differences among age groups were most marked between less than 15 years group and elder groups. In other words, there was little difference between the lead concentration of hair in more than 31 years group and 16-30 years group while the concentration from less than 15 years group was markedly lower than elders.

3. Variations from working processes (mono-type, stereo-type and type-foundry) in printing workers: The lead concentration was the highest at the type-foundry workers, 18.9 μg/g as shown in Table 4 and it was 1.6 times higher than mono-type workers ($P<0.05$).

4. Comparison of lead contents in hairs from taxi-drivers by years of driving history: Table 5 shows the lead concentration in hair by years of driving history, less than 5 years, 6-10 years and more than 11 years of driving group. The lead concentrations of hair in each groups were 8.1, 11.4 and 14.9 μg/g. It indicates that the lead concentrations of hair from taxi-drivers increase as their years of driving history increases.

Table 4. Lead concentrations in hair by working processes in printing workers

Working process	No.	Pb μg/g dry weight (Mean±S.D.)
Mono-type	6	11.5±7.8 (2.1-21.2)
Stereo-type	5	14.7±1.4 (10.3-12.8)
Type-foundry	7	*18.9±8.5 (10.1-28.2)
Total	18	15.0±5.9

( ) : Range
* : Significant from mono-type at $P<0.05$

Table 5. Lead concentrations in hair by years of driving

Year	No.	Pb μg/g dry weight (Mean±S.D.)
<5	4	8.1±2.1 (2.6-11.9)
6-10	10	*11.4±3.7 (4-13.4)
11<	7	*14.9±8.1 (4-28.6)
Total	21	11.3±8.9

( ) : Range
* : Significant from below 5-driving year group at $P<0.05$

Summary

The result can be summarized as follows;

1. The ranges of lead content from individual human hair are very wide.

2. Lead concentration of hair is higher in occupationally exposed group than uninvolved group.

3. Lead concentration of hair is higher in urban residents than rural ones. And higher in female than male but not significant statistically.

4. The lead concentration of hair increases as their years of driving history increases in taxi-drivers.

References

Kwang-Chong Kim: The Study on Working Environment and Health Status of Workers Handling Lead.

Atsuhiro Nakano, Ichiro Wakisaka: Comparison of Hair Mercury Concentration Between Rural and Urban Residents of Kagoshima-Prefecture, (J.J.P.H) 7, 425-428, 1976.

Kanagawa Public Nuisance Center: Analysis and Interpretation of Environmental pollutants, K.P.N.C., Tokyo.

Clair C. Patterson: Contaminated and Natural Lead Environments of Man, Arch. Environ. Health 11, 344-360, 1965.

Ann. N. Clarke, David J. Wilson: Preparation of Hair of Lead Analysis, Arch. Environ. Health 28, 292-296, 1974.

Min Young kim,. Hong Keun Lee. Moonshik Zong: A Study on the Concentration of Certain Heavy Metals of Air in Seoul, Korean Journal of Public Health 11:1, 130-141, 1974.

D.H. Hofreuter, E.J. Catcott: The Public Health Significance of Atmospheric Lead, Arch. Environ. Health 3, 82-88, 1961.

Naomi Baumslag: Trace Metal Studies in Bushman Hair, Arch. Environ. Health 254-257, 1976.

D.I. Hammer, J.F. Finklea, et al.: Hair Trace Metal Leaves and Environmental Exposure, Am. J. Epidemiology 93 2. 84-91. 1971.

Robert A. Kehoe: Normal Metabolism of Lead, Arch. Environ, Health 8, 232-249. 1964.

Henry A. Schroeder, Alexis P. Nason: Trace Metals in Human Hair, J. of Invest. Dermatology 53:1. 71-77, 1969.

Henry A. Schroeder, Isabel H. Tipton et al.: The Human Body Burden of Lead, Arch. Environ, Health 17, 965-977, 1968.

Henry A. Schroeder, Joseph J. Balassa et al.; Abnormol Trace Metals in Man: Lead, J. Chron, Dis. 14. 4, 408-424, 1961.

David Mouw, Kenneth Kalitist et al.: Lead Possible Toxicity in Urban VS Rural Rats, Arch. Environ. Health 30, 276-280, 1975.

D. Weiss, B. Whitlen: Lead Content of Human Hair, Science 178, 69-70, 1972.

Leslie M. Klevay: Hair as a Biopsy Material, Arch. Environ. Health 26, 169-172, 1973.

Teresa Giovanoli-Jakubczak et al.: Measurement of Mercury in Human Hair, Arch. Environ. Health 28, 139-144, 1974.

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CERTAIN TRACE METAL CONCENTRATIONS IN THE MATERNAL AND CORD BLOOD OF SOME SEOULITES

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Introduction

Certain metals which are widely used in various industries have been implicated as being dangerous to human health following industrial or sometimes atmospheric exposure. Further, when pregnant women are exposed, the children from those are believed to be affected in accordance with the concenration of metals in mother's blood, the duration of exposure, the kind of metals, and so on. It is generally accepted that the placenta facilitates the transfer of a variety of those metals which are essential for the growth of the fetus, but interferes with the transfer of metals which are hazardous for both mother and fetus. However, the mechanism as to how metals come to be diluted or concentrated in the blood of the fetus is still unclear.

It is logically speculated that the placental barrier moderates this mechanism as maternal blood is passed through this barrier to the fetus, but it is not yet clear in all cases whether metals are actively transported (concentrated), passively transported, or simply screened in this porcess.

In these experiments, in order to gain some insight into such functions of the placental barrier, we measured the concentrations of Cd, Pb, Zn, and Fe in both the maternal and cord blood in paired samples.

Materials and Methods

In 1978, a total of 104 paired samples were collected in heparinized, acid-washed tubes from both pregnant women admitted to some local clinics in Seoul for their delivery care, and from the umbilical cords of neonatal babies delivered from them. About 10 ml of venous blood was collected from the mothers before delivery, while the same amount of umbilical cord blood was also collected imediately after the delivery. From the sampled whole blood, the concentrations of Cd, Pb, Cu, Zn and Fe in each sample was determined by atomic absorption spectrophotometry, according to the Kanagawa Public Nuisance Center Method (1974) as described below.

Each blood sample of 5 ml was ashed with 10 ml of nitric acid and 4 ml of perchloric acid, and then treated with sodium-diethyl dithiocarbamate (DDTC) and extracted with methyl-isobutyl ketone (MIBK). The MIBK layer containing the extracted metals was then aspirated into the flame of a Shimadzu AA-630-11 atomic absorption sepectrophotometer. Absorbance at the appropriate wavelengths was measured and recorded on a strip chart-recorder attached to the spectrophotometer. By comparison with standards of known concentration, the concentrations of metals in each blood sample was determined.

Results and Disscussion

The summarized results of the study are shown in Table 1. Presented here are statistics as to the mean values and the standard deviations for all of the metals which were analyzed. In addition, the ratios of the mean values of cord blood vs. maternal blood, the significance of the difference between them, and the equation of regression lines between the dependent variables of concentration in maternal blood and the independent variables of concentration in cord blood are presented.

The number of samples by metal are varied, and especially in case of Cd, Zn and Fe they are much smaller because it was often impossible to obtain a large amount of samples from umbilical cord at delivery table and so was impossible to analyze. Accidental loss of samples after or during the analyzing process of Cu and Pb was another reason.

As shown in Table 1, and Fig. 1 & 2, detailed discussion of the results now follows.

A. Cadmium: The mean concentration of Cd in cord blood was 0.04±0.04 μg/ml which was 0.70 times that found in maternal blood, 0.06±0.05μg/ml ($P<0.001$). Cadmium concentration in cord and maternal blood deternined here were similar to results obtained by Hoshiai (1977).

Regarding the frequency distribution, 33 maternal blood samples out of 86 (38.8%) belonged to the 0.00-0.03 μg/ml group, whereas 42 cord blood samples out of 86 (48.8%) belonged to same group.

In both maternal and cord blood samples, the frequencies by concentration were found to decrease as the concentration increased. However, in cord blood, the frequencies were found to decrease more rapidly.

Between the concentration in maternal and cord blood, a significant positive correlation was found showing a regression line of y = 0.26x + 0.27 (y=concentration in cord blood, x=concentration in maternal blood) with a correlation coefficient of 0.30 ($P<0.01$).

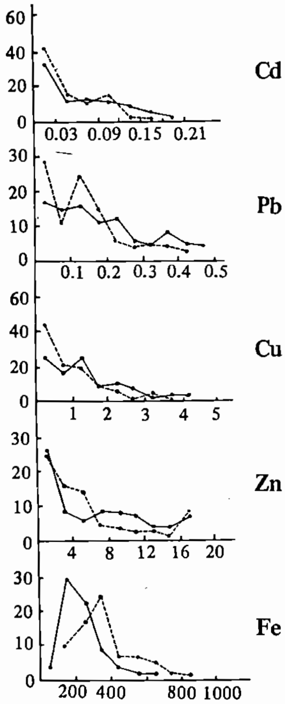

Fig. 1. Frequency distribution (%) of metal concentrations (μg/ml) with respect to kinds of metals; solid lines indicate maternal blood and brocken lines indicate cord blood.

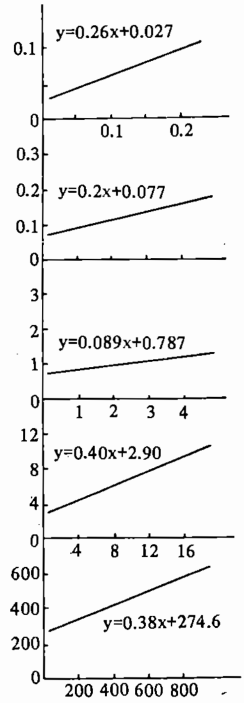

Fig. 2. Correlation of metal concentration between maternal and cord blood with respect to kinds of metals; y indicates concentration in cord blood, x in maternal blood (μg/ml).

Table 1. Comparison by metal

	Cd		Pb		Cu		Zn		Fe	
	Maternal	Cord	Maternal	Cord	Maternal	Cord	Maternal	Cord	Maternal	Cord
Mean	0.06	0.04	0.18	0.13	1.47	0.92	6.97	5.72	238.8	364.2
S.D.	0.05	0.04	0.15	0.11	2.00	0.81	6.62	6.42	133.1	161.8
Number	88		100		104		79		72	
C/M ratio*	0.70x		0.70x		0.62x		0.82x		1.54x	
t-test	2.59 (p<0.001)		2.91 (p<0.001)		2.58 (p<0.01)		1.20 (p<0.1)		5.19 (p<0.001)	
Regression line**	y=0.26x+0.027		y=0.2x+0.077		y=0.089x+0.787		y=0.40x+2.902		y=0.38x+274.6	
r(p-value)	0.30(p<0.01)		0.37(p<0.001)		0.22(p<0.05)		0.42(p<0.001)		0.31(p<0.01)	

note : * C/M ratio indicates concentration ratio of cord/maternal blood.
** y indicates concentration of appropriate metal in cord blood and x in maternal blood in μg/ml.

B. Lead: The Mean concentration of Pb in cord blood was 0.13±0.11 μg/ml, which was 0.70 times that of maternal blood, 0.18±0.15 μg/ml ($P<0.001$).

The mean concentration of Pb obtained here fell in between values obtained in the U.S. by Hecker (1974) and in Japan by Hoshiai (1977). Cord blood values of Pb were never reported in these countries, such that comparison was not possible here.

Regarding frequency distribution, 48 maternal blood samples out of 100 (48%) belonged to the less than 0.15 μg/ml group, while 63 cord blood samples out of 100 (63%) belonged to this same group.

As with the distribution curves of cadmium and copper, the frequency by concentration was found to decrease as to concentration increased in both maternal and cord blood samples. However, in cord blood the slope of the distribution was much steeper.

A positive correlation between concentrations in maternal and cord blood was found to be statistically significant, and showed a regression line of $y = 0.2x + 0.077$ with a correlation coefficient of 0.37 ($P<0.001$).

C. Copper: The mean concentration of Cu in cord blood was 0.92±0.81 μg/ml, which was 0.62 times that of maternal blood, 1.47±2.00 μg/ml ($P<0.01$).

The mean concentration values of Cu in both cord and maternal blood obtained in this tudy were less than values obtained in Japan (1.26 and 1.96, respectively) by Hoshiai (1977).

In this study the decreasement ratio was determined to be 0.62, a value similar to that obtained in the Japanese study (0.64).

Regarding the frequency distribution, a curve quite similar to those of Cd and Pb was obtained showing that 83 maternal blood samples out of 102 (81.4%) belonged to the less-than 1.5 μg/ml group, while 68 cord blood samples out of 102 (66.7%) belonged to this same group.

A positive correlation was found to be significant and showed a regression line of $y = 0.089x + 0.787$, with a correlation coefficient of 0.22 ($P<0.05$).

D. Zinc: The mean concentration of Zn in cord blood was 5.7213±6.4165 μg/ml, which was 0.82 times that of maternal blood, 6.97±6.62 μg/ml ($P<0.1$).

In the case of zinc, the concentration in maternal blood fell in between values obtained in the U.S.A. and Japan. Cord blood concentrations were much lower than results obtained in Japan. With regards to Hoshiai's study, he found that the average concentration of Zn in cord blood (7.44) was 0.61 times that of maternal blood (12.12). In other words, Hoshiai found higher degree of decreasement in cord blood.

With regards to the frequency distribution, the frequency in cord blood was higher in the 2-6 μg/ml group and was lower in the more-than 6 μg/ml group than in maternal blood.

A positive correlation was also found to be statistically significant, and showed a regression line of $y = 0.40x + 2.902$, with a correlation coefficient of 0.42 ($P<0.01$).

E. Iron: The mean concentration of Fe in cord blood was 362.2±161.8 μg/ml which was 1.54 times higher than that found in maternal blood, 238.8±133.1 μg/ml ($P<0.01$). The concentration in cord blood was slightly less than in the Japanese study, whereas the concentration in maternal blood was much lower.

As to the frequency distribution, 29 maternal blood samples out of 72 (40.2%) belonged to the 100-200 μg/ml group, whereas 24 cord blood samples out of 72 (33.3%) belonged to the 300-400 μg/ml group.

The curves revealed that the frequency in cord blood was higher in the 300-400 μg/ml group than in maternal blood, whereas it was lower in the 0.300 μg/ml group.

Both curves were quite different from normal distribution ($P<0.001$), but were unimodal and were positively skewed. A significant positive correlation was found, and showed a regression line of $y = 0.38x + 274.6$ with a correlation coefficient of 0.31 ($P<0.01$).

On the graph (Fig. 2), it may be noted that the concentration in cord blood was higher than that in maternal blood until reaching a concentration of 442 μg/ml, after which the cord blood Fe levels fell below the maternal blood levels.

In view of the above results and discussion, it can be said that the placental barrier concerning metal transfer role from mother to fetus would be a dynamic organ but not a simple passive barrier with purposive selectivity according to kind of metals, concentration of metals in maternal blood, physiological demand or hazard of the metal for fetus, and so on.

There are three well known factors which influence the effectiveness of the human placenta as an organ of transfer: (1) the concentration of the substance in maternal blood and in some instances the extent to which it may be bound to other compounds; (2) the concentration of the substance in fetal blood exclusive of the any which may be found; and (3) the molecular weight of the substance.

Substances of high molecular weight do not usually traverse the placenta, but there are pronounced exceptions, such as immune globulin G, which has a molecular weight of about 160,000.

Summary and Conclusion

Various metals in industries have been implicated in human health. Furthermore, if fertile or pregnanted women are exposed, the children from those are supposed to be affected in accordance with the concentration of metals in mothers' blood, duration of exposure, kind of metals, and so on.

However, the mechanism is still unknown how the concentration of the metals in blood of fetus become diluted or concentrated in method of transferring from maternal blood through placental barrier.

The mechanism of placental barrier to moderate these metal transferring is studied by measuring concentration of Cd, Pb, Cu, Zn, and Fe in both the maternal and cord blood in paired samples.

Concentrations of the above metals were measured with atomic absorption spectrophotometer and the results were summarized as shown in Table 1. From the above results, it was considered reasonably that the placental barrier concerning metal transfer role from mother to fetus would not be a simple passive barrier but a dynamic organ with purposive selectivity according to kind of metals, concentration of metals in maternal blood, physiological demand or hazard of the metal for fetus, and so on.

References

Choo, T.S. and Cha, C.H. (1979) Heavy metal concentration of human blood in Korea.

Pae, E.S. nd Kim, Y.H. (1979) Cadmium concentration in maternal blood and neonatal cord blood. *The New Medical Journal,* 22(8) : 21.

Kim, S.J. (1979) Iron concentration in maternal blood and neonatal cord blood. *Kor. U.M.J.,* 16(3) : 1.

Cha, C.H. (1978) Heavy metal concentrations in blood, hair and urine. Monograph.

Cha, C.H. (1974) Heavy metal poisoning. *The New Medical Journal,* 17 : 47.

Bae, S.K. (1975) Studies on normal values for red blood cells of Korean newborn infants. *J. Ped. Kor.,* 18(9) : 69.

Hoshiai, T. (1977) The concentration distribution of several trace metals and their relationship in whole blood. J.J.P.H., 24(7): 447.

Hoshiai, T. (1977) The trace metals concentration in maternal and cord blood, and placenta of pregnant women living Metropolitan Area, Tokyo. *J.J.P.H.,* 24(11) : 727.

Butt, E.M. et al (1977) Trace metal levels in human serum and blood. *Arch. Environ. Health,* 8 : 52.

Naomi, B. et al (1974) Trace metal content of meternal and neonatal hair. *Arch. Environ. Health,* 12:286.

Louria, D.B. et al (1972) The human toxicity of certain trace elements. *Ann. Inter. Med.,* 76:307.

Hecker, L.H. et al (1974) Heavy metal levels in acculturated and unacculturated populations. *Arch. Environ. Health,* 29:181.

Bogden, J.D. et al (1974) Cadmium, lead, and zinc concentrations in whole blood samples of children. *Environmental Science and Technology,* 8(8);740.

Clausen, J. and Rastogi, S.C. (1977) Heavy metal pollution among autoworker. *British Journal of Industirial Medicine,* 34:208.

Cavalleri, A. et al (1977) Determination of plasma lead levels in normal subjects and in lead exposed workers. *British Journal of Industiral Medicine,* 35:21.

Schroeder, H.A. et al (1966) Essential trace metals in man: copper. *J. chron. Dis.,* 19:1007.

Schroeder, H.A. et al (1969) Essential trace metals in man:zinc. *J. chron. Dis.,* 20:179.

Imbus, H.R. et al (1963) Boron, Cadmium, Chromium, and Nickel in blood and urine. *Arch. Environ. Health,* 6:286.

Kubota, J. et al (1968) Copper, Zinc, Cadmium, and Lead in human blood from 19 locations in the United States. *Arch. Environ. Health,* 16:788.

Kim, I.D. et al (1979) Normal biological and morbidity data of the Koreans. Normal Data Editing Committee, Seoul, Korea.

Shim, K.S. (1974) Sanitary chemistry. Dong Myung Sa, Seoul.

Miura, T. et al (1974) Handbook of occupational health. *The Institute of Science of Labour,* Tokyo.

Pharmaceutical Society of Japan (1973) Standards methods of analysis for hygienic chemists, Tokyo.

Kanagawa Public Nuisance Center (1974) Analysis and interpretation of environmental pollutants, K.P.N.C., Tokyo.

Pritchard, J.A. and MacDonald, P.C. (1976) Williams Obstetrics. 14th ed, Appleton-Century-Crofts, New York.

ILO (1971 and 1972) Encyclopedia of Occupational Health and Safety. Vol. 1 and II, Zeneva.

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CHROMIUM CONCENTRATIONS IN URINE OF WORKERS AND AMBIENT AIR OF CHROMIUM ELECTROPLATING FACTORIES IN JAPAN

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Introduction

There are over 3,000 electroplating factories in Japan, most of which employ fewer than ten workers. Recently in Japan, occupational disease and pollution due to chromium compounds have become a problem.

In small-to medium-sized electroplating factories, I took measurements of chromium in ambient air in workrooms and determined chromium in urine of workers as an index of exposure to chromium compounds.

Materials and Methods

1) Summary of factories investigated: The chromium electroplating is divided into industrial chromium electroplating and decorative chromium electroplating. The work procedures of the two differ.

a) In industrial chromium electroplating: Substance – etching – Cr plating

b) In decorative chromium electroplating; Substance – Cu plating – Ni plating – Cr plating

c) In addition, there is surface treatment (also termed medicine treatment, or more generally, chromate treatment) in which colored membranes and luster membranes are produced. The main work consists of treatment with chromate after zinc plating.

Investigation was conducted from December 1973 to October 1977. The atmospheric chromic acid concentration in industrial chromium plating factories were conducted 16 times. In decorative plating factories, determinations were made 50 times. In surface treatment factories, measurements were made 25 times. The measurement of atmospheric chromic acid concentration was performed in the areas of activity. Most of the factories reported in this paper employ fewer than ten workers and make up about 50% of the total investigated.

2) Determinations were conducted using the following methods:

a) Chromic acid concentration – diphenylcarbazid method

b) Chromium in urine – atomic absorption spectrophotometry

c) Examination of symptoms – CMI (Cornell's Medical Index) complaint questionnaire

Results

1) Atmospheric chromic acid concentration: Table 1 shows chromic acid concentration in the ambient air of the three types of chromium electroplating factories. The concentration did not reach detectable limits in most cases. As for shops indicating less than 10 $\mu g/m^3$, in industrial electroplating factories there were

Table 1. Atmospheric chronic acid concentration

	Industrial electroplating n=114	Decorative electroplating n=246	Surface treatment n=105
under 10 μg/m³	89	214	88
10 – 19 μg/m³	8	15	9
20 – 39 μg/m³	5	12	5
40 – 59 μg/m³	5	1	2
60 – 99 μg/m³	2	2	0
100 – 199 μg/m³	2	2	0
200 – 299 μg/m³	1	0	0
300 – 399 μg/m³	1	0	0
400 – 699 μg/m³	0	0	1
700 – 999 μg/m³	1	0	0
Over 1000 μg/m³	0	0	0
Geometric mean	14 μg/m³	11 μg/m³	11 μg/m³
Arithmetic mean	26 μg/m³	13 μg/m³	15 μg/m³

89 shops, or 78% of the total number investigated. The number of decorative chromium plating factories indicating less than 10 μg/m³ was 214, or 78%. The number of surface treatment factories was 88, or 84%.

Several industrial plating factories indicated levels exceeding the TLV (100 μg/m³). One factory indicated a particularly high concentration of 700 μg/m³. Among surface treatment factories, only one exceeded the TLV. This level was found in a workroom where chromium compounds in powder form were being measured and dissolved in water; thus it was a special case. No other surface treatment factory investigated revealed levels exceeding the TLV. In decorative chromium plating facories, only 2 or 0.8% exceeded the TLV.

2) Chromium in urine: The urinary concentration of chromium was determined as an indicator of exposure to chromium in air. Figure 1 shows the urinary chromium concentration of workers in the three types of chromium plating factories. The mean of industrial chromium plating workers was 22.1μg/1. That of workers in decorative chromium plating was 2.3 μg/1, and that of workers of surface treatment factories was 1.5 μg/1. Industrial chromium plating workers indicated the highest levels of chromium in urine. The figures obtained for decorative chromium plating workers and surface treatment workers were not statistically significant.

For further investigation, I choose one industrial chromium plating factory. The atmospheric chromic acid concentration were monitored over a period of 2 1/2 years.

3) Chromium levels: The industrial chromium factory was surveyed from February 1975 to October 1977. Atmospheric concentration was measured 4 times and urinary chromium concentration was determined 3 times. Table 2 shows the decrease of atmospheric chromium

Table 2. Transition of atomospheric chromic acid concentration

	Feb. 1975 n=9	Jun. 1975 n=6	Aug. 1976 n=19	Oct. 1977 n=15
under 10 μg/m³	5	3	12	15
10 - 19 μg/m³	0	0	4	0
20 - 39 μg/m³	0	1	3	0
40 - 59 μg/m³	1	1	0	0
60 - 99 μg/m³	0	0	0	0
100 - 199 μg/m³	0	1	0	0
200 - 299 μg/m³	1	0	0	0
300 - 399 μg/m³	1	0	0	0
400 - 699 μg/m³	0	0	0	0
700 - 999 μg/m³	1	0	0	0
over 1000 μg/m³	0	0	0	0
Geometric mean	38 μg/m³	25 μg/m³	13 μg/m³	10 μg/m³
Arithmetic mean	143 μg/m³	58 μg/m³	14 μg/m³	10 μg/m³

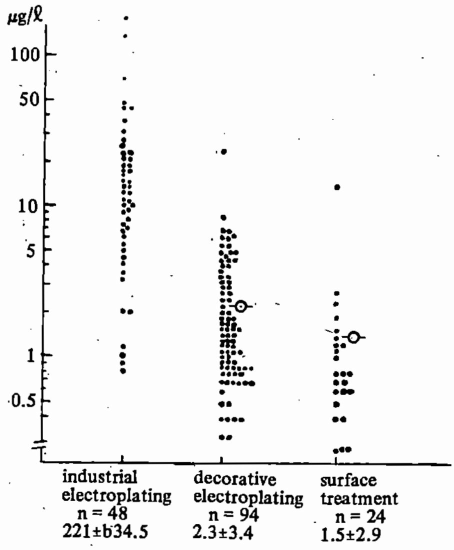

Fig. 1. Urinary chromium concentration.

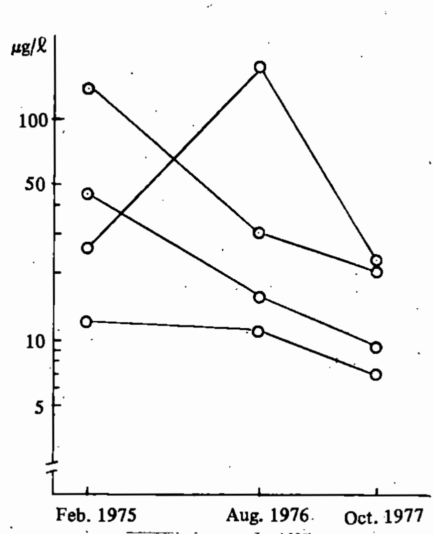

Fig. 2. Transition of urinary chromium concentration.

concentration.

After an investigation in February 1975 improvements were made in this factory in the exhaust system and the electroplating vessels sealed, thereby preventing dispersion of chromic acid mist. The urinary chromium concentration in 4 workers decreased corresponding to the atmospheric concentration. (Figure. 2)

4) *Examination of symptoms:* Urinary chromium concentration in decorative chromium plating workers and surface treatment workers was rather low, but I wished to investigate whether or not there existed problems from the standpoint of occupational hygiene. Subjective symptoms according to the CMI (Cornell's Medical Index) were checked in decorative chromium plating workers. The CMI consists of 207 questions. Organic solvent treatment workers were used as controls. Table 3 shows the statistically significant symptoms. Complaints relating to the respiratory and digestive organs were the most numerous.

Table 3. Strategy of CMI subjective symptoms

	Electro-plating worker n=45	Control n=42
Do you have to clear your throat frequently?	17	4
Do you suffer from a constantly running nose?	10	2
Have you at times had bad nose bleeds?	8	1
Do you usually belch a lot after eating?	15	2
Do you suffer from frequent loose bowel movements?	16	5
Are you constantly too tired and exhausted even to eat?	0	6
Does it make you angry to have anyone tell you what to do?	12	3
Do you often get into a violent rage?	28	14

Conclusion

1) Chromic acid concentration in industrial chromium electroplating factories indicated a tendency toward higher levels than decorative electroplating or surface treatment factories.

2) Industrial chromium electroplating workers indicated the highest levels of chromium in urine.

3) One industrial chromium factory was monitored for 2 1/2 years. Atmospheric concentration decreased due to improvements in the environment and urinary. chromium concentration also decreased.

4) Electroplating factories use not only

chromium compounds but various other chemical substances as well. Thus there still exist many problems. Complaints relating to the respiratory and digestive organs were the most numerous.

References

A. Takizawa, et al.: Studies on Environmental Measurement of Chromium Electroplating Shops, Rodo Eisei, 19(8), 50-53, 1978 (Japan)

I. Ito, et al.: A Survey on Environmental Control in Gilding Factories, Nihon University Medical Journal, 37(8), 31-39, 1978 (Japan)

K. Tsuchiya, et al.: Chromium Concentration in Urine of School Children, Japanese Journal of Hygiene, 32(6), 753-757, 1978 (Japan)

Pierce, J.O., II, et al.: Lead Chromium and Molybdenum by Atomic Absorption, A M A, Arch. of Environmental Health, 13, 208-212, 1966

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PROGRESS IN THE FIGHT FOR A BETTER WORKING ENVIRONMENT

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Since the founding in 1919 of the International Labour Organisation, it has adopted a great many standards in the form of conventions and Recommendations which set forth rules to be complied with or objectives to be attained in the quality of working life.

Some of these standards aim specifically to improve the quality of working life by requiring compliance with certain minimum conditions. This is the case, for instance, with the many standards relating to occupational safety and health, minimum wages, hours of work or holidays with pay.

However, despite the progress achieved in the past 60 years, too many workers are still employed in adverse working conditions and environment. Each year throughout the world millions of men and women, the young and old, die, or are injured, or become incapacitated or ill in workplaces. In industry alone the number of accidents in the world resulting in absence from work is estimated at 50 million a year, or about 160,000 a day. The average is almost certainly higher in the developing countries. To these figures must be added those relating to agriculture and forestry on which world-wide data are not collected. Direct and indirect costs that have to be borne by governments and employers for the compensation of these occupational accidents and diseases would amount to a considerable sum. In addition to the foregoing, the advent of new occupational risks arising out of, for example, chemical substances, radiations, mental stresses, etc. in industry, agriculture, forestry and offices led the International Labour Conference to call upon the ILO to launch an International Programme for the Improvement of Working Conditions and Environment – PIACT – in 1976.

A distinctive feature of PIACT is its insistence on the use in a systematic, co-ordinated and mutually supporting fashion of all the means of action available to the ILO; standard-setting, studies and research, tripartite meetings, exchange of experience and information, and technical co-operation.

National needs being so various, PIACT seeks, within the limits set by its resources, to provide an individualized response to them.

The Programme offers countries a comprehensive choice of technical co-operation facilities from which to select the one best suited to their particular requirements: multidisciplinary teams of consultants; tripartite national seminars on improving working conditions and environment; follow-up and evaluation missions; direct assistance, for example by high-level specialists; national seminars and training courses in specific sectoral or technical fields; and fellowships. Countries can also ask to participate in and thus benefit from the various inter-regional, regional and sub-regional events, such as expert and other meetings, organised by the Programme.

At the Asian regional level, the ILO conducted a three and half months training course in occupational hygiene in Singapore with the financial support from Denmark this year. The course was designed to assist the Asian countries in training selected personnel in occupational hygiene. Thirteen participants from 10 countries including employers' and workers' representatives participated in the course and returned to the respective countries with very fruitful achievements.

Another regional meeting has been just completed this October. The Regional Pilot Workshop on Working Conditions and Environment was organised by the ILO in association with the United Nations Environment Programme (UNEP) in Kuala Lumpur for 8 days and assisted by WHO. It was attended by labour officials from 18 countries in Asia and the Pacific as well as 3 employer and 3 worker representatives from the region. The lectures given and discussions held at the Workshop were supplemented by a demonstration of the manner in which relevant scientific equipment is generally used for sampling and analytical assessment of environment hazards. In addition, 10 industrial undertakings were visited. These provided the participants not only a splendid opportunity of aquainting themselves with recent thinking of the United Nations agencies on the necessity for improvement of working conditions and environment but also the occasion to acquire a first hand knowledge of the manner in which workers are exposed to industrial accidents and occupational diseases.

The third regional activity which the ILO has initiated is "Case studies of costs of occupational accidents and diseases". Additional studies financed by Germany are to be carried out by two consultants in occupational safety and health and in applied economics and statistics, is expected, among other things, to alert governments, employers and workers to the impact of accident costs on productivity and economic development.

At national levels, on the other hand, several activities to fight for a better working conditions and environment have been successfully carried out.

The recommendations of the national seminar on making work more human held under PIACT auspices in Bangladesh in December 1976 are considered a promising field for further PIACT technical co-operation.

In India, three member PIACT multidisciplinary team visited there last November to look into safety questions in the mining industries and submitted a report to the Government of India on the work of the team. It includes chapters on the prevention of roof/side fall accidents in coal mines, the application of electronics in communication and instrumentation in mines safety, dust evaluation and control as well as recommendations.

In Indonesia, concrete follow-up action is under consideration for giving effect to the recommendations of the national seminar on making work more human held in Jakarta in July 1978. Hopefully, half a million dollars would be forthcoming from UNDP to implement these recommendations. Also, the joint WHO/ILO project — development of central and regional occupational health and industrial hygiene laboratories — is being executed by the WHO and ILO participation.

In Korea, the project of National Institute of Labour Science, financed by UNDP, became operational in October 1978 with the appointment of the Chief Technical Adviser from the ILO. We are visiting the Institute on Thursday afternoon. Its objective is the establishment of the Institute which will assist industry in the promotion of occupational safety and health.

In Pakistan, a PIACT preparatory mission was undertaken in 1978 and this is to be followed by a multidisciplinary mission very soon. Further, the project — Strengthening of the factory inspectorate in Sind and Punjab — is going on. This project is designed to strengthen the existing factory inspectorates in Karachi and Lahore so as to enable them to expand their activities in the field of occupational hygiene and prepare a plan for the further development of occupational hygiene in the country. Also in Pakistan, the project of Mines rescue and safety in Baluchistan and Punjab is under way with the financial assistance from Norway. This large-scale project assists the responsible ministry in the initial operation and further development of mines rescue stations and the improvement of mines safety in the provinces of Baluchistan and Punjab.

In Philippines, considerable progress has been made in finalizing the PIACT assistance to be given to the Government in following up on the Philippine Tripartite National Conference on Improving Working Conditions and Environment which was held in Manila in December 1977.

From end-June onwards Dr. K. Kogi of the Japan Institute for Science of Labour spent several weeks in Philippines assisting the Government in implementing two major follow-up projects. He has drawn up an inter-ministry ergonomic checklist to serve as an operation tool for the joint incentives-cumsanctions programme set up by the Department of Labour and Board of Investments for coordinated action in bettering working environment in many export firms.

In Sri Lanka, the project of the Institute of Occupational Safety and Health and Environmental Protection which was approved in 1976, has now ended at the systematic identification and control of health and safety hazards in workplaces and at the development of national skills in preventive occupational medicine, safety engineering, environmental hygiene, work physiology, occupational toxicology and other related discipline. WHO participated as associate agency with substantial expertise and fellowship components.

In addition to those mentioned above, three more PIACT programmes were sounded out to hold a tripartite national seminar on improving working conditions and environment in Malaysia, Sri Lanka and Thailand next year.

PIACT activities are being conducted throughout the world and further progresses are expected to cover all employment sectors and to mobilise and national institutions.

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Session 5.
Mental Health in Industry

PSYCHOLOGICAL CHANGE OF WORKERS OF A PROJECT IN RURAL AREA

Heru SATOTO, *Indonesia*

The setting of the project

A project of liquefying plant for natural gas is set up in northern tip of Sumatra island, on the coast line of Areh. It consists of 3 trains of liquefaction processes, condensate extraction plant, tank farm, utilities, workshops, offices, LNG harbor, 2 community complexes. The whole area covers about 2500 acres, and the site was purchased from local villagers who used previously as brackish fish ponds and coconut plantation. Soil structure is generally fit for agriculture and in some spots there are limestones. This is one of other things that cause drinking water from wells has a higher content of hardness minerals. The site was picked since it is by the strait of Malacca as a busy waterway and just about 30 km from the gas field. Besides, it is located by the main road along the island as the main communication means. This will give a considerable impact to the growth of community development as a result of industrialization.

Cultural background of local people is practically agricultural life with a religious accent. This makes a more or less a static community which enjoys calm and peaceful life even though with lower rural standard of living. The extent of their religious life is not filled up with ritual ceremonies, but merely practising the basic faith of Islam. The temperament is stable enough but a bit suspicious to any new influence. This is understandable regarding the past isolation from Western life style.

The LNG plant itself is still a novelty design, bearing a higher technology in chemical engineering. For a developing country like Indonesia, the introduction of this kind of technology to an agricultural community, will result interactions in any sector of life. Considering the national importance of future profits, this multi million dollar project is built: which means the mobilization of all funds, forces and skills.

The import of technology is always accompanied with the import of sophisticated material and equipments and most important thing is the involvement of foreign skilled engineers. Since their number is limited compared to the size of the project, it also requires the utilization of Indonesian skilled and semi skilled labors. These people mostly came from other parts of the country, who have different cultural background from local people. Foreign people who used to be called as expatriates consist of a good collection of nationals: Koreans, Japanese, Americans, French, Germans, Filipinos, Indians, and other nationalities in smaller quantities. By looking at this international group, introduction of new way of thinking and life habits to local people is inevitable. In the same time, other Indonesians, used to be called as nationals, joined the party to take part in the project life.

Activities that require response of local people

The influx of either expatriates or nationals in any case will have a significant impact to local people's attitude. Involvements of local people in the project activities include:

1. The rush to apply any kind of job in the project. Due to their lack of proper education and technical experience, generally they start as labors. Their number is increasing rapidly, reaching 6000 men during peak time. The background of this rush is merely due to attractive remuneration offered by project.

2. Change of daily life. By working in the project they work 60 hours a week that is from 7 a.m. to 6 p.m. with 1 hour break for lunch. Since they are contracted annually, they try very hard to perform as best as they can, hoping that their contract will be extended next year. Project life is very harsh. Strick rules with penalties is sometimes overcome their behavior. Physically they are exposed to hard work under hot sun, and mentally they are burdened with mixed feelings and emotions. Mostly they are hired as single status, away from their families and at the same time they have to follow orders in English and work with strange equipments.

3. Adaptations to different cultures, brought in by various nationalities and other nationals. These people are actually try to demonstrate good gestures to local people, but with their own way. As a rule, adaptation takes time. In the project bulletin a regular article is always presented concerning on how to behave with local people. For instance: do not embarrass them with discussion about religion, habits and man-women relations. This seems brings good effect to improve personal relations, proven by increasing number of local people to become a reliable teammate with expatriates.

Response of local people toward this drastic change to their life is a growing process. Phasing can be categorized as follows:

I. Suspicious and confused. This happened when the first time they were engaged to project job.

II. Agitations. This occured after some time (months) with the job. They start to realize that there are differences on compensations, facilities etc. In fact they have got higher income than when they are out of work, but as human nature they demand ultimate satisfaction at shortest time.

III. Understanding and stabilization. When they have gained a good personal relations with anybody in the project and felt the benefit of improvement of skills they can apply on their work. Financially, they become more stable.

They can send the money to their families regularly and some of them had plans to build their own house and save for future entrepreneurship.

VI. Depression. This happened when the project was about to finish (3 years). They are anxious to get another job to utilize his ability. Mostly they got encouraging recommendation from the project to make it easier to find next assignment. But since big projects are not a continuous happening, they miss the joy of being a project worker. Some of them give up this dream and turn into petty businesmen with their savings as their capital.

The above phases based on observations and interviews. It is difficult to find the right parameter to monitor the process. There are some evidences that might support those phases.

1. Accident cases. Despite the number of accidents and stringent safety precautions, there are some fatal ones that are caused by human attitude derived from their previous habits. Case I. During lunch time, the weather was so hot that lead anybody to take shelter. After finishing his lunch, a worker took a nap in a groove near a pile of dirt. When the whistle blew at 1 p.m. to srart back the work, another worker moved the buldozer pushing the pile and apparently burried his friend unintentionally.

Case II. Reluctant to find the right tool, a worker used an iron bar and a hammer to release a tube of huge tractor tire. Without releasing the air pressure he kept hammering to insert the bar between the rim and outer tire. By unknown cause the bar lost its grip and bounched to hit his forehead. The blow is so hard that smashed both his hard hat and his skull.

These cases happened during first year of project, suffered by new workers.

2. Productivity. This project is an on schedule one. Since the rule of no work-no pay is applied, absenteeism is considerably cut off. This coincides with phase III, where they have reached the acceptance as project workers.

3. Skill development. Development of skills thru formal (welding, instrumentation) as well as informal instructions (pipe fitting, carpentry, rigging etc.) can be observed by the end of project. Many of them have achieved international standard of any one of these skills, as shown in a quite number of them are sent to Saudi Arabia to do similar job with higher grade. This group is a minority from phase IV, where personal achievements only count for the next project job.

Discussion

The existence of the above mentioned phasing is inevitable. The aim of efforts is to remedy any one which is considered unfavorable. This is to eliminate or at least minimize phase I, II, IV and utilizing the left over times to extend phase III. Phase I and II can be overcome by extensive explanations written as well as orally, stating that it is necessary to know how is a project life looks like. Reveal any consequence, not merely for financial reasons. In actual situation, it might be difficult to implement this procedure. This is due to limited time for recruitment and type of workers needed is not for higher level. And yet if this human factor is neglected, future problems can be expected. Recruiting office is dealing with low educated applicants, where they would sign any document exposed without thoughtful considerations.

On the other hand, this explanation procedure is not an impossible thing. Applicants can be grouped and briefed by local instruction, with local language. Hopefully a subtle human approach can be achieved. If this practice can be routinely implemented, there is a guarantee of more peaceful future job atmosphere. This is most important things to accomplish the project sucessfully.

In overcoming phase IV, there must be a closer relations with government bodies or other projects to plan the absorption of the work force. Maybe the result will not be 100%, but it must be planned as early as recruitment period. Any redundancy will become a burden for local community. Almost none of ex-project workers will return to agricultural life. They have been industrialized, and this is a point of no return. Anyway these group of work force is a precious human investment for the country.

The economy of a developing country is directed to better expectations in industrialization.

Conclusion

To propose a project, human development must be planned vigorously. Both local and incoming peoples must be thoroughly prepared. Any cultural gap may disturb the project and further become employment problem for the involved country. If the project finishes its construction phase and becomes operational, it is very unlikely to expect significant absorption of existing workers. This will become a drawback that is really preventable.

References

Levi, L : Occupational mental health : its monitoring, protection and promotion, JOM, January 1979, Vol. 21, No. 1.

Satoto, H : Arun LNG Medical Department: A historical report to Bechtel Incorporated June 1978.

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MENTAL DISORDERS AMONG INDUSTRIAL LABOURERS IN INDONESIA

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Introduction

The statistics put forward below represent the findings during my assignments in some industrial locations/districts in Kalimantan (one of Indonesia's larger islands), the metropolitan city of Jakarta and West Java.

Viewed from the health aspects, these districts indeed show great differences, yet, I venture to present this as a contribution to sensitize the health workers against the occurance of some psycho - socio - cultural problems among the industrial labourers assigned to the outer islands in Indonesia.

The prominent diseases encountered in Kalimantan (Tony et al, 1973) collected from twelve different places were:

1. anemia and other deficiencies .... 20 %
2. respiratory tract infections .... 20.6 %
3. malaria .... 18.8 %
4. gastrointestinal tract infections ..... 11.6 %
5. disease of the skin .... 11 %

There has been little information on neurological and psychiatric cases reported, except few scattered impressions put forward by some health-workers in the country. This paper is endeavoured to bring forward to all health-workers to draw their attention to this important aspects of health, which is left untouched for so long and needing immediate solution.

Some Psychiatric Problems Needing Attention

To better treat the psychiatric problems met among labourers, we must know the factors giving rise to this problems.

We can grouped the etiological factors according to three causes:

I. organobiological factors
II. psychological factors
III. socio-cultural factors

I. Conditions Related With Organobiological Factors

A. Malaria

Malaria is still one of the parasitic infections, being rife in Indonesia except the island of Java. This is easily recognized by its characteristic symptoms and a simple laboratory examination. Even though labourers are given preventive therapy with chloroquine or amodiaquine, some are still succumbing to it. Sometimes it is accompanied by simple psychiatric symptoms, like weakness and neurasthenia (usually among chronic cases also suffering from anemia !). In some patients organic brain syndrome is prominent, giving symptoms such as severe pyrexia with apathia, confusion.

Primary treatment is focused on malaria itself and on the other hand serious management have to be given to overcome the general condition of the patient.

B. Anemia and Deficiencies

Anemia and deficiencies are one of the serious problems met among labourers, because of lack of nutritional knowledge accompanied by cultural beliefs leading to low productivity capacity. (Low performance can be measured objectively by man-hour capacity). In peripheral areas 30-40% of labourers had a haemoglobine content of 12g% or lower (N = 1023).

This percentage was higher if compared with labourers in Jakarta and West Java, who had a rate of 27% (N = 617).

C. Head Trauma

Head trauma caused by traffic accidents seldom occurred in the project. (Special attention must be given to these areas, where road were flooded by crude oil from the newly explored wells). Acute psychiatric disturbances like traumatic delirium, amnesia,confabulatory syndrome were found. Other chronic brain syndromes like post traumatic personality disorder or other psychoneurotic type also occurred among the victims.

II. Conditions Related with Psychological Factors

Most of the labourers working in periphery are natives of Java. Marked environmental changes and absences from family, sometimes as long as one year or more, give rise to all kinds of stress, aggravated by limited recreational fascilities. All this leads to frustration and stress which find relief in quarrels, fighting and other aggressive outlets, sometimes leading to death.

Extra-marital intercourse with prostitutes/ temporary wives constitutes a major problem. The statistics from East Kalimantan (from Sangatta, Tanjung Santan and North Bontang, where staffs are given holidays every six months and skilled labourers got their vacation only once a year — N = 2230) showed a frightening: 78— 92% as compared with 30% of the labourers in Jakarta and West Java (N = 977).

Alcoholics and homosexuality were found only among foreigners/expatriates and very few of their relatives.

Incidence of neuroses and psychosomatic disorders are not differing too much with the general population. (Data collected from Panda Raya Health Fascility and Djasa Ubersakti Health Center Sangatta).

III. Conditions Related with Sicio and Cultural Factors

In Indonesia we met some special cases, called as : culture-bound phenomena; yet they cannot be grouped in already classified disorder — e.g.: amok and kesurupan.

Amok: It is a state, that comes up suddenly or is preceded by ritualistic or mystic ceremony in a person (usually male) entering into a trance-like state.

In this state he becomes aggressive toward persons, animals and other objects within his reach. After some time the person becomes completely normal again and acts as if nothing has happened. Often also the stage just passes due to exhaustion.

Kesurupan (possessed by the devil): Most of the Indonesians believe that some spirits like ghosts/satans/demons can enter our body with or without our own will. Djamaluddin, Prayitno and Banunaek (1971) comparing this hasolopan/kesurupan with other neurotic reaction (dissociative—reaction). Theoretically the symptoms could be defined from the discription as a dissociation of EGO, the orality (depersonalization), the clouding of their consciousness, amnesia and other symptoms. Patient's behaviour change to be a theatral and hystrionic one; so that he begins to make a spiritual speech etc. Most of the cases are healed by the dukun (native healer), and there is to protect them from being possessed for the second time by evil spirit.

Both of them are treated as an emergency case. According to the author's experience, the most potent neuroleptic drug for such cases is "chlorprothixene" (which is available in Indonesia).

Companies/industries in the periphery must take into account the customary practices of the general population e.g.:

Eighty percent of the inhabitants of Indonesia are Moslems. In the fasting month (Ramadhan) and the celebration of hari raya Idulfitri, productivity is decreased. (among unskilled labourers sometimes is as low as 50%).

There is also the custom of returning to their village two weeks before the celebration of Idulfitri and returning to the jobsite two weeks after the celebration. Of those staying during this period only 40 – 50% remain active. This unfavourable condition must be realized in advance to this period.

The Indonesian Diagnostic Classification and Glossary of Mental Disorders

Setyonegoro and Roan et al. have tried to outline the uniformity in grouping mental disorders. This started in 1973 when the Directorate of Mental Health, gathered together all institutions and specialists in this field from the whole Indonesia. That occasion was the beginning/turning point in the discussion of psychiatric cases in the usage of a uniform terminology (which is based on W.H.O. classification/I.C.D. – 1965).

This classification and glossary are suplemented to this paper.

Outcome Expected

There are multifarious factors faced by health workers in remote areas. All of us realize that "data collecting" in accurate and exact manner will be the only method to standardize our problems. So, it is every doctor's duty, to expose the concrete data in their country, that the next "health planning" can be made relevant to the demand of the population in a realistic way.

In the line with such idea, the W.H.O. classification will provide its usefulness for grouping the diseases.

In spite that not all doctors in Indonesia recognize this classification, our ministry of health will be able to distribute a complete manual for them (including doctors who work in industries or companies).

Suggestion for Further Actions

Notwithstanding that this paper is based only on a unsophisticated study, the author tries to appeal to all health workers in the field of Occupational and Safety Health:

1. to stress that manpower recruited from Java, working in the periphery, should be given an intensive check both physically and psychologically to eliminate unsuitable conditions.

2. to remind that any advice, which will be given to industries or companies in rural areas, are always supported by objective data. So the psychiatric problems deriving from multifarious factors such as psycho - socio - cultural circumstances, must be always taken into their account.

3. to make use of the data collecting from remote areas, which might be very similar with other rural areas in the world.

4. to participate the use of W.H.O. Classification of Diseases (I.C.D. VIIIth revision 1965), when they discuss psychiatric cases. In that way we are always concerned to use a similar language.–

References

Djamaludin: "Hasolopan", A mental illness occurs among the Bataks in Tapanuli and the Karo lands (DJIWA IV/1 – 71).

Kusumanto Setyonegoro et al: Pedoman Diagnosa Gangguan Jiwa di Indonesia (Disgnostic Manual of Mental Disorders in Indonesia; 1973).

Prayitno & Banunaek: Kasus Reaksi Kesurupan (DJIWA I/2 – 71) (Kesurupan Reaction).

Suma'mur P.K.: Ilmu Hygieny Perusahaan dan Kesehatan Kerja (1967) (Occupational Health and Industrial Hygiene)

Tony Setiabudhi et al: Hasil Survey Kesehatan di Kalimantan Timur (1973). (Some Datas collected on Health Survey in East Kalimantan).

Tony Setiabudhi: Health Problems among D.U. Labors at Sangatta (1974).

Tony Setiabudhi: Pedoman Keselamatan Kerja untuk Seluruh Karyawan-karyawan P.T. Djasa Ubersakti (1975) (Manual for Safety Health.)

Tony Setiabudhi & Rosalina Judono: Hygiene Perusahaan dan Kesehatan Kerja bagi karyawan-karyawan P.T. Panda Raya Electric LTD (1979) (Manual on Occupational Health and Industrial Hygiene).

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A CLINICAL STUDY OF HOSPITALIZED PATIENTS WITH POSTTRAUMATIC NEUROSIS

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Introduction

The incidence of posttraumatic neuroses has been increasing following the increase of industrial accidents. This disabilities have been presenting considerable problems to the fields of law and industry as well as to that of medicine.

At present, it is generally considered that posttraumatic neuroses are not the direct result of anatomical or physiological changes produced by the trauma. But the clinical features of posttraumatic neuroses had been described in the aspect of organic etiology since nineteenth centry. For example, John E. Erichson named "the railway spine" for the syndrome of posttraumatic hysteria, hypochondriasis, and neurasthenia which were originated by the organic causes according to his opinion.

In clinical practice, various diagnostic terms, such as traumatic neurosis, posttraumatic neurosis, accident neurosis, or compensation neurosis, have been taken at one's convenience. Among the above mentioned terms, the "traumatic neurosis" was coined by Oppenheim (1889), who attributed the condition to neuronal damage of molecular nature. But this concept was changed over the two World Wars and much attention was paid to the psychological aspects as the causes of posttraumatic neurosis.

Presently, the interests to these disorders have increased in Korea, but there have been little studies about these conditions. From this viewpoint, the author studied fifty - seven inpatients diagnosed as posttraumatic neurosis with respect to their socioeconomic status and clinical features.

Materials and Methods

We have seen 57 cases posttraumatic neuroses out of 2558 cases admitted at department of neuropsychiatry of Yoido St. Mary's Hospital from January, 1975 to October, 1978. (Total cases with posttraumatic neurosis were 71, but 14 cases were excluded due to insufficient medical records.)

The medical records were reviewed in regard to the following characteristics:

Table 1. Age and sex distribution

Age \ Sex	M(%)	F(%)	Total(%)
10~19	5 (10.0)	4 (57.1)	9 (15.8)
20~29	12 (24.0)	1 (14.3)	13 (22.8)
30~39	20 (70.0)	1 (14.3)	21 (36.8)
40~49	11 (22.0)	1 (14.3)	12 (12.1)
50~59	2 (4.0)	0 (0.0)	2 (3.5)
Total	50(100.0)	7(100.0)	57(100.0)

Table 2. Socioeconomic status

Occupation	No(%)	Educational level	No(%)	Economic status	No(%)
Mineworker	23 (40.4)	Lack of schooling	5 (8.8)	Upper class	0
Semi-skilled worker	13 (22.8)	Primary school	22 (38.6)	Middle class	8 (14.0)
Seaman	6 (10.5)	Middle school	13 (22.8)	Lower class	47 (82.5)
Office man	5 (8.8)	High school	13 (22.8)	Unknown	2 (3.5)
Student	4 (7.0)	College	3 (5.3)		
Others	6 (10.5)	Unknown	1 (1.7)		
Total	57 (100)		57 (100)		57 (100)

Table 3. Causes of accident

Causes	No(%)
At working	47 (82.5)
1. Blow by heavy goods	24 (42.2)
2. Gas intoxication at inner part of mineral products	10 (17.5)
3. Fall down	5 (8.8)
4. Electric injury	2 (3.5)
5. Others	6 (10.5)
Traffic accident	9 (15.8)
Assault	1 (1.7)
Total	57 (100.0)

Table 4. Incubation period and average duration of hospitalization.

Incubation period	No(%)	Average duration of hospitalization
Below 1 week	17 (29.8)	86.4
Above 1 week, below 1 momth	15 (26.4)	98.7
Above 1 month, below 3 months	8 (14.0)	93.4
Above 3 months, below 5 months	8 (14.0)	148.3
Above 5 months, below 8 months	9 (15.8)	242.4
Total	57 (100.0)	

Table 5. Duration between injury and the admission to the department of neuropsychiatry and average duration of hospitalization.

Duration	No(%)	Average duration of hospitalization
Below 1 month	4 (7.0)	61.3
Above 1 month, below 3 months	17 (29.8)	84.8
Above 3 months, below 6 months	25 (43.9)	113.8
Above 6 months, below 1 year	8 (14.0)	221.4
Above 1 year	3 (5.3)	220.0
Total	57 (100.0)	

Table 6. Premorbid personality and average duration of hospitalization

Premrobid personality	No(%)	Average duration of hospitalization
Passive aggressive	15 (26.3)	132
Hysterical	6 (10.5)	179
Obsessive-compulsive	2 (3.5)	380
Others	3 (5.3)	68
Without personality disorder	31 (54.4)	91
Total	57 (100.0)	

Table 7. Diagnostic classification (DSM-II) and average duration of hospitalization.

Classification (DSM-II)	No(%)	Average duration of hospitalization
Depressive neurosis	18 (31.6)	110.9
Hysterical neurosis	15 (26.3)	61.6
Conversion type	13 (22.8)	66.4
Dissociative type	2 (3.5)	27
Anxiety neurosis	1 (1.7)	40
Unspecified neurosis	23 (40.4)	173.9
Total	57 (100.0)	

Table 8. The relationship between the nature of injury and duration of hospitalization

Lesion and severity	No(%)	Average duration of hospitalization
Head trauma	30 (45.5)	
1. Loss of consciousness c̄ skull fracture and/or intracranial hemorrhage	10 (15.2)	282.5
2. Transient loss of consciousness c̄ or s̄ scalp laceration	12 (18.2)	101.2
3. No loss of consciousness c̄ or s̄ scalp laceration	8 (12.1)	72.1
Back trauma	12 (18.2)	69.1
Trauma of extremity	8 (12.1)	109.2
1. c̄ Fracture	3 (4.5)	
2. s̄ Fracture	5 (7.6)	
Other areas	5 (7.6)	192
None	11 (16.7)	44.9
Total	66 (100.0)	

1) Adminission rate, sex and age distribution

2) Socioeconomic status

3) Causes of accidents

4) Incubation period, and the duration between injury and the admission to the department of neuropsychiatry

5) Premorbid personality and classification of neurosis by DSM-II

6) The relationship between the nature of injury and duration of hospitalization

7) Symptom distribution by the sites of lesion.

Results and Discussion

1) Admission rate, sex and age distribution: The admission rate in this study was 2.8%. Thompson reported that the current increase of posttraumatic neurosis was not due to the new upsurge, but the increase of understanding about this disorder. Miller reported that each year more than a million people in Great Britain are injured at work or on the roads, and he revealed that 47 case of 200 cases with head injury had psychoneurotic complaints. Many researchers have mentioned that the incidence of posttraumatic neurosis has been increasing gradually. In this study, it was revealed that the incidence rate was 2.4% in 1975, 3.0% in 1976, 3.4% in 1977, and 4.1% as of the ends of October, 1978 respectively. By Miller's report in age distribution it was revealed that the rate was 24% over 40's, 21% below this age group and no one in the class of children. The mean age in this study was 32.3 years old and it was revealed that the rate was 80.7% between twenties and forties. The rate (24.6%) over forties in this study was similar to Miller's study. What was differnet from his study was that the youngest age was 11 and there were 9 cases (15.8%) among teens mostly injured by the traffic accidents. In women, there were 4 cases (57.1%) among teens and this rate was the highest, suggesting the current situation of many late teens' girl working in industrial area. As Lee indicates, the fact that posttraumatic neurosis has its peak incidence among twenties to forties in men suggests that it is this age group that have to take independency and responsibility and they are actually under the continuing threat of accidents in industry.

2) Socioeconomic status and causes of accidents: Miller reported that unskilled or semiskilled workers acounted for 47%, and the cases from lower class were more the half. In this study, minors and semiskilled workers accounted for 40.4% and 22.8% respectively. By Miller's study, the educational background was relatively high. But according to this study, it is revealed that the educational level below middle school accounted for 70.2%. The causes of the accidents were closely associated with job and the accidents occurred at work in 82.4%. The rate of the traffic accidents was 15.8% and similar to Miller's 16%. It is now evident that posttraumatic neurosis has a close relationship with socio-economic status. The fact that posttraumatic neurosis more frequently occurs among minors in Korea is consistent with this study. It is because relatively well-guarranted legal system and personality structure are precipitating factors to induce posttraumatic neurosis.

3) Incubation period, and the duration between injury and the admission to the department of neuropsychiatry: Kolb defined incubation period as the period between the time of the injury and the appearance of neurotic disability and he commented that this period had its great significance in excluding the organic causes and in preventing the neuroses.

As to incubation period, Miller said that in the cases of neuroses mainly composed of hysterical symptoms develop after a incubation period of a few weeks to a few months and Thompson reported that the neurosis develops after a incubation period of a few months in general.

In this study 56.2% of neuropsychiatric patients should develop neurotic symptom within 3 months after trauma and mean incubation period was 51.9 days.

It was considered that incubation period was directly proportional to the average duration of hospitalization.

It can be said that as Kolb and Henderson indicated, during this period vague imagination and continuous rumination gave him more chances for profits, reimbursement, and evasion of responsibility. All these things are considered as inducing factors that made the incubation period proportional to the duration of hospitalization.

The average duration between injury and the admission to the department of neuropsychiatry was 14 months by Miller and 12 months by Auerbach. In this study it was shorter than that of U.S.A. The range of it was from 8 days to 3½ years (average 146.9 days). The cases pertaining to the duration above 3 months and below 6 months were 43.9% of total cases. 87% of total patients were admitted to neuropsychiatric department within 6 months after the accident. Average duration of hospitalization was directly proportional to the duration between injury and the admission.

Thompson reported that 92 cases of total 500 cases (18.4%) had operation after trauma and the result of this study was similar to that of Thompson with the data of 10 cases of total 57 cases. This study showed that 40.4% of total patients was directly admitted to neuropsychiatric department without consultation from other department. To be concluded, reconsideration should be urged about the nature of treatment as well as many socioeconomic aspects including reimbursement problem and doctor's fee.

Kolb insists that a repetition of physical examinations may aggravate symptoms when organic disease exists and porduce them when no disease exists. And also, he says that the physician's words and acts may have a suggestive effect upon the patients. This study revealed that the sooner neuropsychiatric treatment the shorter the average duration of hospitalization would be. From these viewpoint the management of posttraumatic neuroses requires neuropsychiatric treatment as soon as possible after trauma under the cooperation with general practitioner and doctors in the other fields.

4) Premorbid personality and classification of neurosis by DSM-II: In relation to personal predisposition, it has been stressed that posttraumatic neurosis tends to occur especially in patients with a particular type of personality. By Kolb, persons of a paranoid tendency, those who are insecure, and those who crave sympathy and attention are predisposed to posttraumatic neurosis. According to Auerbach's report, among the 50 head-trauma patients 37 persons (74%) had moderate degree of pretraumatic personality disturbance, and the latter was significantly related to severity of posttraumatic symptoms. While Miller stressed that the premorbid personality was an important predisposing factor, he idicated that there was no valid parameter of personality, and the fact that assessment of the patient prior to his accident was both subjective and retrospective. Assessment of pre-accident personality therefore presents special difficulties and little reliabilities. With these qualifications, evidence of some significant predisposing factor was found in 20 (42.6%) of 47 cases by Miller. And similarly in this study, among the 57 cases, 26 cases (45.6%) showed immature personality. Because of the frequent tendency of these patients to conceal positive evidence in their pre-accident histories this figure is more likely to be an underestimate than an overestimate. As compared with the average duration of hospitalization in the aspect of treatment, that of the cases of immature premorbid personality and social mal-adaptation was about two times longer than that of the cases of relatively well-harmonized personality induration.

Kolb described that the presenting features of this reaction might be anxiety, hypochondriasis, conversion, or mixed type. And frequently, the conversion symptoms were sufficiently prominent so that compensation neuroses were often classified among the hysterias by him. On the contrary, Peterson said that mixed neurosis was the most common form of posttraumatic neurosis, presenting as a complex of symptoms associated with anxiety, conversion symptoms, and hypochondriasis. In this study, mixed or atypical neurosis of anxiety, conversion, hypochondriacal symptoms was the highest as 40.4% of all cases, the 2nd highest was depressive neurosis (depressive type as 31.6% and hysteria as 26.3% in order). As compared with the average duration of hospitalization according to the types of nruroses, that of unspecified neurosis was the longest of all cases. Next was depressive type, and there was considerable differences in the duration between these types and hysterical or anxiety neuroses.

5) The sites of the lesion, severity of the injury and distribution of symptoms: By Kolb, the pretraumatic personality and the setting and circumstances of the accident are often more significant than the sverity of the injury in producing posttraumatic neurosis, and the probability of developing posttraumatic neurosis following a relatively slight injury is greater than if the injury is so disabling that it is obviously compensable. Miller reported that gross neurosis occured in 31% of patients without radiological evidence of skull fracture, and that the incidence of psychoneurosis in patients who were never unconscious was 42%. This study is similar to above mentioned report and there are no trauma or, if any, a slight injury in 54.6% of all cases. Comparing the severity of the injury with the average duration of hospitalization, the more severe the injury, the longer the duration. As Auerbach indicated, if the neurological signs appeared due to severe brain damage, the duration of the hospitalization prolonged and the symptoms aggravated.

So we should study further about this aspect. Headache is not only the most prominent symptom (23%) among head trauma patients, but also common in the patients without head trauma or in the patients of trauma on extremities. Auerbach insisted that the head had great psychic value, and injury to it might represent an overwhelming of the ego, and that the headache, dizziness and other symptoms originally caused by organic damage might serve a nucleus for a neurosis. In this study, headache is the commonest symptom in the cases with or without head trauma.

Miller also reported that complaints of intractable pain or other disability in the injured part were common. In general, it is now evident that the symptoms on the head sensory organs, central or peripheral neuromuscular system according to the injured part are most prominent and in addition, other psychiatric symptoms, such as insomnia, depression, memory impairment are also prominent.

Conclusion

Fifty seven impatients diagnosed as posttraumatic neurosis were studied with respect to their socioeconomic status and clinical features.

The results were as follows.

1) The admission rate of posttraumatic neurosis out of the total number of psychiatric inpatients was 2.8%, and this rate appeared to be increasing year by year.

2) The patients were predominantly male (87.7%) and in the distribution of ages, most (80.7%) of them were found to be in the 20-40 year age range.

3) The incidence of posttraumatic neurosis is related to social status. Amongst 57 cases, mineworkers and the other semi-skilled workers were 63.2%. Educational level was relatively low; the group below highschool graduation was 70.2%. Mostt (82.4%) of the patients were lower class in economic status. And most of the accidents occured during working.

4) The average (incubation period) was 51.6 days, and the cases which showed neurotic symptoms within three months after injury, were 70.2%. The longer the incubation period, the longer the average duration of hospitalization.

5) The average duration between injury and the admission to the department of neuropsychiatry was 146.9 days. Many cases (43.9%) were admitted between three months and six months after injury. Most (87%) of the patients were hospitalized at the department of neuropsychiatry within 6 months after injury. The longer this duration, the longer the average duration of hospitalization.

6) Premorbid personalities were immature in 45.6%. The average duration of hospitalization of these cases was longer than the cases without personality disorder.

7) The diagnostic classification based on DSM-II revealed that the cases of mixed type or unspecified neurosis with indiscriminable mixtures of multiple symptoms of various type of neurosis were 40.4% and the next was depressive neurosis. In the average duration of hospitalization, the above two types with predominantly somatic complaints were longer than the others.

8) In the severity of injury, the cases of minor degrees were 54.6%. But in the cases of head trauma, the more severe was the injury, the longer the average duration of hospitalization. The same was true in the cases of the traumas of various other portions and they showed longer duration than the cases without any injury. So to speak, the incidence rate of posttraumatic

neurosis was relatively higher in the cases of minor severity and there was no significant relationship between severity of injury and that of posttraumatic symptoms. But the more severe was the injury, the longer the average durations of hospitalization. Most symptoms (58.1%) were distributed appropriately to the injured parts. These were the symptoms of central and peripheral nervous system such as the ones of head, sensory organ, and neuromuscular system. Except them, the other psychiatric symptoms were 27.0%.

References

Tichener, J.L. and W.D. Ross: Acute or Chronic Stress as Determinants of Behavior, Character, and Neurosis. American Handbook of Psychiatry, 2nd ed., Vol. 3, Arieti, S., New York, Basic Books Inc., 1974, pp. 39-60.

Henderson, D. and R.D. Gillespie: A TExtbook of Psychiatry, 7th ed., London, Oxford University Press, 1955, pp. 201-204.

Oppenheim, H.: Die Traumatischen Neurosen, Berlin, Hirshwald, 1889, quoted, from 5)

Keiser, L.: The Traumatic Neurosis, Philadelphia, J.B. Lippincott Co., 1968.

Miller, H.: Accident Neurosis, Brit. Med. J., 1:919-925, 992-996, 1961.

Thompson, G.N.: Post-traumatic Psychoneurosis-A stastical survey, Amer. J. Psychiat., 121: 1043-1048, 1965.

Kolb, L.C.: Modern Clinical Psychiatry. 9th ed. Philadelphia, W.B. Saunders Co., 1977, pp. 331-334, 521-522.

Peterson, G.C.: Organic Brain Syndromes associated with Brain Trauma; Comprehensive Textbook of Psychiatry, 2nd ed., Vol. I, Freedman A.M., H.I. Kaplan, B.J. Sadock, Baltimore, Williams & Wilkins Co., 1975, pp. 1093-1108.

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Session 6.

Work and Health in Agriculture

EFFECTS OF CLIMATICAL CONDITIONS AND WORK LOAD ON THE PERIPHERAL BLOOD PICTURES

I. Blood Pictures at the Four Seasons of the Year

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Introduction

Basic health parameters such as RBC count, hemoglobin concentration, serum protein concentration, and hepatic function have been evaluated in the field of occupational and environmental health as general indicators of health, and the evaluation becomes increasingly important in recent years in relation to the validity of maximum permissible concentrations for working people or environmental standards for general population under various climatical and social conditions.

The present study was initiated to make quantitative evaluation of the climatical and occupational factors as modifiers of the basic health parameters; Part I primarily deals with the influence of the climate, especially that of the temperature, while the effects of work load will be discussed in the succeeding Part II. A preliminary report was presented in the 8th Asian Conference on Occupational Health, held in Tokyo in 1976.

Table 1. Groups and locations of the people studied.

Groups and locations			Numbers	Work types
Males				
College students		Seoul	21	None
Factory workers in plant T		Sendai	22	Electronics production
ibid.	in plant S*	Sendai	10	ibid.
ibid.	in plant I*	Iwakuni	20	Clerks in chemicals production
ibid.	in plant N	Bombay	11	Chemicals production
Females				
College students		Sapporo	23	None
ibid.		Sendai	26	None
Factory workers in plant S*		Sendai	9	Electronics production
College students		Seoul	22	None
Factory workers in plant O		Ohtsu	38	Spinning and weaving
ibid.	in plant I*	Iwakuni	25	Clerks in chemicals production

* The rooms were air-conditioned.

Materials and Methods

Surveys were carried out in 4 cities (Sapporo, Sendai, Ohtsu and Iwakuni) in Japan, Seoul, Korea, and Bombay, India, with 227 examinees (84 males and 143 females) in 11 groups as summarized in Table 1. The examinees were selected so that either their work loads were essentially constant throughout the year, or they were free from any specified work load (i.e., college students).

The annual fluctuation of the out-door temperature in the areas studied is illustrated in Fig. 1. It is evident that the temperature (and also the relative humidity) is high throughout the year in Bombay while the four seasons of the year are apparent in other areas. The temperature goes up over 26°C in summer in Iwakuni while it drops below -5°C in winter in Sapporo. The undulation of the relative humidity also parallels that of the temperature, ranging from ca. 65% in winter to ca. 80% in summer. It should be added that the humidity stays fairly constant at around 75-80% in a lake-side city of Ohtsu. To examine the effects of artificial climates, 4 groups of the people were included in the examinees who had been engaged in clerical service or electronics parts production in the air-conditioned rooms. The temperature there was maintain at 18°C to 22°C with slight changes in winter and summer.

The subjects were examined 4 times a year, once in each season. Blood samples were taken from cubital vein before the lunch time, immediately anti-coagulated with EDTA, and analyzed for the items shown in Table 2. A preliminary study revealed that determinations of haemoglobin concentration and serum protein

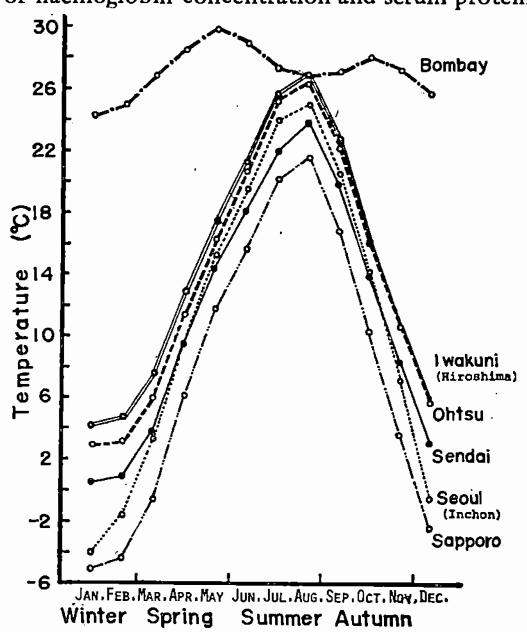

Fig. 1 Seasonal changes in monthly mean temperature in the locations.

Table 2. Items studied with blood.

Items	Method
Erythrocyte counts	Auto cell counter
Leucocyte counts	Coulter counter or Toa microcell counter
Hemoglobin concentration	Cyanmethemoglobin method
Haematocrit value	Capillary method
Serum protein concentration	Refractometry

concentration give the most accurate and reproducible data among the items studied. Accordingly, the presentation of the results and the discussion will be focussed on the hemoglobin and serum protein.

Results

Relation between the temperature and the hemoglobin concentration is shown in Fig. 2 A-G.

The hemoglobin levels in the blood of male Seoul students (Fig. 2A) marked an annual cycle being higher in winter-spring and lower in summer. The reverse relation between the hemoglobin level and the temperature could be confirmed in the factory workers in Plant T in Sendai as shown in Fig. 2B. Contrary to these findings, the hemoglobin concentrations were essentially constant throughout the year in the blood of factory workers in Bombay, where the temperature also stayed constantly high in the range of 24-30°C all the year around (Fig. 2C). The annual cycle in hemoglobin concentrations reversely related to the temperature changes was observed in female groups as well. Fig. 2 D to F summarize the cases of girl students in Sapporo, Seoul and Sendai, respectively. Although the degree of changes in hemoglobin concentrations is variable depending on the cases, the tendency of being higher in winter-spring and lower in summer-autumn is commonly observed independent

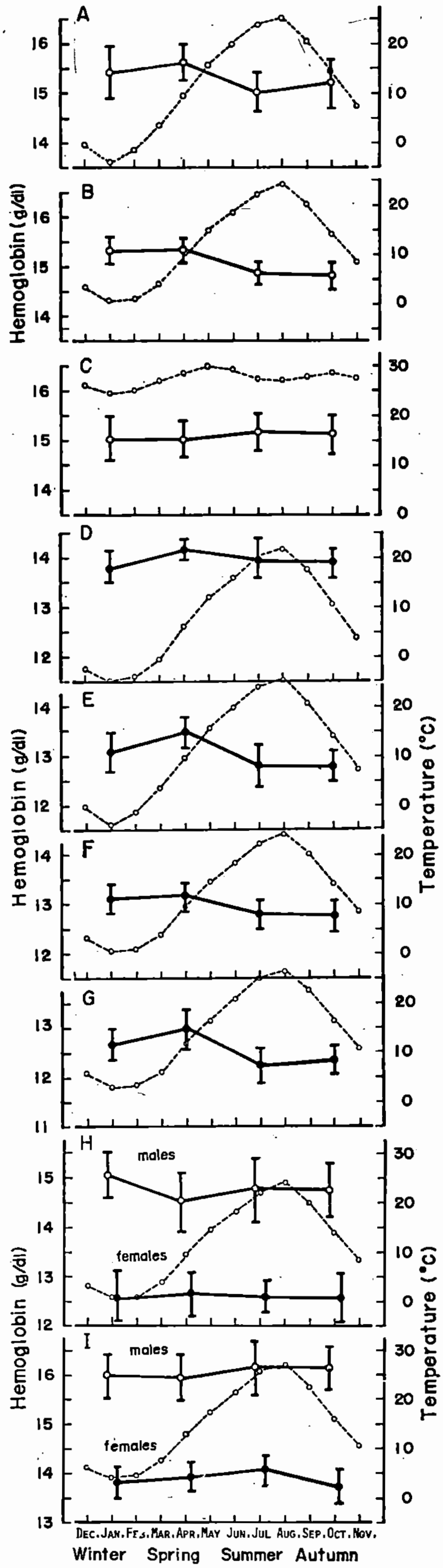

Fig. 2. Circles (open for males and solid for females) connected with solid lines indicate mean hemoglobin concentrations together with 95% confidence limits as shown by arrows. Broken lines depict annual changes in out-door temperature.

to the locations of the examinee groups. Furthermore, the same could be detected among the female weaver group in Ohtsu (Fig. 2G), where the relative humidity is rather constant (75-80%) throughout the year.

The annual cycle in hemoglobin concentrations was not observed in the examinees who had been serving in the air-conditioned rooms (Fig. 2H and I). From the studies of the factory workers in Plant S in Sendai where the rooms were air-conditioned for the production of fine electronics parts, it was found that the hemoglobin concentrations stay essentially constant in both males and females regardless of the wide variation in out-door temperature (Fig. 2H). This was also the case of clerkmen and girls in the air-conditioned Iwakuni plant office as shown in Fig. 2I. The difference in hemoglobin cententration, higher (in both sexes) in Iwakuni groups than in Sendai groups, might be attributable to better work conditions in the former.

To summarize the findings of the seasonal variation in the hemoglobin concentration, the mean hemoglobin levels in the four seasons of the year are tabulated (Table 3). It is evident as mass observation that the people, who work or study in conventional rooms under wide variation in out-door temperature, reveal higher hemoglobin concentrations in winter-spring and lower values in summer-autumn with an annual cycle dependent to the seasons of the year. Such cycle, however, will not be observed when the out-door temperature stays rather constant throughout the year as is the case in Bombay or when the rooms are air-conditioned to minimize the effects of the undulation in the out-door temperature.

The effects of the seasons of the year and further modifications by the air-conditioning, as observed in hemoglobin concentration, could also be observed in the studies of serum protein levels, even though less clearly. Typical cases are illustrated in Fig. 3. Girl stuaents in Sapporo (Fig. 3A) revealed reduced serum protein levels when the temperature went up to over 20°C in summer. In Sendai, serum protein levels of male workers in Plant T and female college

Table 3. The mean hemoglobin concentrations.

Groups and Locations		N	Seasons Spring	Summer	Autumn	Winter	Stastical significance** of the difference
Males							
Factory workers in Plant T	Sendai	22	15.32	14.85	14.81	15.32	Spr., Wint. > Summ., Aut.
ibid. in plant S	Sendai	10	14.52	14.76	14.73	15.04	Wint. > Spr.
College students	Seoul	21	15.60	15.04	15.20	15.42	Spr. > Summ. > Aut.
Factory workers in plant I	Iwakuni	20	15.96	16.14	16.15	15.99	
ibid. in Plant N	Bombay	11	15.01	15.14	15.09	15.04	
Females							
College students	Sapporo	23	14.16	13.96	13.87	13.80	Spr. > Wint., Aut.
ibid.	Sendai	26	13.12	12.76	12.75	13.08	Spr., Wint. > Summ., Aut.
Factory workers in plant S	Sendai	9	12.64	12.60	12.57	12.60	
College students	Seoul	22	13.47	12.81	12.80	13.07	Spr. > Wint., Aut., Summ.
Factory workers in plant O	Ohtsu	38	12.97	12.23	12.35	12.67	Spr. > Wint. > Summ., Spr. > Aut.
ibid. in plant I	Iwakuni	25	13.92	14.06	13.74	13.81	

* Unit; g/dl.

** The inequality signs (>) indicate that the difference in the means between the seasons is of statistical significance ($p < 0.05$) as examined with t-test.

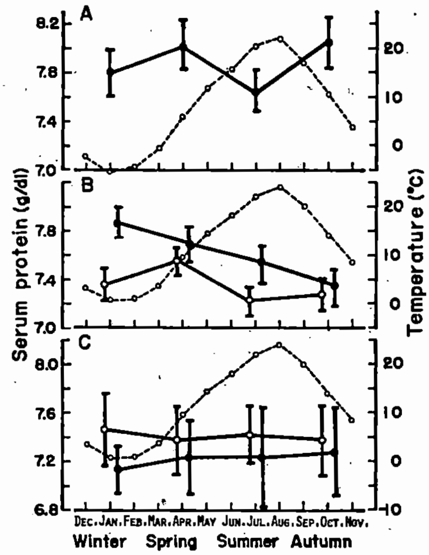

Fig. 3. Symbols are as in Fig. 2.

students were higher in winter-spring (Fig. 3B). In the case of the workers in the air-conditioned rooms in Plant S (Fig. 3E), no seasonal variation in serum protein levels could be detected in both sexes.

Discussion

The present study clearly demonstrates that the peripheral blood biochemistry such as hemoglobin concentration and serum protein concentration vary as a function of the seasons of the year. Such seasonal variation was further confirmed by the negative observation on the examinees who live where variation in the outdoor temperature is less, or who serve in air-conditioned rooms. Although the role of humidity was not studied extensively, the fact that the female weavers in Ohtsu where the humidity is rather stable throughout the year also reveal seasonal variation in hemoglobin concentration suggest that the temperature, rather than the humidity, plays the primary role. Effects of possible reduced intake of food, especially that of animal protein, is worthy of consideration. Studies are currently in progress in our laboratory through the collection of the food in the four seasons of the year for the nutritional evaluation.

Because of the limitation inherent to the field survey of the healthy working people, it was not able to examine the possible hemodilution in hot season. Indeed, the reduced hemoglobin and serum protein concentrations as observed in college students in summer-autumn could be taken as physiological rather pathological. Nevertheless, the present observation indicates that the seasonal variation should be taken into account for the evaluation of peripheral blood pictures.

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EFFECTS OF CLIMATICAL CONDITIONS AND WORK LOAD ON THE PERIPHERAL BLOOD PICTURES

II. Seasonal Variation in Agricultural Work Load and its Effects on Blood Picture of the Farmers

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Introduction

As Part II of the present communication, the effects of work load on the peripheral blood pictures will be described. Agricultural work will be taken as a model because of its wide variation in the work load depending on the seasons of the year.

Materials and Methods

Blood sampling and analytical methods used were as in Part I of this report. Examinees were composed of 6 groups (3 for each sex) of farmers of 4 types of agricultural activities (Table 1 and Fig. 1). They were examined of, in addition to the items in Table 1 in Part I of this report, hepatic function, triglyceride and cholesterol levels in serum, protein, sugar, occult bleeding and urobilinogen in urine as well as ECG (over 40 years-old only), and those with any pathological finding were excluded.

Rice production has been the most fundamental agricultural activity and extensively mechanized. The farmers are equipped with various machines such as seedling planters and rice harvesters. The work load is essentially limited in spring and autumn, and is estimated to be least among the 4 types. Only female farmers, in total, were available for the study because of reduced muscular work. Due to the shortage of rice field, many farmers are engaged in the production of other species in addition to rice. A typical case is tobacco leaf production, which starts with seeding in early spring and ends with selection of dryed leaves in late autumn. The farmers are exposed to hot climate, especially they harvest green leaves. From the view point of work load, the load can be considered as the combination of two lines in Fig. 1 (i.e., rice and tobacco) when the tobacco farmers produce rice also. To examine this type of combined activity (i.e., "rice and others"), 38 male and 27 female farmers were studied. In viticultural activities as represented by 15 male farmers, the work load is concentrated and heaviest in 1-2 months in summer when they struggle to harvest grapes in a short period of the best time. The work load of the dairy farmers is extremely heavy. Milking of cows and husbandry in the cowhouses, taking about 3-4 hours daily, should be kept going every day without any holidays or vacation, even if the farmers are ill. They are busiest in warmer season for the production of hay and silage as well as seeding and harvest of dent corn and turnip. In some cases, they produce also rice for their own consumption.

Table 1. Groups of the agricultural people studied

Groups	Locations	Numbers
Males		
Dairy farmers (●)	Sendai	28
Farmers for "rice and others" (○)	Sendai	38
Viticultural farmers (△)	Takamatsu	15
Females		
Dairy farmers (●)	Sendai	32
Farmers for "rice and others" (○)	Sendai	27
Rice farmers (▽)	Sendai	49

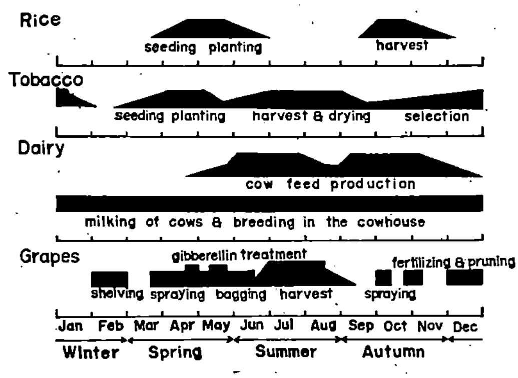

Fig. 1. Work load in various seasons of the year in the production of rice, tobacco, grapes (viticulture) and milk (dairy).

Results

While the spring values among 3 groups in each sex did not differ very much from each other, a marked decrease in hemoglobin concentration was observed in the blood of dairy farmers (both males and females) in summer-autumn season; the autumn mean was lower than the corresponding spring value by ca. 1.5 g/dl. It is possible to consider that almost half of the dairy farmers were next to anemic in autumn. No such dramatic decrease was observed in other groups. In fact, the hemoglobin concentration of the female rice farmers dropped only slightly in summer, and soon returned to the winter-spring level early in autumn. The decrease was observed in the "rice and others" group and the viticulture group during summer-autumn season, but the extent was not comparable to that of the dairy farmers.

In order to detect the difference more clearly, further calculations were made based on the observations shown in Fig. 2. Namely, the spring value was taken as the standard he-

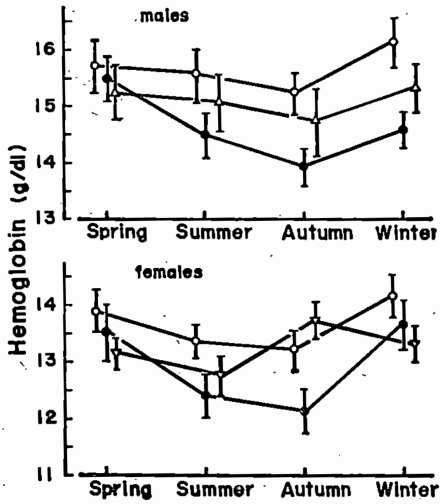

Fig. 2. Hemoglobin concentration. Open circles, salid circles and triangles are as indicated in Table 1.

moglobin concentration and the difference between the spring value and the value in other season was calculated. From the results, the group mean and 95% confidential limit was figured out as shown in Fig. 3. In males, the seasonal variation pattern of hemoglobin was essentially the same in the "rice and others" group and the viticulture group, while the decrease in hemoglobin concentration in the dairy farmers was most marked in autumn; the difference between the spring and summer values and also between the summer and autumn values are of statistical significance ($p < 0.05$). In female groups, the following two findings are worthy of noting. First, the female dairy farmer revealed marked drop in hemoglobin concentration in summer-autumn as their male counterparts. The second point is the quick recovery in hemoglobin concentration of the rice farmers after a slight decrease in summer; the autumn value was in fact higher than the spring value.

Essentially the same findings were reproduced when the serum protein concentrations in 6 agricultural groups were determined and plotted against the seasons of the year (Fig. 4). The difference between the groups were, however, less evident. The serum protein levels in the male dairy farmers did not differ significantly from the counterpart values in the "rice and others" group, although both recorded reduction in summer-autumn period. A preliminary study of nutrition revealed a relatively lower intake of total calories and protein among the viticultural farmers. This shortage might reflect on the lower serum protein level in this group (Fig. 4). The decrease in the serum protein levels in summer-autumn was observed also in the female farmers of the dairy and

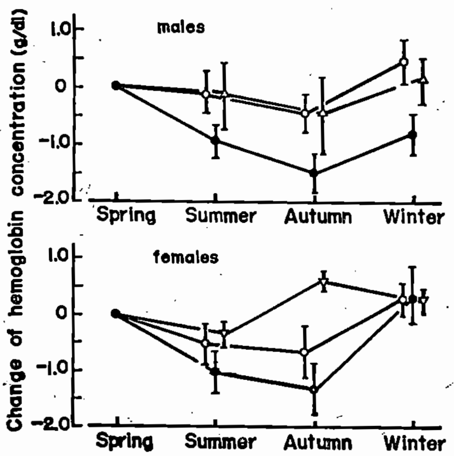

Fig. 3 Changes of hemoglobin concentration. The symbols and arrows mean as in Fig. 2. The spring value is taken as standard and the difference from the spring value is shown. Calculation in made for each individual, from which the group mean and 95% confiaential limit is figured out.

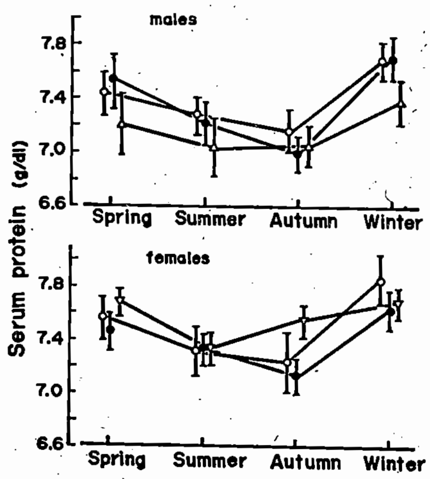

Fig. 4. Serum protein concentration. The symbols and and arrows mean as in Fig. 2.

"rice and others" groups. To the contrary, the female rice farmers had enough high serum protein in autumn-winter after a slight decrease in the hot season.

Further comparisons were made as was the case of hemoglobin concentration analysis. The serum protein level in spring was taken as the standard, and the difference from which was taken to detect any change (fig. 5). The decrease in summer-autumn season was observed in all the groups studied, but was most marked among the dairy farmers of both sexes. The recovery followed in winter to return to the spring level.

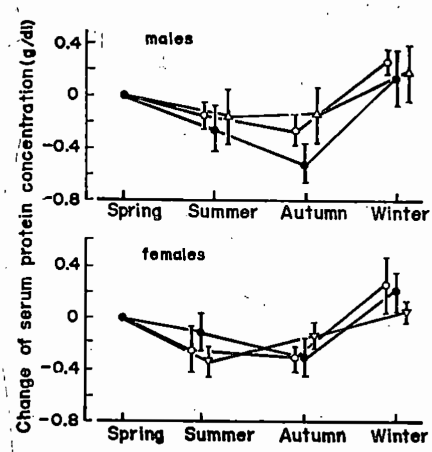

Fig. 5. Changes of serum protein concentration. The Symbols and arrows mean as in Fig. 2. Calculation in made as in Fig. 3.

Discussion

As shown in Figs. 2-5, seasonal variation in hemoglobin and serum protein concentrations are detected among 6 agricultural groups. The extent of the decrease in summer-autumn season appears to be proportional to the work load of the season. As stated in the Material and Method section, rice production has been intensively mechanized to avoid heavy work in summer, and duration of daily work has also been shortened to save enough time for sleep and recovery. In contrast, dairy work, by the nature, hardly fits for mechanization, milking and husbandry need many human hands, and cow feed growing in the mountain slopes often does not accept farm wheels. These two extreme patterns in agricultural activities, although not quantitatively evaluated, reflect on the blood chemistry findings such as hemoglobin and serum protein concentrations. It is apparent that, in addition to the climatical factors per se as discussed in Part I of this report, the blood pictures will be influenced by the work load, which is also a function of the climates in the case of agri-

Table 2. Average daily intake of food in Japan.

Time of surveys	Japan as a whole	Agricultural families	Non-agricultural families
Total calories (Cal.)			
May, 1970	2,210	2,324	2,166
Nov., 1974	2,187	2,298	2,162
Nov., 1976	2,159	2,261	2,138
Recommendation	2,132		
Protein (g)			
May, 1970	77.6	78.0	77.4
Nov., 1974	78.7	80.0	78.8
Nov., 1976	78.7	80.9	78.2
Recommendation	65		
Animal protein (g)			
May, 1970	34.2	30.3	35.7
Nov., 1974	37.9	34.6	38.8
Nov., 1976	38.1	36.4	38.4

* Values are cited from National Nutritional Survey.

culture.

From the nuturitional view points, it was well known that the agricultural people in Japan had not been comparable to their non-agricultural counterparts in 1960's. Recent survey in 1970's, however, clearly demonstrated that there exists no longer any difference between agricultural and non-agricultural families as far as intake of total calories and protein are concerned (Table 2). In fact, the former take more protein, if not animal protein, than the latter. Such improved nutritional status may result in fairly high hemoglobin and serum protein concentrations in winter-spring season. One of the questions yet to be answered is the food quality in summer-autumn when farmers are busiest in their agricultural activities. Studies are currently in progress in our laboratory to examine possible seasonal variation in the pattern and quality of food intake among the various agricultural groups.

CAUSAL FACTORS OF ANEMIA IN FARMERS AND FISHERMEN —Japan and Korea Co-operative Study—

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and Don Kyoun KIM, *Korea*

Introduction

We measured the prevalence of anemia in the following districts: K1 (a fishing village) and K2 (an agricultural village) of Northern Kojedo in Kyung Nam Korea, and J1 (a company's housing quarter), J2 (a mountainous village) and J3 (an agricultural village) of Akadani in Niigata Prefecture Japan[1)2)].

Though many causal factors of anemia were considered, we tried to investigate the relationship between the nutritional status and the occurrence of anemia in this study.

Method

We employed 13g/dl for hemoglobin(Hb) and 1.052 for whole blood specific gravity(Gb) as the criteria for the diagnosis of anemia in men, and 12g/dl and 1.050 in women[3)].

We analysed the variables shown in Table 2 as the causal factors.

In order to generate a summary index of nutritional status, an estimation of hemoglobin was made by mutliple regression analysis. We chose the following items as the parameters of nutritional status: X1 Broca's Index(BI), X2 serum total protein(TP), X3 serum total cholesterol(CH), X4 serum triglyceride(TG), X5 urinary glucose(UG), X6 age and X7 sex.

Results and Discussion

The prevalence of anemia with the means and standard deviations for Hb and Gb was shown in Table 1, which suggested that anemia was one of the health needs in both Northern Kojedo and Akadani.

The means and standard deviations, and the frequencies of the persons with abnormality for the causal factors were shown in Table 2. It was found that parasitic infections were closely related to anemia for Koreans.

The multiple correlation coefficient increased in order of K2, K1, J3, J2 and J1 (Table 3), and the order suggested that of nutritional status. The improvement of nutritional intake was also important for the prevention of anemia.

The summary index of community health status obtained by applying principal component analysis[2)] (Fig. 1) showed the validity of the multiple regression analysis which was applied to the summary estimation of nutritional status.

References

1) Tanaka, H. et al.: Practice for Defining and Solving

Table 1. Prevalences of anemia, and the means and standard deviations for hemoglobin and whole blood specific gravity

Sex	District	Number of subjects	Age	Prevalence of low Hb(%)	M±SD for Hb (g/dl)	Prevalence of low Gb(%)	M±SD for Gb
Men	K1	18	51.3±10.1	11.1	14.1±2.5	11.1	1.054±0.003
	K2	30	58.7±11.0	26.7	13.7±1.3	23.3	1.053±0.003
	J1	21	50.4±8.7	9.5	15.0±1.4	0.0	1.057±0.003
	J2	58	56.7±10.6	10.3	14.5±1.2	6.9	1.056±0.003
	J3	62	56.8±8.8	11.3	14.0±1.2	4.8	1.055±0.003
Women	K1	50	51.2±10.8	28.0	12.7±1.5	20.0	1.052±0.003
	K2	57	52.3±9.9	26.3	13.0±1.1	19.3	10.52±0.002
	J1	29	53.0±10.6	13.8	13.0±1.5	6.9	1.053±0.003
	J2	100	56.1±11.2	28.0	12.7±1.5	12.0	1.052±0.003
	J3	164	53.6±12.3	19.5	12.8±1.4	11.6	1.053±0.003

Table 2. The means and standard deviations, and the frequencies of the persons with abnormality for the causal factors of anemia.

Sex	District	Height (cm)	Broca's index	Serum total protein (g/dl)	Serum total cholesterol (mg/dl)	Serum triglyceride (mg/dl)	Urinary protein (%)	Urinary glucose (%)	Helminthic eggs in the stool (%)
Men	K1	165.6±5.7	91.5±10.2	7.41±0.57	155.3±24.3	116.6±93.9	0	5.6	61.0
	K2	161.8±6.8	95.8±9.6	7.23±0.55	152.4±33.2	106.6±106.8	16.7	0	43.3
	J1	160.5±8.1	93.0±13.3	7.35±0.41	165.3±32.7	123.0±80.5	0	0	0
	J2	157.1±6.3	96.9±9.1	7.67±0.48	174.9±43.2	98.4±84.9	3.4	1.7	1.7
	J3	156.9±5.7	100.5±11.8	7.44±0.44	173.7±30.4	96.7±78.0	8.1	0	1.6
Women	K1	153.7±5.3	90.3±8.8	7.45±0.51	155.4±36.7	68.0±28.4	4.0	0	68.0
	K2	151.7±5.4	96.8±9.7	7.46±0.43	144.2±23.3	81.5±44.2	3.5	3.5	52.6
	J1	147.7±5.4	100.7±13.9	7.41±0.40	180.3±25.0	111.5±92.5	0	0	0
	J2	146.7±7.5	100.2±13.1	7.67±0.49	180.0±35.6	91.4±52.2	1.0	0	0
	J3	147.5±6.4	104.0±12.8	7.58±0.44	174.9±33.4	94.5±42.1	7.9	0.6	3.0

Table 3. The results of multiple regression analysis

District	Standardized partial regression coefficient							Multiple correlation coefficient
	X1* (BI)	X2* (TP)	X3* (CH)	X4* (TG)	X5* (UG)	X6* (Age)	X7* (Sex)	
K1	−0.1488	0.2268	0.2027	0.0479	0.0560	−0.2523	−0.3549	0.5121
K2	0.1515	0.0831	0.2149	0.0563	−0.0691	−0.2483	−0.3102	0.4950
J1	0.3884	0.1070	−0.2762	0.0132	0.0000	−0.1659	−0.5734	0.6905
J2	0.1291	0.1909	−0.0643	0.0326	0.0013	−0.0202	−0.6208	0.6259
J3	−0.0314	0.2466	0.1194	0.0707	0.0816	−0.1090	−0.5135	0.5670

Y(Hb) = a1X1(B1) + a2X2(TP) + a3X3(CH) + a4X4(TG) + a3X3(CH) + a4X4(TG) + a5X5(UG) + a6X6(Age) + a7X7(Sex)

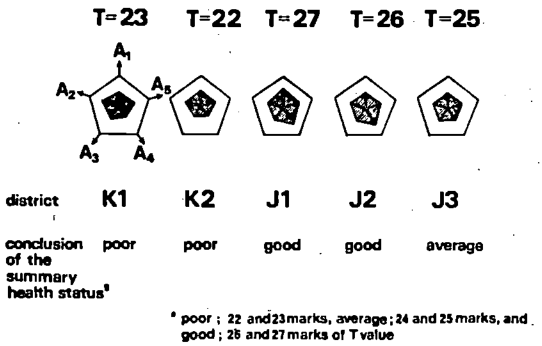

Fig. 1. A summary health status of the district by pentagon expression.

Community Health Problems, Japan and Korea Co-operative Study (Report 1), Osaka City Med. J., 23: 21-35 (1977)

2) Tanaka, H. et al.: Application of Principal Component Analysis to the Evaluation of the Community Health Status, Japan and Korea Co-operative Study (Report 2), Osaka City Med. J., 24: 143-154 (1978)

3) Tanaka, H. et al.: Public Health Activity for the Prevention of Nutritional Anaemia of Women in a Japanese Rural Population, Jap. J. Hygiene, 31: 337-346 (1976)

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DISEASES ASSOCIATED WITH RICE CULTIVATION

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From time immemorial agriculture has been the most important source of living and rice cultivation forms one of the most valuable items of food among other agricultural products in Thailand. Our rice cultivation is still practised following the old agricultural techniques of rainfed inundation and flood irrigation which involves the creation of large area of land covered with water for several months of the year. The farmer who has to work in the flooded field is liable to contract one or more diseases directly or indirectly associated with water. Most of these diseases affect a majority of the population, weakening their bodies and hindering their working capacity to the detriment of the socio-economic development of communities.

Diseases associated with rice cultivation are numerous; they range from those transmitted by vectors to those through ingestion of contaminated water or living in poor environmental conditions. The flooded field and the warm sunshine is favourable to vectors breeding and propagation as well as intense disease transmission.

1. Diseases contracted through mosquito vectors

The water on the rice field and in the irrigation and drainage channels serves as a favourable breeding source for many species of mosquito which are responsible for transmitting a large number of diseases to human beings.

Malaria

Malaria is the most important mosquito-borne disease. Malaria fever is an acute and chronic blood parasitic infection, characterized by fever, chills, headache, body ache, anaemia and splenomegaly, often with serious complication. It is caused by protozoa of the gonus Plasmodia; the species commonly found are: P. falciparum and P. vivax. The first one usually causes serious or fatal complication, while the other is of a chronic type.

The common vectors of anopheles are: A. minimus, A. balabacencis, A. maculatus and A. sundaicus.

In general dam construction is usually carried out in the jungle area where malaria is prevalent in endermic form. The labour population and also the farmers of the newly opened up area are non-immune hosts. The dam and the irrigation project connected there with may result in the increase in the number of breeding places. These are favourable to the spread of malaria infections.

Dengue Haemorrhagic Fever

Dengue haemorrhagic fever is caused by arbovirus and transmitted from person to person by Aedes aegyptis mosquito. The disease usually manifests itself as an out break or in an epidemic form in the community, and is characterized by high fever, haemorrhagic phenomenon, hepatomegaly, and circulatory failure. Most cases are found in children under 15 years of age with high incidence at pre-school age (1-4 years old).

Aedes aegypti is domestic mosquito and usually breeds in and around houses in various kinds of water containers.

Japanese B. encephalitis

Japanese B. encephalitis is a viral infection caused by Group B arbovirus, characterized clinically by fever associated with central nervous system involvement resulting in paralysis, coma and death. The infection has various clinical manifestations ranging from mild febrile with or without meningo-encephalitis symptoms to fulminating febrile with severe encephalitis.

The disease is transmitted by Culex gelidus and Culex tritaeniorhynchus mosquitoes which breed readily in paddy fields and similar types of water beds. Swine, bird and horse and animal reservoirs. The mortality rate is rather high, being 30% or more.

Filariasis

Filariasis in Southeast Asia is caused by Wuchereria bancrofti. The infection may be relating to the lymphatic system including inflammatory lesions with fever, obstruction and dilatation of lymphatic channels with hypertrophy and hyperplasia and lastly fibrosis and elephantiasis.

The parent worms produce offsprings known as microfilariae which appear in the peripheral blood usually during night time, being ready for transmission by mosquitoes. Many species of Anopheles, Culex, Manania and Ades mosquitoes, are vectors which are related to the irrigation system and flooded fields.

2. Diseases contracted through contact with contaminated water or soil

The water in the rice field and the wet soil on its banks and irrigation channels can act as receptacles for parasites. The infective lava waits for the opportunity to penetrate through the skin of the victim that gets in contact with water or soil.

Schistosomiasis

There are two types of Schistosomiasis in Southeast Asia.

a. Schistosomiasis japonica in the Philippines and Indonesia, the snail vector being Onchomelania quadrasi (Philippines) and O. hupenis lindoesis (Indonesia).

b. Mekong schistosomiasis in Laos and Thailand, the vector snail being Lithoglyphopsis aperta.

The disease is characterized by chronic-abdominal disturbances and dysenteric symptoms with fever and terminating with cirrhosis of liver, splenomegaly and ascitis. The worms are in the mesenteric vessels of the small and large intestines. The eggs come with feces and hatch in the water as miracidia, then penetrate into the snails. It develops into cercaria swimming in the water ready to infect man by penetration through the skin. The flooded field with warm sunshine is favourable for the snails and also for the cercaria.

Hook worm Disease

Hook worm or Ancylostomiasis is one of the most common helminth infections among the bare foot workers in the wet or flooded soils.

The worms are localized in the small intestine resulting in chronic blood and protein loss from the host. The common symptoms are fatigue, weakness, dyspnea, pallor, epigastric fullness. In heavy infection with long duration, the patient becomes markedly anaemic with mental and physical retardation. In moist climate and soil with improper disposal of human excreta containing worm eggs, the larvae are ready to infect human host through the skin.

3. Diseases contracted through ingestion of contaminated water of food

The water on the rice field can act as a reservoir for the diseases and parasites. This take place directly by drinking contaminated water or indirectly by eating food, vegetables, that have been cultivated, washed or in contact with such water. The gastrointestinal diseases are the most common one.

Amoebiasis

Amoebiasis is an infection of Entamoeba histolytica being localized in the large intestine resulting in frequent bloody and mucous stools, abdominal pain and tenesmus. The contaminated water and raw vegetables are the main sources of infection.

Cholera

Cholera is an acute infectious epidemic disease caused by Vibrio cholerae, characterized by profuse diarrhea of a colourless waterly material resulting in dehydration, muscular cramps, acidosis and shock. The infection spreads rapidly by drinking water, contaminated food in the poor environmental sanitation and personal hygiene.

Shigellosis

Shigellosis or Bacillary dysentery is an acute gastro-entero-colitis caused by Shigella and is characterized clinically by fever, diarrhea with bloody stools, abdominal pain and tenesmus, vomiting and dehydration. The contaminated water, vegetable and food are the sources of transmission.

Typhoid and Paratyphoid

Typhoid and paratyphoid or enteric fever is caused by Salmonella group and is characterized by high fever, coated tongue, mouth dry, uncomfortable anorexia, pains in the limbs and body and insomnia. The infected urine and feces from the carrier contaminate in the water, vegetables, and food are the common epidemic sources of the disease.

4. Nutritional Disorder

Malnutrition is one of the most common problems among the farmers because of their lack of nutritional knowledge, old traditional concepts, beliefs, increasing number of children in the family and also the poor economic status and environmental health.

The common occurrance is malnutrition anemia which is caused by iron defficiency, protein and caloric malnutrition usually occur in children of preschool ages which is the cause of growth retardation. Vit. A, B, B_2 deficiencies are also common which causes the eye and skin lesions, beriberi, angular stomatitis which can be found among the children in the farmer's family.

Protective measures for disease prevention and control in the rice fields.

1) Measures against the spread of mosquito-borne diseases

a. Attach direct to the mosquito and larvae

The situation in rice field presents certain disadvantages in the application of measures that in other circumstances have proved their efficiency.

The chemical application is costly and also the rice plant obstructs the proper and uniform distribution of the larvicide. The plant may suffer from the chemical which is effective against the larvae and has to be used in sufficient dosage for a long period of time. Residual insecticide spraying of houses also has problems technically, operationally and financially. Public non-responsiveness and also the different habits of the mosquitoes are the problems to be solved. The protection by screens, bednets, repellents also had some dis-advantages of the kind of the house and sort of life of farmer that are not suitable. The use of natural enemies such as fish usually needs other supplemental methods. The isolation of the houses by locating them beyond the flight range of the vector is also impossible. Prophylactic and therapeutic treatments are difficult to maintain; but may be the most convenient method of aid to suit the required purposes.

b. Land and water management

About fifty years ago agronomists in the USA and USSR proved that rice cultivation by intermittent irrigation was not only feasible but also advantageous, as the yield of certain rice varieties increased without lowering the quality of the crops. Since then, health authorities have advocated the change of the techniques of cultivation from constant flooding to cyclical irrigation and draining periods as an effective means of controlling mosquitoborne diseases.

The intermittent irrigation was performed in Portugal from 1935 to 1939, in the cycle of 10 days water inundation and 7 days drainage; Madras, India in 1940 to 1941 in the water cycle of 4½ days and 2½ days drainage; Toyama, Japan in 1950 in the water cycle of 3 days and 1 day drainage. The successful results with increasing yields of the crop were achieved.

Intermittent irrigation to be effective for mosquito control, must be based on the observation of mosquito and soil characteristics and environmental conditions as well as irrigation and drainage facilities. Thus the inundation period of the cycle should be shorter than the time of the mosquito deposed egg to develop into a flying adult; this time varies with mosquito species, food, climatic conditions, etc.

For the benefit of health and productive improvement of rice growers this techniques might be adopted as a trial by all rice producing countries.

2) Measures against the spread of other water associated disease

a. Attack on the intermediate hosts

The life cycle of the parasites can be interrupted by an attack on their intermediate host such as snail, fish, crabs, etc.

Snail is the difficult one to be controlled because the dry interval periods of irrigation would have to be much longer and the snail can live outside the water. Chemical application by using molluscacides is difficult and expensive. Natural enemies sometimes give the remarkable reduction, such as in Puerto Rico, USA, where rival snail is used to complete for food and servival with the snail host, and gradually to replace the infective snail.

b. Environmental sanitation

Excreta disposal — the excreta is the most serious wide-spread of the parasites and gastro-intestinal diseases and is also the most difficult to confine in such a way that it would prevent the contamination with water and soil. The use of "night soil" human and animal excreta, as fertilizer is still a common practice in the fields in Asia.

Water supply — it is rather a dream in practice to provide clean water for the farmers to drink and utilize. To collect rain water from the roof of the house into the jars or tanks as drinking water is the common practice of the farmers.

Basic sanitation and health habit such as, walking barefoot on the wet soil, defaecating on the ground or in the bush, washing hands before taking food, etc. have to be educated as preventive measures and repeat continually.

There are two points for improving the health and productive capacity of rice farmers and these are:

1. Changing the rice cultivation from flood irrigation to intermittent irrigation that supplies the required amount of water and permits a proper drainage to dry the land from time to time.
2. Introducing the extension and improvement of basic health and habit, sanitation, services and water supply, proper means of excreta disposal and efficient vector control.

References

Water Resources Development in Thailand — Royal Irrigation Department — Thailand

ICID 2nd Regional Afro-Asian Conference-Additional Technical Papers

Water-related Diseases in the Lower Makong Basin — School of Tropical Disease Thailand

Yearly report of 1977 of the Royal Irrigation Department — Thailand

Pijit L. SONTHORN: Royal Irrigation Hospital Samsen, Bangkok, Thailand.

HEALTH OF WOMEN ENGAGED IN AQUICULTURE OF OYSTERS AND SEA WEEDS

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Introduction

Women in the primary industry such as agriculture as well as aquiculture are very important as workhands; especially if the industry is of small scale and organized as the family trade, women contribute it to an almost equivalent extent to men. On the same time, many of them are housewives and some are rearing children. Consequently, they constitute themselves a target population for the occupational health care program in the community.

Aquiculture of oysters, *Ostrea gigas* and sea weeds of the genus *Porphyra* is popular for the main subsistence in area facing the Bay of Matsushima, Miyagi Prefecture, Japan. The family is a unit in carrying aquicultural activities, among which the position of women is like that mentioned above. They shell oysters or collect sea weeds. A health care program for women was settled up in 1974 as a joint activity of regional institutions concerned (Co-operative of Fishery, Town Government, Health Center etc.). Thus, their health could be analysed in a biomedical and social context.

Methodology

Interview Survey on Living, Work and Health

At attendance to the annual medical examination, the women were interviewed by public health nurses from the health center covering the area or the town government for their familiar structure of household, allocation of time in a day as well as the kind of work for each season of full-activity (autumn and winter) and of leisure (spring and summer) of aquiculture, and the health complaints.

Medical Examination

A physical examination, a cardiac evaluation, analysis of venous blood specimen (hemoglobin content) and body weight measurement were completed for each attendant. Examinations were conducted usually in summer.

Health Education

After every occasion of medical examination, a physician and public health nurses visited the women in order to explain the result of examinations and to consult an appropriate medical care or an amendment of their daily living for betterment of health.

Findings

Seasonal Change of Work and Living in Relation to Age and Status in Family

Work of women was regulated by the seasonal change of aquicultural activities (Table 1). In the fullactivity season, over 60% of them worked for aquiculture, and in the leisure season, some shifted from aquiculture to agriculture or employment in retailor's shop, restaurant or hotel. Allocation of time in a day was regulated by season, age and status in family (Fig. 1 & Table 2). The longest work and the shortest sleep were observed in wives of younger generation in an extended family.

Table 1. Work of women according to the season related to aquicultural activities

Kind of work	Leisure	Full activity
A. Agricultural work	44 (21.0%)	133 (63.6)
1. Sea weeds	3	57
2. Oysters	29	46
3. Sea weeds & oysters	1	21
4. Sea weeds, oysters & others	4	4
5. Others	7	5
B. Agricultural work	38 (18.2)	13 (6.2)
C. Employed in shops, restaurants and hotels	31 (14.8)	11 (5.2)

Numerals in the table are numbers and percentages in parenthesis.

Table 2. Allocation of time in a day according to season and status in family

Status in family	No.	Work-hour		Sleep-hour		Other	
		L.	F.	L.	F.	L.	F.
Wife in a nuclear family	63	4.8	8.5	7.5	7.2	11.7	8.2
Wife of younger generation in an extended family	100	5.2	8.9	7.4	7.1	11.3	8.0
Wife of elder generation in an extended family	45	2.9	6.0	7.9	7.6	13.2	10.5
F-statistics		P<0.05	P<0.001	P<0.05	P<0.05	ns	P<0.05

L : leisure season; F: full-activity season (1975)

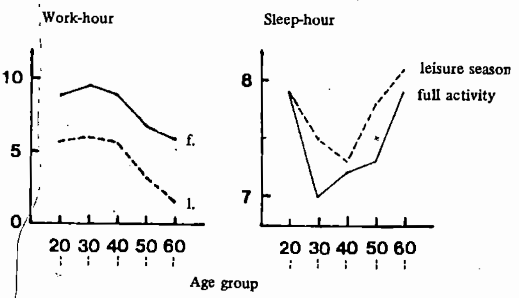

Fig. 1. Work- and sleep-hour of women by age-groups and season in 1975.

Health Complaints and Related Factors

Among various health complaints claimed, those with high frequencies as over 30% in the entire population were "general ill feeling," "fatigability of eyes," "stiff shoulders" and "numb feeling in hand fingers." Age-related pattern of prevalences was distinct for some complaints (Fig. 2), i.e., the increase with age was for "general ill feeling," "fatigability of eyes," "disabled walk," "disabled vision" and "disabled hearing," and the peak frequency in middle age groups, which worked more harder than other age-groups, was for "stiff shoulder" and "numb feeling in hand fingers."

Age was an index of not only biological but also social nature, since a strong association was found between it and the status in family. Thus, the variables presumably related to the prevalence of health complaints were examined for each age-group by multi-regression analysis. The variables selected were hemoglobin content, Rohrer index, systolic blood pressure, subsistence of household, residential area, woman's status in family, time-lengths of sleep or work in leisure season and full-activity season, dietary intake of rice, soya soup and salted pickles. As expected, different combinations of variables with significance were found in different age-groups. For instance, the complaint, "general ill feeling" was inversely associated with the work-hour in the full-activity season and positively with both the dietary intake of rice, soya soup and salted pickles and the systolic blood pressure only in an age-group of 30s, that means the women of this age-group with hypertension had the ill-feeling, could not work longer and liked to eat salty meals. The number of complaints was inversely associated with the dietary intake of rice, soya soup and salted pickles and the systolic blood pressure in an age-group of 40s, and positively with the specialization of household activities into only aquiculture and the condition of being wife of younger generation in an extended family in an age-group of 50s; the former suggests a biomedical mechanism, i.e., the women with hypotension had a greater number

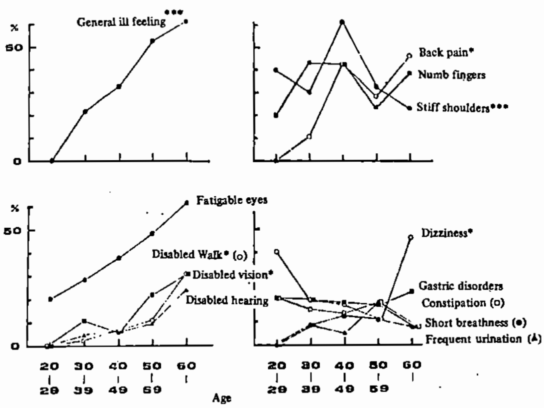

Fig. 2. Prevalence of health complaints as a function of age in 1975.

Table 3. Pattern of persistence of the complaint : Ill feeling on general physical condition.

		+ + +	+ − − + + −	− + + − − +	− − −	Others	Total (%)	X^2-statistics
Age	20~39	0	11(28.2)	1(2.6)	21(53.8)	6(15.4)	39(100.0)	
	40~49	0(12.1)	16(24.2)	9(13.6)	23(34.8)	10(15.2)	66(100.0)	P<0.05
	50~	6(11.3)	12(22.6)	7(13.2)	11(20.8)	17(32.1)	53(100.0)	
Status in family	Wife in a nuclear family	8(15.7)	9(17.6)	7(13.7)	17(33.3)	10(19.6)	51(100.0)	
	Wife of younger generation in an extended family	3(3.8)	25(31.6)	7(8.9)	32(40.5)	12(15.2)	79(100.0)	P<0.05
	Wife of elder generation in an extended family	3(10.7)	5(17.9)	3(10.7)	6(21.4)	11(39.3)	28(100.0)	

The pattern is shown by using the mark; + or −, where + and − means respectively positive and negative ill feeling at a specific occasion among three interviews (from the left to the right, it is 1974, 1975, 1976).

of complaints, and the latter does a socio-psychological problem of the women who stayed as the wife of younger generation despite of her age over 50 years. Likewise, some specific complaints were associated rather with physical conditions in certain age-groups, e.g., "low back pain" in age 40s had a positive with hemoglobin level and a negative association with Rohrer index; and other some were associated with demographic characteristics of women.

Changing Prevalences of Some Health Complaints During a 3-year Period

Three kinds of health complaints; "general ill feeling," "gastric disorders" and "numb feeling of hand fingers," showed a significant decrease in the prevalence, and the patternized persistence of "general ill feeling" differed by the age-group and the status in family (Table 3). In other words, wives of younger generation in an extended family and of age 20-39 had become to complain to a less extent in 1976 than the previous years. This might be resulted from the change in women's work and living; comparing their living in 1974 with that in 1976, the significant changes were as follows, (1) elongation of sleep-hour in full-activity season, especially in an age-group of 30s, and (2) the decrease in number of persons who were routinely using some medicaments.

Change in Health Levels from the Results of Medical Examination

If the decreased prevalence of the health complaints was resulted from the behavioral change of women as was suggested in the previous section, the improvement of the objective health conditions should have simultaneously occurred. For the total number of 189 women who had twice attended at the medical examination in 1974 and 1976, body weight, hemoglobin level and systolic blood pressure were compared between the two examinations according to the age-group. No significant difference was found for body weight in any age-groups. The same was for hemoglobin levels, but a significant reduction in the level of systolic blood pressure was noted. The distribution pattern of systolic blood pressure had clearly shifted to a lowered level in 1976 (Fig. 3), but that of hemoglobin level showed a deflection toward an increase only in the level below 11 g/dl (Fig. 4). This change in distribution pattern suggests the decrease in number of women with low hemoglobin levels below 10 g/dl. Certainly, the difference in hemoglobin levels between 1974 and 1976 was dependent upon the level in 1974; the low level in 1974 was associated with a positive difference (Fig. 5).

Levels

Again, correlation and multiregression analyses were applied in order to find out the significant combination of variables, in which some new ones like locality of birth, number of illness experienced, number of attendance to the health education meeting, use of medica-

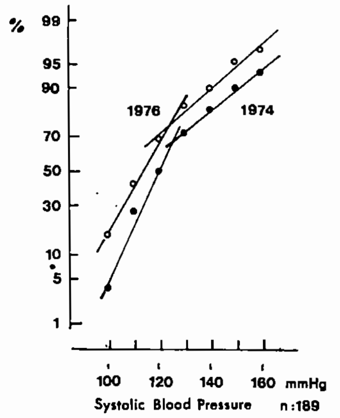

Fig. 3.

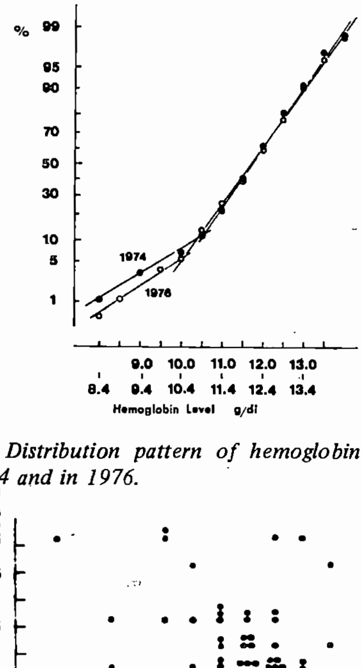

Fig. 4. Distribution pattern of hemoglobin levels in 1974 and in 1976.

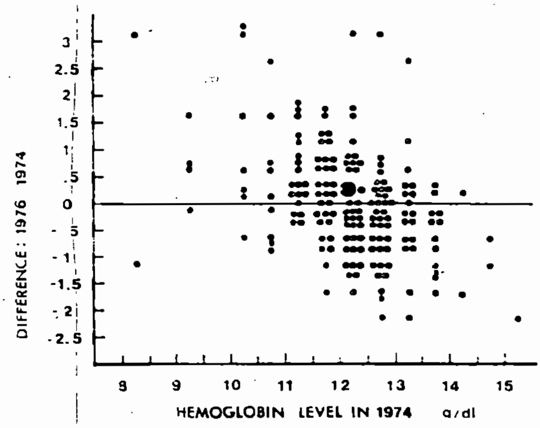

Fig. 5. Change of hemoglobin level by the level in 1974.

ments and clinical medical care by physicians, were included in addition to the variables used already for analysis of health complaints.

In the correlation analysis, a significant variable for difference of hemoglobin levels was the number of attendance to the health education meeting only the women with hemoglobin levels below 12 g/dl in 1974 (No significant variables were found in the entire women).

The multiregression analysis revealed significant positive association of Rohrer index and use of medicaments and negative one of "general ill feeling," and in the women with hemoglobin level below 12 g/dl in 1974, the difference of hemoglobin levels was associated positively with the sleep-hour in the full-activity season in 1976 and negatively with that in 1974.

Discussion

Interacting Characters of Health and Work

The most prominent impression through this analysis is laid on interacting characters of health and work. The women who work harder have not many health complaints, have normal blood pressures and have more preferable health behaviors, in a general sense, and by working harder, their health conditions are going to be affected, e.g., "numb feeling of hand fingers" is very usuall after shelling of oysters for over several hours in a day and this complaint remains still in the leisure season at 20-40% of prevalence in women of over all age-groups.

Impact of Health Care Program

The working women form a suborganization within the Matsushima Cooperative of Fishery, and this took an initiative for organizing the health care program for them. Thus, their participation to the program was so perfect already in th scratch that they had eagerly attended at the medical examination and health education. The behavioral change, noted as the elongated sleep-hour in the full-activity season in 1976, should have been resulted from the acceptance of health care activities, with which the reduction of levels of systolic blood pressure was accompanied. Diminishing rates of prevalence of the complaint, "general ill feeling" were also notified in an age-group of 20-39 and in the wives of younger generation in extended family. As already mentioned, these women were the most heavily loaded by work; thus the change of the allocation of time in a day in the full-activity season seemed to be feasible enough to induce changes in their health.

Nevertheless, the improvement of hemoglobin level happened to occur quite differently from that of the health complaint and the systolic blood pressure. Only the women with hemoglobin levels below 12 g/dl in 1974 showed the improvement, and the anemic women who had attended more frequently at the health education increased more their hemoglobin levels. Thus, an impact of the health care program was obvious through two different channels; one was rather general as influencing blood pressure of over-all women, and the another was more specific for the anemic women.

Concluding Remarks

The on-going analysis on women's health has been described in biomedical and social context in recognition of the importance of comprehensive understanding of health. In the analysis, capacity for work, health complaints and some physical conditions were selected as "phenotypic" expression of health, and the configuration of health thus obtained was tightly coupled with, and had fluctuated by, the seasonal, or annual change of living conditions. The health care program, a newly introduced environmental factor, had modulated the configuration of health on both individual and group levels. At present, the long-term effect due to such a short-term (3-year) program can not be assessed. We can not afford any rational basis to assess the long-term effect from the present analysis. However, the configuration of health which is created by and sustained with a specific ecological setting would be very vulnerable by the change of ecological setting. During and just after the health care program, women might have health-oriented attitude, but they may be very easy to turn toward money-oriented attitude. Then, the apparently the same living condition may undergo the change of the meaning after the attitude change of man. Thus, our further work is necessarily to investigate the underlying mechanism of behavioral change already happened to occur in these women.

Acknowledgement

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References

Suzuki, T., Hatano, K., Takemoto, T., et al.: Seasonality of Allocation of Time in a Day on Women Engaged in Aquiculture in the Bay of Matsushima in Relation to Their Familiar Status, Japan. J. Public Health, 26, 147-153, 1979 (In Japanese).

Suzuki, T., Hatano, K., Takemoto, T., et al: Health Complaints of Women Engaged in Aquiculture in the Bay of Matsushima, Japan. J. Public Health, 26, 425-432, 1979 (In Japanese).

Suzuki, T., Hatano, K., Takemoto, T., et al.: Persistence of Health Complaints in Women Engaged in Aquiculture in the Bay of Matsushima, Japan. J. Public Health (In Press) (In Japanese).

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Session 7.

Occupational Toxicology

OCCUPATIONAL EXPOSURES TO CARBON MONOXIDE IN TOKYO FIREFIGHTERS

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Firefighters are exposed to various toxic products of combustion during the practical performance of their duties. Carbon monoxide (CO) may be the most ubiquitous agent of those products in the fire atmosphere, and has been shown to have deleterious effects on the cardiovascular system and/or the central nervous system. Because of the several variables involved in CO uptake during actual firefighting situations, the degree of exposure to CO from smoke inhalation in firefighters is, unfortunately, less well known.

Using measurements of CO concentrations in expired air as an indication of the level of exposure experienced by each individual firefighter, we investigated the amount of occupational exposure to CO and examined the effect of various parameters, such as sorts of component materials of burning buildings the length of the career, the role of the function, the duration of exposure time, and the cigarette smoking habit, on the level of exposure.

Methods

Subjects — One hundred and sixty-four firefighters of the Tokyo Fire Defense Board volunteered to participate in this study. There were 117 smokers and 47 nonsmokers. The subjects were all male and had a mean age of 30.1 (S.D. 9.1) in smokers and 31.8 (S.D. 9.1) in nonsmokers. The program had been explained to the subjects previously. The length of careers and the role in their function as well as the duration of exposure time were noted.

Measurements of breath CO concentrations.— The occupational exposure to CO was investigated by measuring the CO concentration in the expired breath after the fire fighting and in the ordinary time. To collect the breath samples, the subjects were instructed to hold their breath for 20 seconds, then discard the first few hundred milliliters of their expired breath and collect the last portion in a thick polyethylene bag which had been confirmed to show no significant CO losses for a period shorter than 48 hours. The breath samples were analyzed by the nondispersive infrared analyzer. The estimated carboxyhemoglobin (COHb) levels were calculated by the following equation of A. Ringold (1):

COHb % = 0.5 + (expired CO in ppm) x 0.2

Protocols.— The major fires selected from fires occurring in the city of Tokyo were studied during a year from December, 1977 to November, 1978. The major fire meant the fire that had a burning floor area of 300m^2 and above in case of wooden or mortar constructions and of over 50 m^2 in case of reinforced concrete buildings. From each subject the expired air sample was collected just after his return to the station from the fire spot, that is the collecting was done approximately 30 to 60 minutes later from the end of the firefighting. The another sample was also taken from the same subject in the ordinary day, before when he had not been dispatched to the fire spot at least for last four days.

Results

Results in smokers and nonsmokers were analyzed separately because of the great difference in baseline expired CO levels related to smoking habits.

The degree of CO exposure in firefighters were shown in Fig. 1, 2 and 3. Mean values of expired CO concentrations after the firefighting were 15.5ppm in nonsmokers and 26.0 ppm in smokers (estimated COHb levels were approximately 3.5%. and 5.7% respectively), whereas in ordinary time breath CO values in nonsmokers and smokers averaged 4.8ppm and 16.5ppm respectively (estimated COHb levels were 1.5% and 3.8%) (Fig. 1). In both nonsmokers and smokers, there was a significant increase in expired CO levels after the exposure to the fire atomosphere ($p<0.001$). In Fig. 2 and 3, data were displayed in cumulative frequency distributions for visual comparison. Maximum values of breath CO concentrations were 58.0ppm (12.1% COHb) in nonsmoking group and 57.2ppm (11.9 COHb) in smoking

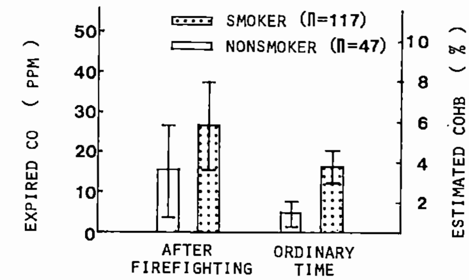

Fig. 1. Mean values of expired CO concentrations after the firefighting in comparison with those in ordinary time. The vertical lines indicate one standard deviation.

group. After the firefighting, one-tenth of our samples had COHb levels above 6.7% in non-smokers and 8.7% in smokers.

Sorts of burning materials influenced the degree of CO exposure in firefighters, which was shown in Fig. 4. In the nonsmoking group, mean breath CO values were 22.0ppm (range 5.2ppm to 58.0ppm, n=16) in case of the fire of reinforced concrete buildings, 11.3ppm (3.5ppm to 23.8ppm, n=15) in case of mortared constructions and 11.6ppm (6.0ppm to 26.4 ppm, n=16) in case of wooden houses. And in the smoking group, those were 27.5ppm (6.5ppm to 51.4ppm, n=46), 28.4ppm (7.2ppm to 57.2ppm, n=36) and 21.4ppm (7.0ppm to 38.9ppm, n=35). There was a significant difference between the case of reinforced buildings and that of wooden structures ($p<0.05$).

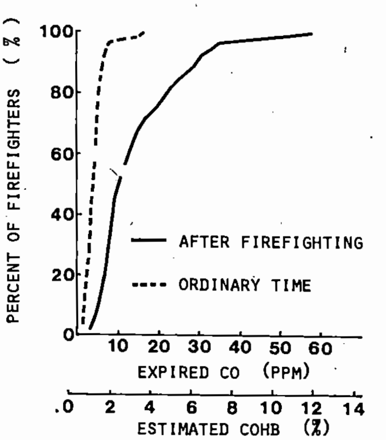

Fig. 2. Cumulative frequency distribution of expired CO concentrations in nonsmoking firefighters.

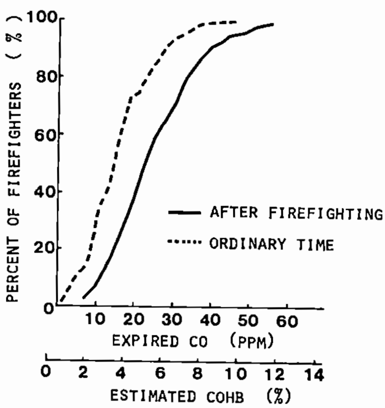

Fig. 3. Cumulative frequency distribution of expired CO concentrations in smoking firefighters.

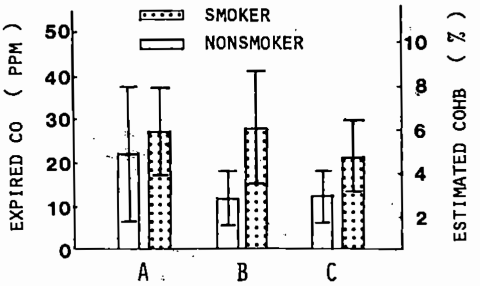

Fig. 4. Alteration of the degree of CO exposure according to sorts of burning materials. A, B and C represent in case of reinforced concrete, mortared and wooden structures, respectively.

According to the role in the function, subjects who practically fought the fire were divided into three groups: the leader of the small squad, the ordinary firefighter, and the van who discharged their functions nearest to the fire. Twelve subjects, all of whom had smoking habits, were classified the van group, and their mean expired CO values showed 34.2ppm after the firefighting, whereas the value of leaders and ordinary firemen in the smoking group were 27.6ppm and 24.0ppm, respectively. There was a significant difference between the van and the both of the leader and the ordinary fighter in the degree of exposure to CO. However, there was no significant difference in the measurement value between the leader and the ordinary fighter in both nonsmokers and smokers.

There were no significant correlation between the degree of CO exposure and the duration of exposure time, and also between the expired CO in ppm and the length of career.

Discussion

We had investigated an occupational exposure to CO in firefighters by measuring the expired breath CO concentrations after their return to the station from the fire spot as well as on an ordinary working day.

The data presented in this study indicated that during the performance of their duties at the fire, Tokyo firefighters were exposed to levels of CO which significantly raised the level of their blood COHb. It had been demonstrated that any increase in COHb and the resultant decrease in blood oxygen carrying capacity had caused a compensatory increase in cardiac output and a diversion of blood to those organs most sensitive to oxygen lack (2). Four percent nonsmoking firefighters and 14% smoking firefighters had estimated COHb levels of above about 8%, which level was considered to be high enough to increase the oxygen debt incurred during exercise (3), to impair the cerebral function (4), to affect visual threshold (5) and to impose a burden on the cardiovascular system (6). Based on several literatures with emphasis on the effects of CO on the cardiovascular systems, COHb saturations of 15-17% had produced vascular changes resembling atherosclerosis and/or ultrastructural changes of the myocardium in experimental animals (7, 8).

Considering that the real attainment of COHb levels during their duties would be higher than the measurement value that represented the value after the return to the station, and that increased oxygen demand of various tissue during the firefighting because of the high energy consumption aggravated the effect of a given COHb level, it could be implied that for a significant proportion of firefighters the COHb level would reached to the harmful level for their health.

Although it appeared difficult for firefighters to accurately predict the degree of exposure they were receiving at any given fire because of the variables involved in CO uptake, it could be pointed out that the degree of CO exposure would alter according to the sort of burning materials, and tended to be severer in the case of reinforced concrete or mortared buildings than in the case of wooden ones, and it was also observed that the COHb levels had an inclination to be higher in the van than in the leader and ordinary fighter, and that the smoking group had higher mean COHb levels than the nonsmoking group. It seemed to explain one reason for the higher degree of CO exposure at the fire of reinforced concrete structures which included prefabricated houses was that inner components of those buildings invariably consisted entirely of synthetic materials so called plastics which produced a large amount of toxic gases under fire conditions.

It could be considered that the exposure to CO at the fire would indicate the possible exposure to other noxious gases or airborn contaminants in the fire atmosphere.

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References

1. Ringold, A., J.R. Goldsmith, H.L. Helwig, R. Finn and F. Schuette: Estimating recent carbon monoxide exposure. Arch. Environ. Hlth. 5: 308-318, 1962.
2. Paulson, O.B., H. Parving, J. Olesen and E. Skinhoj: Influence of carbon monoxide and of hemodilution on a cerebral blood flow and blood gases in man. J. Appl. Physiol. 35: 111-116, 1973.
3. Chevalier, R. B., R. A. Krumholz and J.D. Ross: Reaction of nonsmokers to carbon monoxide inhalation. J.A.M.A., 198: 135-138, 1966.
4. Beard, R.R. and N. Grandstaff: Carbon monoxide exposure and cerebral function. Ann. NY Acad. Sci. 174:385-395, 1970.
5. McFarland, R.A.: The effects of exposure to small quantities of carbon monoxide on vision. Ann. NY Acad. Sci. 174: 301-312, 1970.
6. Ayres, S.M., S. Giannelli, Jr. and H. Mueller: Myocardial and systemic responses to carboxyhemoglobin. Ann. NY Acad. Sci. 174: 268-293, 1970.
7. Thomsen, H.K. and K. Kjeldsen: Aortic intimal injury in rabbits. Arch. Enviro. Hlth. 30: 604-607, 1975.
8. Kjeldsen, K., H.K. Thomsen and P. Astrup: Effect of carbon monoxide on myocardium – Ultrastructual changes in rabbits after moderate, chronic exposure. Circ. Res. XXXIV: 339-348, 1974.

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CLINICAL APPLICATIONS OF THE HYPERBARIC OXYGEN THERAPY IN THE MANAGEMENT OF ACUTE CARBON MONOXIDE POISONING

Dork Ro YUN, *Korea*

I. Introduction

Carbon monoxide poisoning is one of the most serious public health problems in Korea. According to author's recent survey on the incidence of carbon monoxide poisoning, the scale of health hazards is threating one, unfortunately. Among 30 millions of people who use the coal briquette as a domestic fuel for heating and for cooking, almost one million are suffering from noxious gases of coal briquette, especially from carbon monoxide. More than 85 percent of the intoxicated by carbon monoxide are mild cases with those symptoms as headache, emesis and chest pain, but around 15 percent of the intoxicated are semi-comatous or comatous. This fatal cases have been estimated around three to four thousands annually.

In Korea, we are installing very unique underfloor heating system called as 'ONDOL.' The coal briquette gas passes through the horizontal flues below the mad-plastered stone floor covered by oil paper and exhausts out through the chimney located in the opposite site of the fire place. The regurgitations of the exhausted gas take place by weather conditions, poor chimney and broken flues, and leak into the room through the door or broken floor pad. However, the anthracite coal is the largest underground energy source in Korea, and the cost of it is very reasonable in consideration of our economy.

Initially, author studied this serious health problems in the point of view of preventive medicine since 1963. The extensive status surveys brought us such a disappointing conclusion that carbon monoxide poisoning in Korea is involving many complicated socio-economic variables. So many socio-economic and cultural factors are acting as an unshaken impediment on the way to final solution of this preventable accident.

Author's second approach to this problem of seeking more effective therapeutic measures seems to be out of the realm of preventive medicine. But, general indifference of the clinicians to this social malady pushed us to the territory of the clinical practice by opening the Hyperbaric Chamber Unit (one man, clinical type) in Seoul National University Hospital at 19th Jan., 1969. It has been more than 10 years since our initiation of the Hyperbaric Chamber Unit in Korea.

Now, there are 112 hospitals operating Hyperbaric Chamber Unit in Korea. There are 33 general hospitals with Hyperbaric Châmber Unit in Seoul City. Author made a survey on carbon monoxide poisoning of 4 general hospitals in Seoul for the comparison of recovery rate by year. The epidemiological data and clinical findings were obtained from Seoul National University Hospital.

II. Findings

1. Hyperbaric Chamber

a. The distribution of hospitals operating Hyperbaric Chamber Unit is illustrated in Fig. 1. The hospitals operating chamber unit are concentrated in urban area like Seoul or Busan. Two cities occupy almost half of the total units.

b. The Hyperbaric Chamber Unit operating in Korea is in Fig. 2. These all chambers have been built by Korean mechanics.

2. Recovery Rate

4 general hospitals, actively operating Hyperbaric Chamber Unit in Seoul City were chosen and recovery rates were observed from 1975 to 1978, full 4 years.

In S-hospital, we observed the recovery rate is a bit getting well by year. In N-hospital, average is much higher than S-hospital recording 99.2 percent recovery rate. In R-hospital, recovery rate is getting better and reach the best in 1977, marking 99.5 percent. In C-hospital, average is very high in 1977 and 1978. There is no failure in the management of carbon monoxide poisoning by Hyperbaric Oxygen Therapy. Total average recovery rate approaches almost 99 percent and this result is almost equivalent to Dr. Smith's report from Glasgow, Scotland. Early discovery of the patient and prompt delivery to Hyperbaric Unit promise

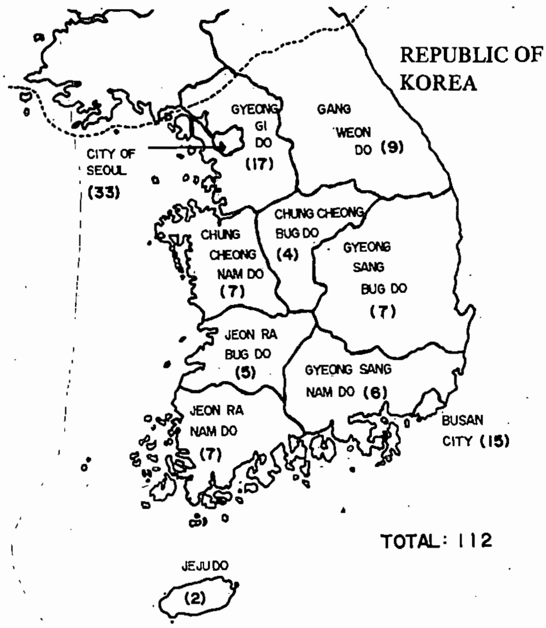

Fig. 1. The Distribution of the Hospitals Operating Hyperbaric Chamber Unit in Korea. (1979, present)

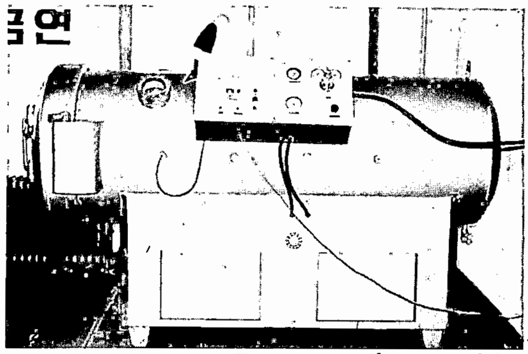

Fig. 2. Hyperbaric Chamber Unit (one man, clinical type, designed by Yun, D.R., 1969).

Table 1. Recovery rate of carbon monoxide poisoning patients by hyperbaric oxygen therapy by hospitals from 1975 to 1978

	1975	1976	1977	1978	Total
S-Hospital					
No. of cases	194	202	148	63	607
No. of expired	5	6	2	1	14
Recovery rate(%)	97.4	97.0	98.6	98.4	97.7
N-Hospital					
No. of cases	312	357	193	158	1,020
No. of expired	2	1	4	1	8
Recovery rate(%)	99.4	99.7	97.9	99.4	99.2
R-Hospital					
No. of cases	74	134	107	60	375
No. of expired	3	2	1	1	7
Recovery rate(%)	95.9	98.5	99.1	98.3	98.1
C-Hospital					
No. of cases	65	325	207	385	982
No. of expired	1	5	0	0	6
Recovery rate(%)	98.5	98.5	100	100	99.4
Total					
No. of cases	645	1,018	655	666	2,984
No. of expired	11	14	7	3	35
Recovery rate(%)	98.3	98.6	98.9	99.5	98.8

Table 2. Number of patients by month and year

Month \ Year, No. & %	1969		1970		1971		1972		1973		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Jan.	33	14.2	24	11.9	14	6.9	34	11.1	41	11.2	146	11.2
Feb.	23	9.9	14	6.9	0	0	21	6.9	28	7.7	86	6.6
Mar.	25	10.7	6	3.0	21	10.4	30	9.8	28	7.7	110	8.4
Apr.	21	9.0	8	4.0	13	6.4	21	6.9	38	10.4	101	7.7
May	21	9.0	10	5.0	12	5.9	12	3.9	20	5.5	75	5.7
June	12	5.2	9	4.5	11	5.4	14	4.6	15	4.1	61	4.7
July	6	2.6	8	4.0	5	2.5	11	3.6	6	1.6	36	2.8
Aug.	0	0	5	2.5	9	4.5	11	3.6	5	1.4	30	2.3
Sept.	17	7.3	4	2.0	5	2.5	25	8.2	33	9.0	84	6.4
Oct.	17	7.3	24	11.9	21	10.4	33	10.8	38	10.8	133	10.4
Nov.	31	13.3	41	20.4	40	19.8	29	9.5	52	14.1	193	14.8
Dec.	27	11.6	48	23.9	51	25.2	65	21.2	61	16.7	252	19.2
Total	233		201		202		306		365		1,307	

Table 3. Age and sex distribution of carbon monoxide poisoning cases treated by Hyperbaric Oxygen Therapy (from 1969 to 1973, Seoul National University Hospital)

Age \ Sex, No. & %	Male		Female		Total		Population, Seoul (1970, Oct. 1), % to Total
	No.	%	No.	%	No.	%	
0–4	2	0.3	3	0.4	5	0.4	12.35
5–9	12	2.1	16	2.2	28	2.1	11.49
10–14	16	2.8	21	2.9	37	2.8	12.12
15–19	85	14.8	138	18.7	223	17.1	12.27
20–24	112	19.5	147	21.0	259	19.8	10.94
25–29	105	18.3	105	14.3	210	16.1	9.77
30–34	71	12.4	39	5.3	110	8.4	8.49
35–39	36	6.3	43	5.9	79	6.0	6.28
40–44	21	3.7	30	4.1	51	3.9	4.57
45–49	16	2.8	21	2.9	37	2.8	3.70
50–54	22	3.8	31	4.2	53	4.1	2.70
55–59	21	3.7	27	3.7	48	3.7	2.06
60–64	16	2.8	42	5.7	58	4.4	1.46
65–69	16	2.8	24	3.3	40	3.1	0.85
70–74	10	1.7	22	3.0	32	2.4	0.53
75–79	6	1.0	12	1.6	18	1.4	0.27
80–84	2	0.3	5	0.7	7	0.5	0.12
85+	0	0	3	0.4	3	0.2	0.04
Unknown	4	0.7	5	0.7	9	0.8	
Total	573	100.0	734	100.0	1,307	100.0	100.0

almost 100 percent recovery. Many complications and long admission were found in ineffective management of patient.

3. Epidemiological Characteristics (from Seoul Nat'l Univ. Hospital data)

a. Seasonal variations

We can observe that the peak time of carbon monoxide poisoning is from September to May, but we still have some patients in summer time, especially from cooking accident (Table 2).

b. Age distribution

Peak age groups are from 15 years to 30 years. These age groups mainly composed of working population from rural area. Their living conditions are not satisfactory in the view-point of sanitation (Table 3).

c. Arrival time to unit and admission rate

The arrival time is very good index in determining the clinical prognosis. The earlier arrival time, the better prognosis is (Table 4).

d. Complications

Acute decubitus is most frequent complication, especially in young, fatty female. Many clinicians make diagnose this complication as burns. Without adequate management the mental sequellae, appear a month later, are serious medical problems (Table 5).

Table 4. Admission rate by arriving time

Arriving time	No. of Cases	No. of Admission	Rate of Admission
–4:00	32	3	9.4%
4:00–6:00	61	5	8.2%
6:00–8:00	115	17	14.8%
8:00–10:00	202	24	26.7%
10:00–12:00	118	52	44.1%
12:00–14:00	40	23	57.5%
14:00–16:00	36	15	41.7%
16:00–	67	15	22.4%
Total	671	184	27.4%

Table 5. Complications of admitted cases

Complications	No. of Cases	%	% to Total
Pulmonary edema and aspiration pneumonia	29	34.1	15.8
Trophic changes such as decubitus, burns and myositis etc.	31	36.5	16.9
Neurological disorders	20	23.5	10.9
Psychological disorders	5	5.9	2.7
Total	85	100.0	

III. Discussion and Summary

I have discussed on carbon monoxide poisoning as one of the most serious health hazards in Korea. The extent of the national suffering is far more than the general public understandings. The therapeutic effectiveness of Hyperbaric Oxygen Therapy in carbon monoxide poisoning is remarkable, but it couldn't be the best and final resolution for this problem. This is the second line defense. But in this moment, as I mentioned in the introduction, we have no choice. To choose the best measure we still have long way to go. As long as we use anthracite briquette coal as our most prevalent domestic fuel, we are living with awful risk all the time.

The development of Hyperbaric Oxygen Therapy in Korea may seem curious to all audience, because this unit is still regarded as one of the item of very expensive medical luxury. We resolved expensive cost by local supply. In number, not in capacity, Korea seems to be the next to United States. I hope we can apply the Hyperbaric Oxygen Therapy in other clinical entities of diseases in near future.

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CHRONIC CARBON DISULFIDE POISONING
— Its Effective Health and Environmental Control in the Viscose Rayon Industry —

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Carbon disulfide (CS_2) is a typical industrial toxic chemical, and the most important substance inevitable to use in the production of viscose rayon fibres. The long story of Japanese viscose rayon industries over 60 years tells us the valuable experiences concerning how to protect the workers from CS_2 poisoning by means of technical and administrative measures, and health surveillance programs. At present, the acute or subacute types of CS_2 intoxication found at the initial period of viscose rayon industry apparently became undetectable by several countermeasures taken for these years, but chronic type of the intoxication has come up with prolongation of CS_2 exposure duration occurred as the result of shortage of labor force after high economical growth period during 1960's. Thus, present major interest in research work on CS_2 poisoning focusses on angiopathy due to long-term exposure to CS_2 of relatively low level with intermittent high exposure.

Our recent epidemiological studies on Japanese CS_2 workers revealed that early clinical signs of chronic CS_2 poisoning were retinal microangiopathy characterized by capillary microaneurysms and small dot hemorrhages, and renal microangiopathy. In the Congress, I shall briefly present the clinical picture of CS_2 retinopathy, and report the health and environmental control measures of chronic CS_2 poisoning, which had or have been done in Japan, paying attention to development of CS_2 retinopathy.

Retinopathy in chronic CS_2 poisoning

The ophthalmologic appearance of CS_2 retinopathy includes microaneurysms, small dot hemorrhages and exudates. Such ophthalmoscopic abnormalities are very similar to those seen in the early stages of diabetic retinopathy, corresponded to stage Ia, II and IIIa of Scott's classification.

Microaneurysms and hemorrhages are more common than exudates in CS_2 retinopathy. They are seen as small red dots in both direct ophthalmoscopy and color fundus photography. At the earliest stage of CS_2 retinopathy, isolated microaneurysms are common. In later advanced stages the microaneurysms increase in number and are usually accompanied by hemorrhages or exudates. Venous dilation, proliferative changes such as intraretinal or preretinal new vessel formation, or fibrous retinitis proliferance usually seen in diabetic retinopathy have never been observed in CS_2 workers.

I present here some typical fluorescein angiographs and color fundus photographs showing CS_2 retinopathy:

Figure A and B: A is a fluorescein angiograph of the left eye of a worker having an exposure history of 18 years in only the dissolving department. Several microaneurysms can be seen around the posterior pole. Neither hemorrhages nor exudates can be seen. B is his color photography of the same eye. Figure C and D: C is a fluorescein angiograph of the right eye of a worker having an exposure history of 18 years in the desulfurization and spinning departments. Many microaneurysms can be seen around the outer part of the macula. D is the corresponding color photograph. Figure E and F: E is a fluorescein angiograph of the right eye of a worker having an exposure history of 20 years confined to the desulfurization department. Numerous microaneurysms can be seen around the posterior pole. The appearance seems to be very similar to that of an early stage of diabetic retinopathy. F' is his color photograph.

The dose-response relationship between such retinal changes and CS_2 exposure were confirmed by several epidemiological studies, using direct ophthalmoscopy, color fundus photography and fluorescein angiography. According to recent epidemiologic results obtained from ophthalmologic examination on 400 CS_2 and 390 control workers of a rayon filament plant, the prevalence of retinopathy was highly correlated with the index of exposure dosages, which was calculated from individual exposure history, job-time studies and past CS_2 concentrations at the exposure sites since commencement of viscose rayon production.

Health and environmental control of chronic CS_2 poisoning

On both occupational health of workers and control of exposure in Japanese viscose rayon industries, the Research Committee for Occupational Health of the Japanese Chemical Fibre Association, founded in 1938, has played an important role. It was noteworthy that the Committee was composed of personnel of administrative, medical and technical sections in each industry.

The first protocol for periodic medical examinations for the prevention of CS_2 poisoning was made in 1953 by the Committee, based on intensive investigations on the health status of workers and CS_2 exposure conditions of all Japanese rayon factories.

Since 1965, we performed several epidemiologic studies on workers exposed to CS_2, which were mostly sponsored by the Japan Chemical Fibre Association.

The discovery of retinopathy in chronic CS_2 exposure had a great impact on occupational health practices in the viscose rayon industry in the following points: 1) the Research Committee of the Japan Chemical Fibre Association revised the protocol for the periodic medical examinations in 1973, 2) the Ministry of Labor completely revised the recognition criteria of CS_2 poisoning in the Workmen's Compensation Insurance Act in 1975, in compliance with recommendations by the Research Committee, and 3) the Japanese Industrial Health Association adopted 10 ppm as the TLV for CS_2 in 1975.

Main technical measures for the prevention of CS_2 poisoning which had been done in Japanese viscose rayon factories for these 50 years include: 1) introduction of vacuum kneader in place of dry churn, 2) improvement of general (dilution) ventilation of the workroom, 3) enclosure and local exhaust ventilation of the technological processes, 4) installation of glass screens on the spinning machines, 5) improvement of slivers and cake processing, and 6) recovering of CS_2.

These technical measures, especially installation of special screens on the spinning machines was most effective for lowering the concentrations of CS_2 in the spinning room. However, recent periodic ophthalmologic examinations on the workers have clearly shown that CS_2 retinopathy develops even under the present CS_2 exposure level about 10-15 ppm of 8-hours TWA. This means that additional control measures of exposure are required for the protection of workers from evolution of CS_2 retinopathy. In this respect, new technologic developments such as the SINI viscose process, the auto-doffing process, and the continuous spinning process make it possible to reduce the total exposure dosage of the workers.

In addition to these control methods, administrative measures such as improvement of shift work system are effective for shortening of exposure time. In Japanese viscose rayon industries 3 shifts by 4 groups system was taken instead of day and night shift or 3 shifts by 3 groups systems. In future, the rotation of workers periodically to CS_2-free workplace should be introduced, when considering other chronic effects of CS_2 on the cardiovascular system.

Geographical differences of CS_2 angiopathy

A puzzling feature of chronic CS_2 poisoning is the apparent variation in the clinical pictures of CS_2 angiopathy among different countries. Both clinical case studies and epidemiological studies have shown that CS_2 angiopathy in European countries is manifested as atherosclerotic diseases of the cerebral and coronary vessels. In Japan, on the other hand, CS_2 exposure results in microvascular, non-atherosclerotic diseases of the retina and the kidney. The well-controlled comparative studies of Finland and Japan clearly demonstrated that retinopathy attributable to long-term CS_2 exposure did not occur in Finnish workers.

However, recent epidemiological studies in East Germany showed that an increased prevalence of retinopathy related to duration of exposure was found in German CS_2 workers. For determining whether such geographical differences in retinopathy are of genetic or environmental origin or both, it is necessary to accumulate much informations on the prevalences in many countries. According to a recent communication, it is delightful that the National Institute of Occupational Safety and Health of the United States has started ophthalmologic examinations to detect CS_2 retinopathy since last February. It is desirable that such ophthalmologic investigations are carried out in the viscose rayon industries of Asian countries in near future.

References

Goto, S. and Hotta, R. (1967) The medical and hygienic prevention of carbon disulfide. Toxicology of carbon disulfide. Excerpta Medica Foundation, Amsterdam.

Goto, S., Hotta, R. and Sugimoto, K. (1971) Studies on chronic CS_2 poisoning. Int. Arch. Arbeitsmed., 28: 115-126.

Goto, S. et al. (1972) Retinal microaneurysm in carbon disulfide workers in Yugoslavia. Pracov. Lek., 24: 66-70.

Sugimoto, K., Goto, S. and Hotta, R. (1976) An epidemiological study on retinopathy due to carbon disulfide. Int. Arch. Occup. Environ. Hlth., 37: 1-8.

Sugimoto, K., Goto, S. and Hotta, R. (1976) Studies on chronic carbon disulfide poisoning. A 5-year follow-up study. ibid., 37: 233-248.

Sugimoto, K. et al. (1977) Ocular fundus photography of workers exposed to CS_2. A comparative epidemiological study between Japan and Finland. ibid., 37: 97-101.

Sugimoto, K. et al. (1978) Studies on angiopathy due to carbon disulfide. Retinopathy and index of exposure dosages. Scand. J. Work Environ. Hlth., 4: 151-158.

Sugimoto, K. and Goto, S. (1979) Retinopathy in chronic carbon disulfide poisoning. Neurotoxicity of the visual system. Raven Press, New York (in press).

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AN ELECTROPHYSIOLOGICAL STUDY ON THE RELATIONSHIPS BETWEEN (ω-1) OXIDATION OF STRAIGHT-CHAIN HYDROCARBONS (C: 5-7) AND PERIPHERAL NEUROPATHY IN RATS

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Introduction

It is known that both n-hexane and methyl n-butyl ketone (MBK or 2-hexanone) are neurotoxic (Inoue et al., 1970; Allen et al., 1975). A recent study (Divincenzo et al., 1976) has revealed that these two chemical toxic substances have a common metabolite, 2,5-hexanedoione (acetonyl acetone), as an end-product. 2,5-hexanedione has been considered responsible for the development of peripheral neuropathy in man and animals exposed to n-hexane and MBK (Divincenzo et al., 1976; Spencer and Schaumburg, 1975).

In our laboratory, an electrophysiological study on the peripheral neurotoxicity of n-hexane, MBK, 2,5-hexanedione (Misumi et al., 1979) and their structural analogues, considered to be possibly formed by the (ω-1) oxidation of pentane and heptane (Divincenzo et al., 1976; Scala, 1976), has been carried out.

The purpose of the present study is to find a hint to elucidate the relationships between the (ω-1) oxidation of aliphatic hydrocarbon and the peripheral neurotoxicity of the agents with a chemical structure similar to 2,5-

hexanedione (2,5-Hdione) and MBK, i.e., 2,5-hexanediol (2,5-Hdiol), 2-pentanone, 2,4-pentanedione (2,4-Pdione) and 2-heptanone.

Materials and Methods

Forty-seven Donryu strain rats weighing 200-300 g were used for this study. The seven chemical substances used were all more than 99 V% pure and their chemical contents are given in Table 1. Each substance was injected subcutaneously, five days a week, for a period of from 61 to 148 days. The daily injected dose per kg of body weight, which was adopted to be roughly as much as one third or one fourth of the LD_{50} of the respective chemicals, ranged from 200 to 400 mg, as shown in Table 2, along with the total accumulated dose injected during the experiments. Conduction velocity, amplitude of the nerve and muscle action potentials (NAPs and MAPs) and residual latency were used as a parameter for estimating the effects on the tail nerve of rats. The electrophysiological method for estimating the peripheral nerve function has been described in detail in our previous report (Misumi, 1979). Values of the experimental groups were compared with those of the controls at the respective corresponding stages.

Table 1. Treated chemical substances

n-Hexane	$CH_3(CH_2)_4CH_3$
MBK	$CH_3CO(CH_2)_3CH_3$
2,5-Hexanedione	$CH_3CO(CH_2)_2COCH_3$
2,5-Hexanediol	$CH_3COH(CH_2)_2COHCH_3$
2-Pentanone	$CH_3CO(CH_2)_2CH_3$
2,4-Pentanedione	$CH_3COCH_2COCH_3$
2-Heptanone	$CH_3CO(CH_2)_4CH_3$

Results

Clinical features: The n-hexane group showed only dullness of movement throughout the experiments. In the MBK group, dullness in locomotion and stiffness in gait were first observed. Four out of seven rats showed salivation around the second or third month of the experiment. In this group, inhibition of normal growth was moderately observed. In the 2,5-Hdione group, dullness of movement was first observed, followed by a marked flaccid paralysis of the hind limbs which developed from the second week, and most of the animals showed paralysis of the hind limbs from the third week. In this

Table 2. Results of electrophysiological findings

Chemicals	Dose mg/day	Dose Total (g)	Duration of Treatment (day)	Weight loss or inhibit. of growth	Electrophysiological findings MCV (m/s)	SCV (m/s) whole	SCV (m/s) prox.	SCV (m/s) dist.	Amplitude NAP (μv) prox.	Amplitude NAP (μv) dist.	Amplitude MAP(mv) prox.	R.L.
n-Hexane (n=7)	325	10.5	148	±	–	–	–	–	–	↓	–	–
MBK (n=7)	415	11.6	148	+	++	+	+	++	–	↓	↓	↑
2,5-Hexanedione (n=7)	400	2.3	61	++	++	++	++	++	↓↓	↓↓	↓?	↑
2,5-Hexanediol (n=6)	400 (200)	5.5	107	++	++	++	+	++	↓	↓	↓	↑↑
2-Petanone (n=8)	400	6.0	61	–	+?	+?	++?	±?	–	↘	↓?	↓?
2,4-Pentanedione (n=6)	200 (300)	4.1	107	+	–	–	–	+	↓	↓	↓	–
2-Heptanone (n=5)	400 (200)	7.8	107	–	–	–	–	–	–	–	–	–

Note: ↘: slightly, ↓ or ↑: moderately, ↓↓ or ↑↑ : markedly, –: no significantly, ±: $0.1<p<0.5$, +: $p<0.05$, ++: $p<0.02$ by t-test in comparison with the controls.

group, weight loss was also observed from the first week of treatment, continuing to the end of the experiment, but none of the animals died till the end of the experiment. The 2,5-Hdiol group showed almost the same clinical features as observed in the 2,5-Hdione one. But the time of appearance of paralysis in the hind limbs in the former group was fairly delayed in comparison with that of the latter. The 2-pentanone group exhibited only excitablity and at the later stages of the experiment, salivation in four out of 8 animals was temporarily observed. In the 2,4-Pdione group, salivation on the 15th day of treatment was observed in five out of 6 animals, and on the 45th day, four animals showed stiffness or disturbances in gait. Thereafter, all of the animals fell into spastic paralysis of the hind limbs. The 2-pentanone group remained normal throughout the experiments.

Electrophysiological findings: Table 2 summarizes the results of the present electrophysiological studies.

MBK, 2,5-Hdione and 2,5-Hdiol groups showed a marked retardation of the conduction velocity in both motor and sensory fibers of the tail nerve, and a decrease in amplitudes of both NAPs and MAPs. In these groups, it was also found that a prolongation of residual latency develops. In the 2,4-Pdione group, a retardation in the sensory fiber conduction velocity (SCV) was observed only in the distal part of the tail nerve at the later stage of the experiment. A decrease in amplitudes of NAPs and MAPs was also observed. In the 2-pentanone group, a retardation in the SCVs in the whole and proximal parts of the tail nerves was observed only on the 18th day of the experiment, but not observed in the days following even though treatments with the chemicals were continued to the end of the experiments. The 2-pentanone group showed no change in electrophysiological measurements in comparison with the controls throughout the experiments.

Relationships between the amount of dosage and time of appearance of appreciable electrophysiological findings: In order to estimate the potency in peripheral neurotoxicity among the chemical substances, a study of the relationships between the amount of dosage and the time of appearance of appreciable electrophysiological findings was carried out using the data obtained from three series of experiments.

As shown in Table 3, in the 2,5-Hdione group, appreciable changes in the electrophysiological findings began to develop in the first measurement when 1.4 g of the agent was injected over 18 days. On the other hand, in the 2,5-Hdiol group the changes had begun to develop when 4.0 g of the agent was injected over 69 days and the second measurement was taken. No electrophysiological change was

Table 3. Relationships between total accumulated dose(g) and electrophysiological findings

Chemicals	Body weight(g)	Daily dose(mg/Kg)	Time of electrophysiological measurement 18	32	36	46	51	60	72	80	105	142 days
n-Hexane	300	325			3.4 (–)					6.5 (–)		10.5 (±)
MBK	300	415			4.0 (–)					7.5 (+)		11.6 (+)
2,5-Hdione	280-290	400	1.4 (+)	2.3 (+)		2.3 (+)		2.3 (+)				
2,5-Hdiol	190-200	200(400)		1.1 (–)					4.0 (+)		5.5 (+)	
2-Pentanone	280-290	400	1.6 (±)?	3.0 (–)		4.5 (–)		6.0 (–)				
2,4-Pdione	190-200	200(300)		1.2 (–)			1.7 (–)		2.7 (–)		4.1 (+)	
2-Heptanone	190-200	400(200)		1.3 (–)					4.5 (–)		7.8 (–)	

Note: (+): Existence of neurotoxicity, (±): Doubted. Numerals in the upper respective lines represent the total accumulated dosage (g) injected up to the respective stages of the experiment.

observed at the first measurement when 1.1 g of the chemicals had been given. In the MBK group, when 4.0 g of the agent was injected, no change was observed, while 7.5 g of the agent caused a marked change in the electrophysiological findings. The n-hexane group showed only a decrease in amplitude of the NAPs in the distal part of the tail nerve, when 10.5 g of the agent was given to the animals. The 2,4-Pdione group showed a retardation in the SCVs of the distal part and a decrease in amplitudes of the NAPs and MAPs of the tail when 4.1 g of the agent was given.

From the results mentioned above, it appears that the peripheral neurotoxicity of 2,5-Hdione, which has six carbon atoms, was the strongest among the four chemical agents tested in the present experiments, while 2,5-Hdiol was second. Obviously, the third one was MBK and the neurotoxicity of n-hexane was mild in the present experiments. It appears that 2,4-Pdione, which has five carbon atoms and two ketones at the 2 and 4 positions of the carbons, produces peripheral neuropathy of a different type from that of 2,5-Hdione.

Discussion

Divincenzo et al., (1976) have suggested that presumably MBK metabolites, such as 5-hydroxy 2-hexanone, 2-hexanol and 2,5-Hdiol, may also produce peripheral neuropathy since they are all converted *in vivo* to neurotoxin, 2,5-Hdione. Oxidation at the 2 and/or (ω-1) positions of aliphatic hydrocarbon is considered to be related to the development of peripheral neuropathy (Scala, 1976).

In this study, in order to reveal the structure-activity relationships in the chemical agents produced definitely or possibly by the oxidation of hydrocarbon, the peripheral neurotoxicity of MBK, 2,5-Hdione, 2,5-Hdiol, 2-pentanone, 2,4-Pdione and 2-heptanone were studied in rats. It was ascertained that 2,5-Hdiol was neurotoxic as well as MBK and 2,5-Hdione. It appeared that the order of potency among the four chemicals with six carbons was 2,5-Hdion, 2,5-Hdiol, MBK and n-hexane in that order. This may indicate that the metabolic pathway of MBK is converted from 2-hexanol to 2,5-Hdione *via* 2,5-Hdiol and 5-hydroxy 2-hexanone.

Miyagaki (1967), Schaumburg and Spencer (1976) have reported that n-hexane produces peripheral neuropathy in experimental animals. However, in this study, definite evidence for n-hexane to produce neuropathy could not be detected although a decrease in amplitude of the NAPs of the distal part of the tail was observed at the later stage of the experiments. These results might be attributed to a small dosage or to the inadequacy of the subcutaneous injection of n-hexane, which is a strong volatile solvent. The peripheral neurotoxicity of 2,4-Pdione, which has five carbon atoms and is analogous to 2,5-Hdione in chemical structure, was not so marked as that of 2,5-Hdione, since the daily injected doses of 2,4-Pdione were smaller than 2,5-Hdione. Furthermore, the type of neurrotoxicity was different from that of neuropathy due to 2,5-Hdione, because the repetitive injections of 2,4-Pdione produced salivation and spastic paralysis of the hind limbs, while 2,5-Hdione produced flaccid paralysis without salivation.

Conclusion

Peripheral neurotoxicity of 2,4-Pdione, 2-pentanone, 2,5-Hdiol and 2-heptanone was examined in comparison with that of MBK and 2,5-Hdione. It was revealed that 2,5-Hdiol is neurotoxic, and that the neurotoxicity of 2,5-Hdiol is stronger than that of MBK, but not stronger than that of 2,5-Hdione, Furthermore, it was found that 2,4-Pdione is also neurotoxic, but the neurotoxicity of the agent seemed to be mild and slightly different in comparison with 2,5-Hdione. Finally, the peripheral neurotoxicity of 2,5-Hdione was considered to be attributed to the chemical structure of 2,5-Hdione itself, which has six carbon atoms with two ketones at the 2nd and 5th carbon atoms. In the future, more systematic and well designed studies should be carried out concerning these chemical agents, and also concerning other agents such as 2,3-butanedione, 2-butanone, 2-octanone and 2,7-octanedione.

References

Allen, N. et al (1975) Toxic polyneuropathy due to methyl n-butyl ketone. An industrial outbreak. Arch. Neurol. 32:209-218.

Inoue, T. et al (1975) A health survey on vinyl sandal manufactures with high incidence of n-hexane intoxication occurred. Jpn. J. Ind. Health, 12:73-84.

Divincenzo, G.D., et al (1976) Characterization of the metabolites of methy n-butyl ketone, methyl isobutyl ketone in guinea pig serum and their clearance. Toxicol. Appl. Pharmachol., 36:511-522.

Misumi, J. et al (1979) Effects of n-hexane, methyl n-butyl ketone and 2,5-hexanedione on the conduction velocity of motor and sensory fibers in the rat's tail. Jpn. J. Ind. Health, 21:180-181.

Misumi, J. (1979) II. Measurement of the maximum conduction velocity of compound action potentials in the tail nerve of healthy rats. Kumamoto Med. J., 32:1-14.

Miyagaki, H. (1967) Electrophysiological studies on the peripheral neurotoxicity of n-hexane. Jpn. J. Ind. Health, 9:12-23.

Schaumburg, H.H. and Spencer, P.S. (1976) Degeneration in central and peripheral nervous system produced by pure n-hexane: An experimental study. Brain, 99:183-192.

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Session 8.
Load Poisoning

PURIFICATION AND ISOZYMIC PROPERTIES OF HEPATIC δ-AMINOLEVULINATE DEHYDRATASE FROM WISTAR STRAIN OF RATS

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Summary

Two apparently different enzyme fractions of δ-aminolevulinate dehydratase (δ-ALAD: EC 4.2.1.24) were isolated from livers of normal adult male Wistar rats by method of Doyle and Schimke (1969). In another group of Wistar rats, lead nitrate, 130 mg of lead as Pb^{++}/kg of body weight (LD_{50} for rat) was injected into the peritoneal cavity 3 weeks prior to the experiment. The enzyme from livers leaded in vivo were also purified by the same method as described above.

The enzyme fraction I and II were eluted at different NaCl concentrations of DEAE-cellulose column chromatography in the normal group. In the leaded group, the enzyme fraction I did not appear and the fraction II was eluted at the same NaCl concentration as in the normal group.

Biochemical properties of these fractions of δ-ALAD were studied with respect to optimal pH, heat denaturation and kinetic properties. It has been shown that the fraction I has higher enzyme activity, more sensitive to heat denaturation and diffferent velocity of enzymatic reaction according to substrate concentration. It has also been clearly shown that the pattern of heat denaturation of the enzyme leaded in vivo distinctly differ from that of the control group. It cannot be too strongly emphasized at present stage that these two fractions of the enzyme from livers of Wistar rats are isozymes of δ-ALAD unless differences in molecular forms between the fraction I and II are further identified.

Introduction

δ-ALAD catalyzes the condensation of two molecules of δ-aminolevulinic acid (δ-ALA) formed from glycine and succinyl-CoA to yield a pyrrole, porphobilinogen (PBG), an intermediate in the biosynthesis of porphyrins, chlorophyll, and corrin ring of vitamin B_{12}.

It has been demonstrated by Gibson et al. (1955) that the δ-ALAD activity is inhibited by lead in vitro, and the δ-ALAD activity is measured as a tool of screening test of lead workers. In in vivo studies, inhibition of the enzyme activity was also demonstrated. Chung(1979) identified in his previous study two molecular forms of δ-ALAD from livers of ICR inbred strain of mice, which were characteristic in their biochemical, enzymatic and immunoelectrophoretic properties. This report also describes some of the differences in biochemical properties of the enzyme fractions I and II purified from livers of the normal and the leaded in vivo Wistar rats.

Material and Methods

Animal-Adult male Wistar rats were used in the experiment. Rats were divided into two groups: a normal group (11 rats) and a leaded group (7 rats) to which 13 mg of Pb^{++}/100 gm of body weight were administered intraperitoneally 3 weeks prior to the experiment.

Purfication of the δ-ALAD — The enzyme was isolated and purified by the method of Doyle and Schimke (1969). Patterns of DEAE-cellulose column chromatography in the normal group by linear gradient elution with 0.4 M NaCl with a rate of 3 ml/4 min are shown in Fig. 1. Enzyme fraction I (minor peak) was eluted at a NaCl concentration of 0.05 M and the fraction II (major peak) at NaCl concentrations of between 0.15 M and 0.25 M. The each enzyme fraction was concentrated by polyethylene glycol and dialyzed for 12 hours at 4°C against 0.05 M potassium phosphate buffer, pH 6.5 and rechromatographed on DEAE-cellulose column.

Assay method — The enzyme activity was determined by a method of Russell and Coleman modified by Doyle and Schimke (1969). 0.15 ml of aliquot of the purified enzyme was added to an assay mixture containing 0.4 ml of 0.1 M potassium phosphate buffer, pH 6.5. After a 1/2 hours incubation at 37°C, 10 μmoles of δ-ALA, pH 7.0 and 0.05 ml of 0.3 M β-mercaptoethanol in a final volume of 0.75 ml were added, and incubation was continued for an additional 60 minutes in a shaking constant temperature water bath. The reaction was terminated by the addition of 1.5 ml of 10% trichloroacetic acid (w/v) which was also 0.1 M in $HgCl_2$. After centrifugation, 0.5 ml of the supernatant fluid was added to 1.0 ml of 5% trichloroacetic acid, and the PBG formed was assayed by the modified Ehrlich's method with 4 N perchloric acid as described by Mauzerall and Granick (1956). The color formed was proportional to enzyme concentration and the time within the range used. One unit of δ-ALAD activity is defined as that amount of enzyme necessary to form 1 μmole of PBG per hour at 37°C.

Protein measurement — Protein was determined as described by Lowry et al. (1951) with bovine serum albumin as standard.

Results

Protocol for the purification of hepatic δ-ALAD from normal and leaded in vivo Wistar rats are shown in Table 1 and 2, δ-ALAD activity as a crude enzyme in liver homogenate was 13.8 unit/ml and specific activity was 0.16 unit/mg of protein in the normal group. The enzyme fraction I was purified up to 15 times and the

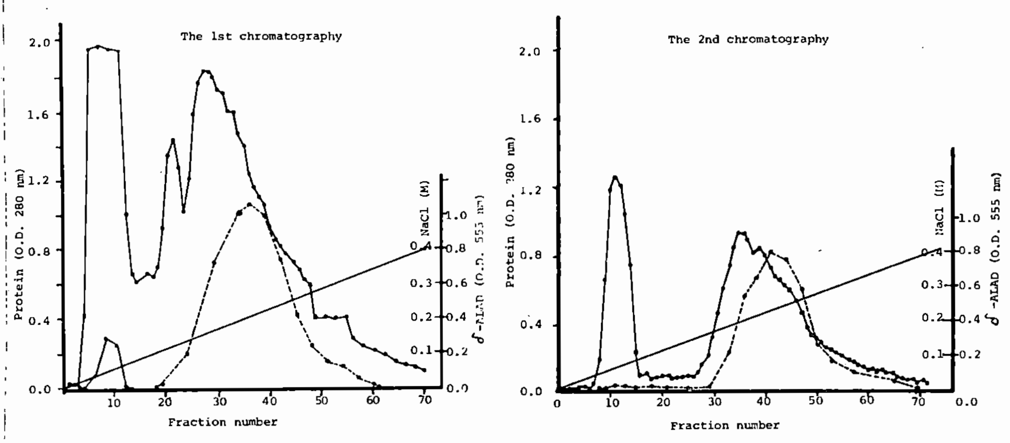

Fig. 1. Chromatography of δ-aminolevulonate dehydratase in normal liver of wistar rats with DEAE-cellulose. The concentration gradient of NaCl is applied linearly from zero to 0.4 M. Speed of elution is 3ml/4ml (—— ; protein, - - - -; δ-ALAD)

Table 1. Protocol for the purification of hepatic δ-ALAD from normal adult Wistar strain of rat

δ-ALAD fraction	Volume (ml)	Protein (mg)	Protein (mg/ml)	Activity (unit)	Activity (unit/ml)	Yield (%)	Specific activity (unit/mg)
Homogenate	407	35,713.3	87.75	5,608	13.8	100.0	0.16 (x 1.00)
Supernatant	319	20,958.3	65.70	4,267	13.4	76.1	0.20 (x 1.25)
Heat (64°C)	233	5,603.7	24.05	2,443	10.5	43.6	0.44 (x 2.75)
35-50% $(NH_4)_2SO_4$ (Active ppt)	16	1,248.0	78.00	1,084	67.7	19.3	0.87 (x 5.44)
DEAE I							
(No. 7-11)	5.3	48.2	9.08	140.5	10.8	2.5	2.91 (x 18.19)
(No. 29-45)	13	240	1.85	560.3	43.1	10.0	23.35 (x145.91)
DEAE II							
(No. 10-18)	10.5	5.7	0.54	4.7	0.5	0.08	0.82 (x 15.13)
(No. 32-55)	23.2	4.9	0.21	336.8	14.5	6.0	22.60 (x141.28)

Table 2. Protocol for the purification of hepatic δ-ALAD from leaded adult Wistar rats.
Lead nitrate, 1.3 mg of lead as Pb per 100 grams of body weight is injected into the peritoneal cavity 3 weeks prior to the experiment.

δ-ALAD fraction	Volume (ml)	Protein (mg)	Protein (mg/ml)	Activity (unit)	Activity (unit/ml)	Yield (%)	Specific activity (unit/mg)
Homogenate	267	18,813.6	70.2	3,220	12.0	100.0	0.17 (x 1.00)
Supernatant	190	11,542.5	60.8	2,084	11.0	64.7	0.18 (x 1.06)
Heat (64°C)	121	2,162.9	17.9	1,278	10.6	39.7	0.59 (x 3.48)
35-50% $(NH_4)_2SO_4$ (Active ppt)	8.8	283.8	32.3	332	37.7	10.3	1.17 (x 6.88)
DEAE I							
(No. 10-20)	10.5	17.2	1.64	8.1	0.77		
(No. 36-50)	13.2	13.6	1.03	240.6	18.23	7.47	17.69 (x104.07)
DEAE II							
(No. 6-10)	4.2	4.0	0.95	0.5	0.12		
(No. 28-40)	11.5	7.8	0.68	50.5	4.39	1.56	6.47 (x 38.08)

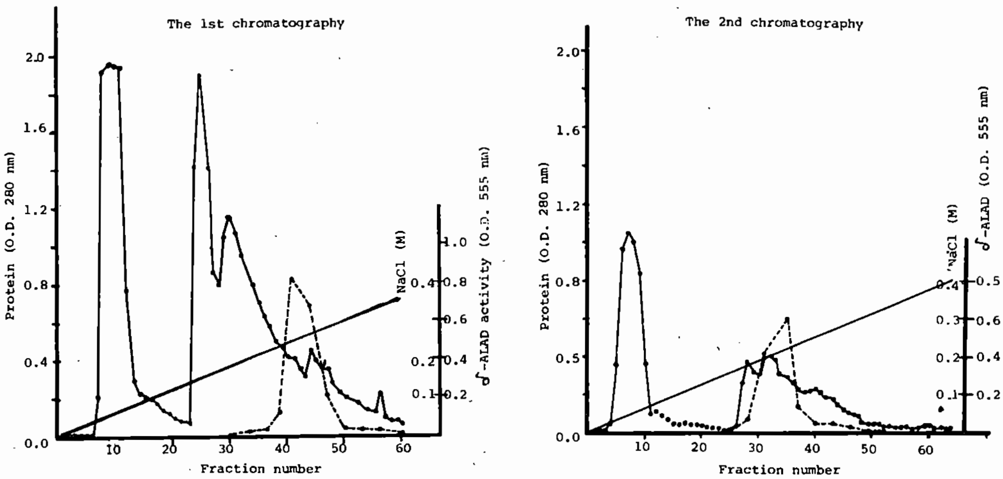

Fig. 2. Chromatography of δ-amino-levulinate dehydratase in liver of Wistar rats to which 1.3mg of lead as Pb^{++}/1000 gm of body weight is administered intraperitoneally 3 weeks prior to the to the esperiment. The concentration of NaCl is applied linearly from zero to 0.4 M. Speed of the elution is 3 ml/4 min. (—— ; protein, - - - ; δ-ALAD)

enzyme fraction II up to 140 times as active as that in the homogenate in terms of specific activity. In the leaded group, the enzyme fraction I that could be seen in the normal group disappeared (Fig. 2), and the activity of the enzyme fraction II decreased down to 4.39 unit/ml and 6.47 unit/mg of protein indicating the 38 times as active as the crude enzyme in the homogenate.

Effect of pH — Optimum pH of the enzyme fraction I was 6.5 whereas the optimum pH of the enzyme fraction II in the normal group and that in the leaded group were identical with a value of pH 7.0. The enzyme activity at the same pH was somewhat higher in 0.1 M tris buffer than in 0.1 M potassium phosphate buffer. (Fig. 3)

Effect of heat treatment — Patterns of heat denaturation of the enzyme fraction I and II in the normal group did not differ each other showing gradual degradation of the enzyme activity with increase in temperature of heat applied. Enzyme fraction I seemed to be more or less sensitive to heat than the enzyme fraction II, remaining about 80% of the control activity (at 37°C for an hour) in the former and about 90% in the latter. In the leaded group, however, pattern of change in enzyme activity with heat treatment was different from that the normal group. The enzyme activity was rather increased up to nearly 130% of its control activity with heat treatment at 45°C for 15 minutes (Fig.

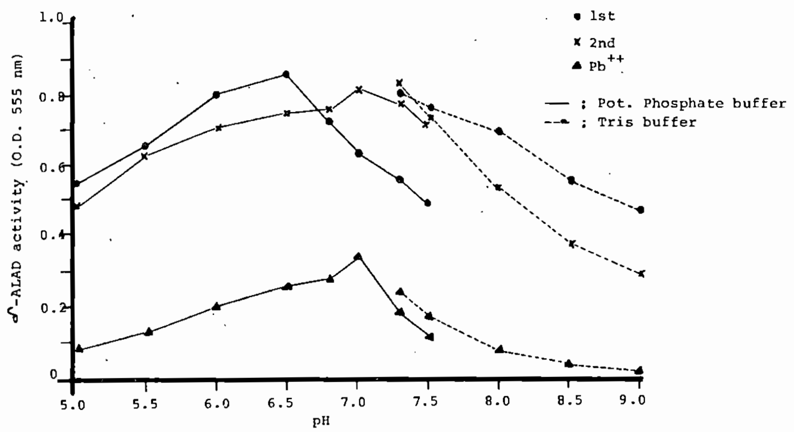

Fig. 3. Effect of pH on activity of purified δ-aminolevulinate dehydratase from livers of normal & leaded Wister Strain of rat in 0.1 M potassium phosphate buffer and 0.1 M Tris ouffer.

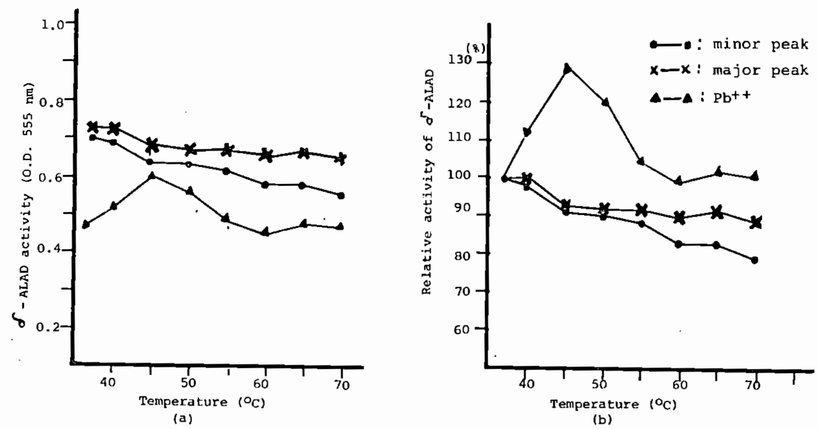

Fig. 4. Effect of heat treatment of purified δ-ALAD from livers of normal and leaded Wistar strain of rat at different temperatures.
After an activation period of 15 minutes at 37°C substrate was added and the incubation continued for 15 minutes at the temperature indicated.

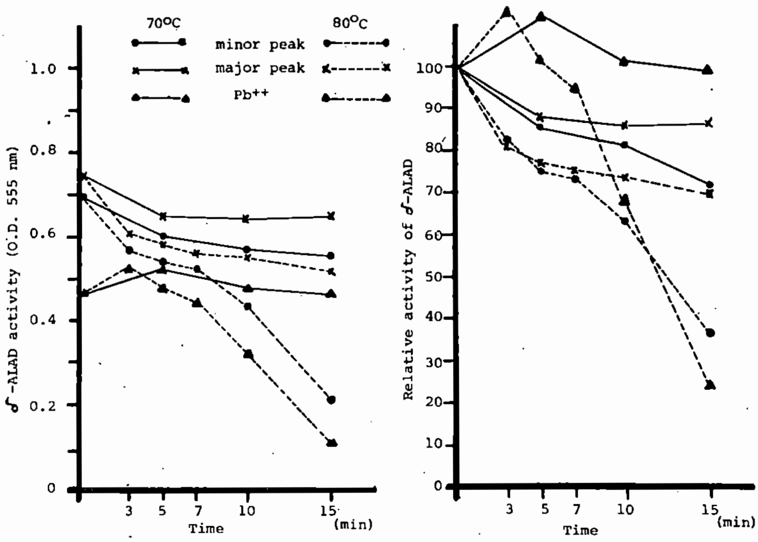

Fig. 5. Heat denaturation properties of δ-ALAD from livers of the normal and the leaded Wister strain of rats at 70°C and 80°C.

4). In general, δ-ALAD is considered to be quite stable to heat denaturation below temperature of 70°C for 15 minutes' application. The enzyme activity, however, rapidly decreased at 80°C showing more sensitive denaturation in the enzyme fraction II than in the enzyme fraction I, in the normal group, and initial rise up to 110% at 3 minutes' incubation in the enzyme leaded in vivo (Fig. 5).

The kinetic properties – The kinetic properties of the enzyme fraction I and II of the δ-ALAD from livers of the normal rats were identical in their Km value, indicating the value of 3.9×10^{-4}M and 3.7×10^{-4}M, respectively Velocity of the enzyme reaction to form PBG per hour at different substrate concentration was more varied in the enzyme fraction I. Affinity of the enzyme to substrate and the velocity of the enzyme reaction were unaltered in the enzyme leaded in vivo (Fig. 6).

Discussion

It has been reported previously that, in mice, the activity of δ-ALAD is under the control of alleles at the levulinate locus (Lv) in Linkage Group VIII (Russell and Coleman, 1963; Hutton and Coleman, 1969; Coleman, 1966). Doyle and Schimke (1969) reported that the differences in the enzyme activity between inbred mouse strains of homozygous for the Lv^a and homozygous for the Lv^b were attributable to differing amount of enzyme protein rather than to any structural changes that modify the

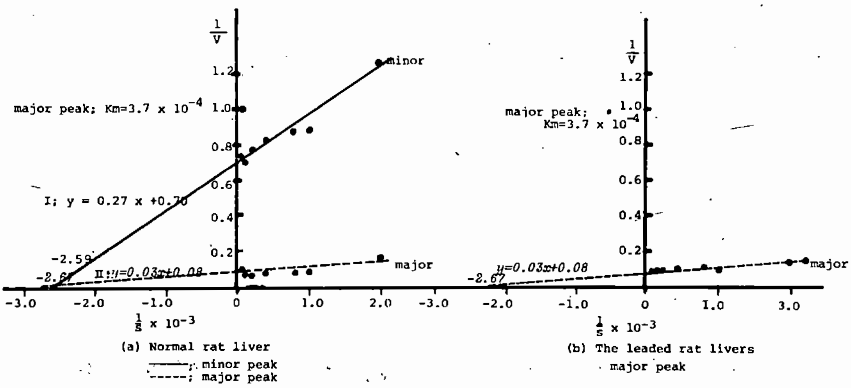

Fig. 6. Effect of substrate concentration on δ-ALAD activity. Substrate was added after 30 minutes activation period and the incubation continued for 60 minutes.

enzyme activity.

Two structual mutations modifying the sensitivity of δ-ALAD to heat have been identified by Coleman (1971). He considered that the structural locus for δ-ALAD was either physically close to or identical with the locus that controls its rate of synthesis. Chung (1979) has demonstrated the presence of multiple forms of δ-ALAD from livers of ICR inbred strain of mice, which were distinguishable by various physical, chemical and enzymatic criteria, including heat stability, electrophoretic mobility, Km value for δ-ALA, and specific enzyme activity. Nevertheless, it is not clearly understood at this present stage whether the two enzymmatically active protein fractions found in this study are isozymes of δ-ALAD or not. The enzyme fractions were indistinguishable in many respects. One thing that is noteworthy is that the enzyme fraction II diminished in its activity showing a different pattern of heat denaturation in the leaded group from that in the normal group. As for the fact that the activity increases by heat treatment, Nikkanen et al. (1972) and Despaux et al. (1977) considered that the inhibition or restoration of the enzyme activity was caused by capture or release of lead by the essential SH groups of the enzyme. Metals would bind the enzyme in one or several allosteric sites, and induce an allosteric transposition to the active or inactive form of enzyme.

Chiba (1976) has also proposed an hypothesis that the δ-ALAD in erythrocytes includes at least two components. One of them, type 1, is inherently active without heat treatment, inhibited by lead in vivo, and cannot be restored by heat treatment. The other, type 2, is inherently inactive, activated by heat treatment, and insensitive to lead in vivo, but type 2 may also be inactivated by lead levels above 1.93 μmol/*l* (40 μg/100 g) blood. Both types of δ-ALAD are subjected to reduction by overheating. Consequently, the activity of type 1 decreases steadily as a function of the period of heat treatment while that of type 2 increases initially, reaches a peak, and decreases.

So far we studied, type 1 and type 2 are considered to correspond to the enzyme fraction I and II, respectively, found both in ICR mice (Chung, 1979) and Wistar rats in this study. Further study is necessary to confirm this hypothesis.

References

Chiba, M. (1976). Activity of erythrocyte δ-aminolevulinic acid dehydratase and its change by heat treatment as indices of lead exposure. *Brit. J. Industr. Med.* 33, 36-72.

Chung, K.C. (1979). In press.

Coleman, D.L. (1966). Purification and properties of δ-animolevulinate dehydratase from tissues of two strains of mice. *J. Biol. Chem.* 241, 5511-5517.

Coleman, D.L. (1971). Linkage of genes controlling the rate of synthesis and structure of aminolevulinate dehydratase. *Science* 173, 1245-1246.

Despaux, N., Comoy, E., Bohuon, C., and Boudene, C. (1977). Postulated mode of action of metals on purified human ALA-dehydratase (EC 4-2-1-24). *Biomed.* 27, 358-361.

Doyle, D. and Schimke, R. (1969). The genetic and developmental regulation of hepatic δ-aninolevulinate dehydratase in mice. *J. Biol. Chem.* 244, 5449-5459.

Gibson, K.D., Neuberger, A., and Scott, J.J. (1955). The purification and properties of δ-aminolevulinic acid dehydratase. *Biochem.* 61, 618-629.

Hutton, J.J. and Coleman, D.L. (1969). Linkage analyses using biochemical variants in mice. II. Levulinate dehydratase and autosomal glucose-6-phosphate dehydrogenas. *Biochem. Genet.* 3, 517-523.

Lowry, D.H., Rosebough, N.J., Farr, A.L. and Randall, R.J. (1951). Protein measurement with the Folin Phenol reagent. *J. Biol. Chem.* 193, 265-275.

Mauzerall, D. and Granick, S. (1956). The occurrence and determination of δ-aminolevulinic acid and porphobilinogen in urine *J. Biol. Chem.* 219, 435-446.

Nikkanen, J., Hernberg, S., and Tola, S. (1972). Modifications of the δ-aminolevulinic acid dehydratase test and significance for assaying different intensities of lead exposure. Work-Environment-Health 9, 46-52.

Russell, R.L. and Coleman, D.L. (1963). Genetic control of hepatic aminolevulinate dehydrogenase in mice. *Gent.* 48, 1033-1039.

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SOME BIOCHMICAL PROPERTIES OF δ-AMINOLEVULINATE DEHYDRATASE IN LIVER HOMOGENATE OF NORMAL AND LEADED IN VITRO FROM ICR MICE

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Summary

Effects of pH and sensitivity to heat denaturation of δ-aminolevulinate dehydratase (δ-ALAD; EC 4.2.1.24) in relation to lead exposure in vitro, stability of the enzyme to storage and to freeze-thawing, sulfhydryl nature and mode of action of metals were studied with crude enzyme in the supernatant of the tissue homogenate obtained from ICR mice.

Optimal pH for the enzyme activity in the normal and in the leaded groups was identical with a value of pH 6.5. Activity of the enzyme in the normal group steadily decreased as the temperature of the heat increased, whereas the leaded enzyme showed enhanced activity at temperature range of 40-50°C with the highest activity at 45°C, and then decreased. The enzyme could be stored frozen at -30°C in a deep freezer longer than 3 weeks without significant loss of the activity, but when it was stored at 4°C in a refrigerator the activity dropped exponentially from the second day of the storage. The enzyme, however, was quite resistant to freeze-thawing. The enzyme was activated by sulfhydryl reagent at a concentration between 0.1 M and 1.0 M. No activity, however, was demonstrated without addition of β-mercaptoethanol or with addition of 2.0 M or more. Various metal ions acted as activators or inhibitors to the enzyme activity according to types and concentrations of metals added.

Introduction

The facts that erythrocyte δ-ALAD activity is readily inhibited by exposure to low concentration of lead in the early stage (de Bruin and Hoolboom, 1967; de Bruin, 1968; Hernberg et al., 1970, 1972), and that method of enzyme assay is relatively simple made the measurement be employed in the medical examination for lead absortion in industry. Delta-ALAD activity, however, as a parameter of a health hazards caused by lead is an biological index and can not get rid of not only the inter-individual but also the intra-individual variations. Besides, experimental variation also plays an important role in reducing the repeatability of the assay. In this context, we studied some biochemical properties of the δ-ALAD from liver homogenate of ICR mice to contribute to raise the reliability of the assay method.

Material and Methods

The enzyme δ-ALAD used in this study was the crude enzyme in the supernatant of liver homogenate from ICR mice. Animals were killed by cervical dislocation, and livers were removed and weighed. Twenty-five percent (w/v) tissue homogenate was prepared at 0°C (ice water) with Potter Elvehjem type homogenizer in 0.15 M KCl which was adjusted to pH 6.7 with 0.02 M potassium phosphate buffer. The homogenate was centrifuged at 2,000 x g for 15 minutes and the supernatant fluid was kept frozen at -30°C in a deep freezer. Lead acetate, 3.96 μmol/*l* as Pb^{++} (equivalent to 80 μg of Pb^{++}/100 g of blood) was added to the supernatant.

The enzyme assay — The enzyme activity was determined by the method of Russell and Coleman modified by Doyle and Schimke (1969) as described in a previous paper. One unit of δ-ALAD is defined as that amount of enzyme necessary to form 1 μmole of PBG per hour at 37°C.

Results

Effect of pH — The effect of pH on the reaction rate was studied with potassium phosphate buffer for the pH range of 6.0 to 7.3. Maximal activity was observed at pH 6.5 both in the normal and in the leaded enzymes, the rate dropping off to about 90% of the maximal value at pH 6.0 and about 80% at pH 7.3 in both groups (Fig. 1).

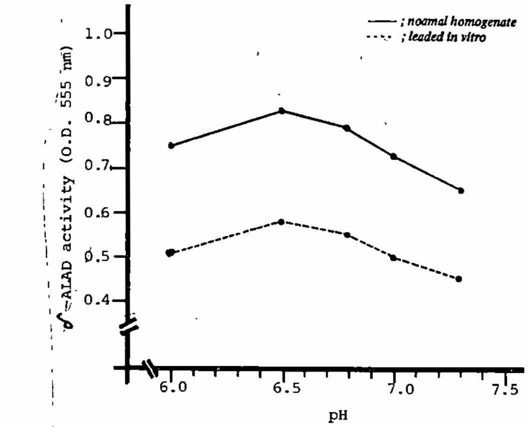

Fig. 1. Effect of pH on δ-ALAD activity in supernatant of livers of homogenates of ICR inbred strain of mice.

Thermal inactivation – δ-ALAD in the supernatant fluids of the normal liver homogenate and in the leaded in vitro, dissolved in 0.1 M potassium phosphate buffer pH 6.8, was heated at various temperatures ranging from 40°C to 70°C in a constant temperature shaking water bath for 15 minutes and assayed for residual enzyme activity by the standard method as described previously.

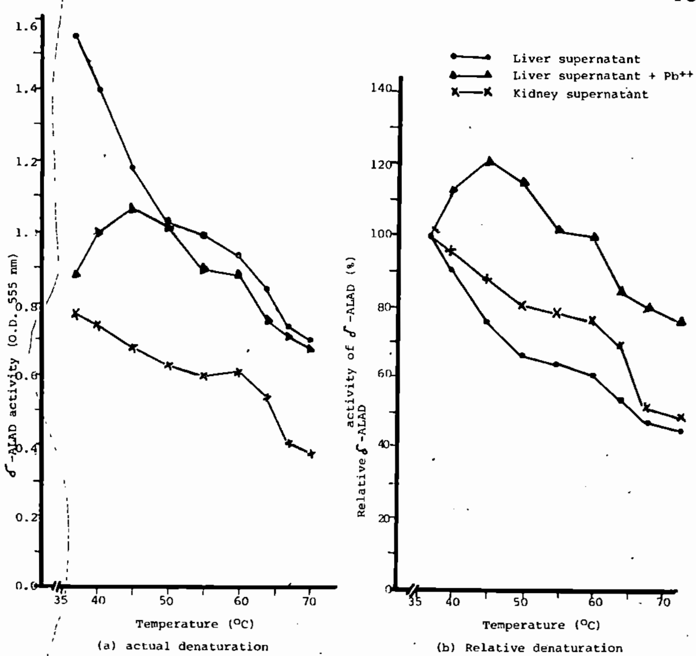

Fig. 2. Effect of heat treatment of δ-ALAD in the supernatants of normal liver and kidney homogenates, and leaded in vitro to liver homogenate from ICR inbred strain of mice.

The enzyme activity dropped off linearly to 45% of the original activity in the normal liver enzyme, yet the enzyme was activated upto 120% of the original activity in the leaded in vitro enzyme. It seemed that the rate of thermal inactivation was somewhat slow in kidney enzyme at temperature ranges from 40°C to 60°C but the activity dropped to 50% of the original activity at 70°C as in the normal liver enzyme (Fig. 2).

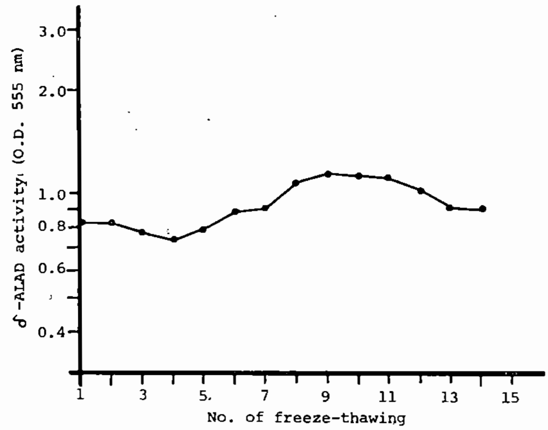

Fig. 3. Effect of freeze-thawing on δ-ALAD activity in the supernatant of liver homogenates of ICR inbred strain of mice.

Effect of freeze-thawing – The δ-ALAD in the supernatant of the normal liver homogenate appeared to be stable against rapid freeze-thawing of the enzyme without showing any decrease in enzyme activity by repetition of the freeze-thawing upto 14 times (Fig. 3).

Effect of storage – The enzyme in the normal liver homogenate could be stored at least 3 weeks or more without any noticeable deterioration in the enzyme activity when it was kept frozen at -30°C in a deep freezer. The enzyme activity in liver, kidney, and brain homogenates, however, decreased exponentially when they were stored at 4°C in a refrigerator, losing more than 50% of their original activity within the 3rd day of the storage (Fig. 4).

Activators and Inhibitors of the enzyme — The enzyme required sulfhydryl reagents, for little or no activity could be demonstrated without the addition of β-mercaptoethanol. The enzyme activity gradually increased with the addition of β-mercaptoethanol before maximal activity obtained at a concentration of 1.0 M. Then the activity sharply dropped to zero at a concentration of 2.0 M (Fig. 5).

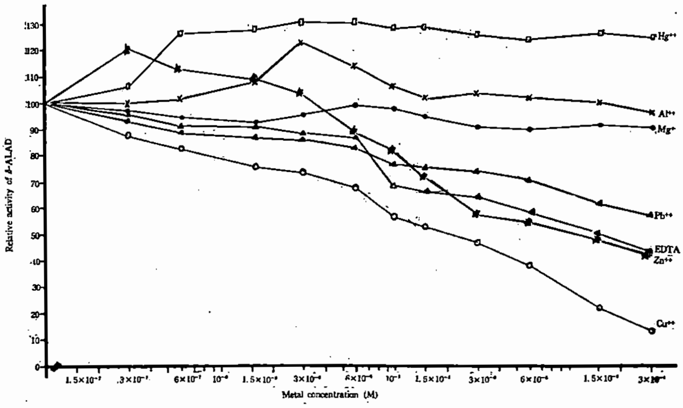

Fig. 6. Relative change of residual enzyme activity by adding various metals at different concentration in vitro from 1.5×10^{-7}M to 3×10^{-4}M.

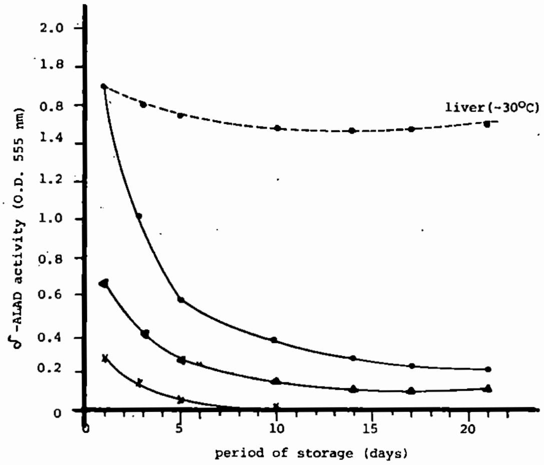

Fig. 4. Stability of δ-ALAD in the supernatant of tissue homogenates from ICR inbred strain of mice after storing them at 4°C in a refrigerator and at -30°C in a deep freezer.

As for the action of metal ions of δ-ALAD, Hg^{++} and Al^{++} ions acted as activators, Cu^{++} ion and EDTA as inhibitors at concentrations as low as 3×10^{-4}M or below. Mg^{++} ion had no effect of δ-ALAD activity at all. Zn^{++} ion acted as an activator at a concentration of 3×10^{-6}M and then as an inhibitor at concentration of 6×10^{-6}M and above. By the addition of Hg^{++} and Pb^{++} with higher concentration above 10^{-3}M, the activity of the enzyme sharply dropped off to 50% of the original enzyme activity in case of Hg^{++} and nearly to null by lead at a concentration of 10^{-2}M, respectively.

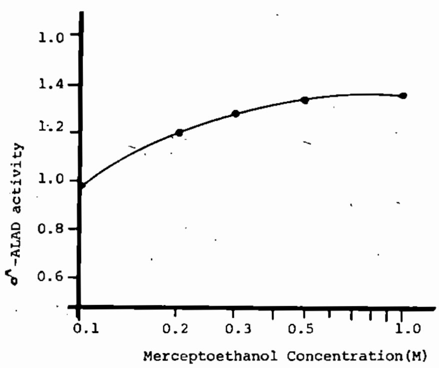

Fig. 5. Effect of mercaptoethanol concentration (M) on δ-ALAD activity in the supernatant of the liver homogenate of the ICR inbred strain of mice.

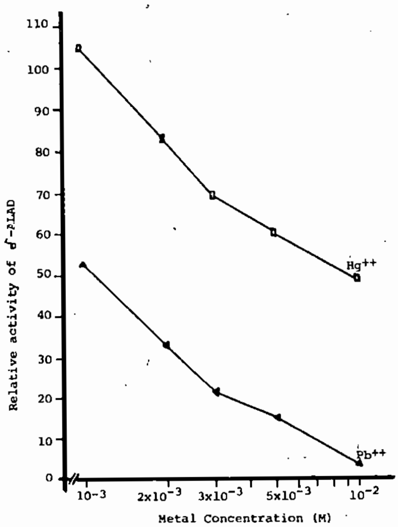

Fig. 7. Effect of Pb^{++} and Hg^{++} on δ-ALAD by adding them to the supernatant of the liver homogenates in concentration from 10^{-3}M to 10^{-2}M in vitro.

Discussion

It has been known that the δ-ALAD are widely distributed among bacterial plants and animal tissues. Properties of the purified enzymes so far studied are well documented by Shemin (1972). Their biochemical and enzymatic properties have been known to be different each other to some extent according to the sources from which the enzyme was isolated. Furthermore, properties of the crude enzyme differ from that of the purified enzyme in many respect. Effects of pH and heat treatment on enzyme activity showed no difference between the crude and the purified enzymes both in the normal and leaded group. There, however, were some discrepancies in the stability to storage and freeze-thawing of the enzyme. Coleman(1970) stated that the enzyme recovered after the second DEAE column could be stored at 2°C for at least 1 week without significant loss of activity and stored at -20°C for 2 months without evidence of deterioration. The crude enzyme, however, was more labile and could not stored even for a few days at 4°C in a refrigerator, and when stored frozen at -30°C, the enzyme maintained its activity as long as 3 weeks evidence of deterioration as the purified enzyme. Even the crude enzyme gradually increased the enzyme activity with the addition of β-mercaptoethanol showing its maximal activity at 1.0 M. The enzyme activity was completely suppressed by the addition of the reagent in concentration over 2.0 M.

Summarizing the results so far reported on effects of metal ions on the enzyme (Despaux et al., 1977; Border et al., 1976; Thomson et al., 1977), all metals are inhibitors at a final concentration greater than 1.5 x 10^{-5}M, and can be classified into 4 types below this concentration.: a) the metals of strong activators (+30%), i.e. zinc and aluminum; b) the metals of weak activators, i.e. mercury, cadmium, tin; c) the metals of weak inhibitors, e.g. managnese; and d) the metals of strong inhibitors, i.e. copper, and lead. Nickel, arsenic, iron and chromium were known as metals without noticeable effect to the enzyme. The results we found in this study were in good agreement with these findings.

It has been confirmed that the δ-ALAD activity may well be affected and complicated with many factors. It is, therefore, advised to pay careful attention in assaying the enzyme in evaluating the lead absorption that the δ-ALAD activity is influenced by many factors and not an specific indicator of lead absorption but the total metal ion concentration in the blood or tissues.

References

Border, E.A., Cantrell, A.C. and Kilroe-Smith, T.A. (1976). The in vitro effect of zinc on the inhibition of human δ-aminolevulinic acid dehydratase by lead. *Brit. J. Industr. Med.* 33, 85-87.

Coleman, D.L. (1970). δ-Aminolevulinate Dehydratase (Mouse Liver). In: Methods in Enzymology, Vol. XVII A. Metabolism of Amino Acids and Amines, Edited by Tabor, H. and Tabor, C.W. pp. 211-216, New York, Academic Press.

de Bruin, A. and Hoolboom, H. (1967). Early signs of lead exposure: A comparative study of laboratory tests. *Brit. J. Industr. Med.* 24, 203-212.

de Bruin, A. (1968). Effect of lead exposure on the level of δ-aminolevulinic dehydratase activity. *Med. del lavoro.* 59, 411-418.

Despaux, N., Bphuon, Cl., Comoy, E. and Boudene, Cl. (1977). Postulated mode of action of metals on purified human ALA-dehydratase. *Biomed.* 27, 358-361.

Doyle, D. and Schimke, R.T. (1969). The genetic and developmental regulation of heaptic δ-aminolevulinate dehydratase in mice. *J. Biol. Chem.* 244, 5449-5459.

Hernberg, S., Nikkanen, J., Miellin, G. and Lilius, H. (1970). δ-Animolevulinic acid dehydratase as a measure of lead exposure. *Arch. Environ. Health* 21, 140-145.

Hernberg, S., Tola, S., Nikkanen, J. and Valkonen, S. (1972). Erythrocyte δ-aminolevulinic acid dehydratase in new lead exposure. *Arch. Environ. Health* 25, 109-113.

Shemin, D. (1972). δ-Aminolevulinic Acid Dehydratase. In: the Enzymes, Edited by Boyer, Vol. 7. Elimination and Addition, Aldol Cleavage and Condensation, Other C-C Cleavage, Phospholysis, Hydrolysis (Fats glycosides), pp. 323-337, New York, Academic Press.

Thompson, J., Jones, D.D. and Beasley, W.H. (1977). The effect of metal ions on the activity of δ-aminolevulinic acid dehydratase. *Brit. J. Industr. Med.* 34, 32-36.

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THE ALTERNATION OF δ-ALAD ACTIVITY IN LEAD INTOXICATED RABBITS

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Introduction

The concentration of lead in blood(Pb-B) is generally accepted to be most valid indicator of lead exposure. But since direct measurements of Pb-B are expensive, time-consuming, and vulnerable to methodological error, there is a need for a simple and reliable test measuring lead absorption.

For this reason, the role of delta aminolevulinic acid dehydratase(ALAD) in lead poisoning has been studied extensively since Haeger-Aronsen introduced the new reliable test method of delta aminolevulinic acid dehydratase activity. It is now well-known that erythrocyte ALAD activity is strongly depressed in both human and animal lead poisoning, and inhibited even before measureable deviations occur in other parameters indicative of the response to lead abosrption.

But as no standard method for measuring the ALAD activity has been fully accepted, and several methods have been introduced, there are some problems in interpretating the results of the test. The selection of optimal pH of substrate is one of the major cause affecting the results. Recently, Nikkanen et al. demonstrated that the optimum pH of ALAD assay shifted to a lower pH level in the blood of persons occupationally exposed to lead but that of normal unexposed persons didn't change. According to the shift of substrate pH at lead exposure, Tomokuni (1974) postulated that the activity ratio (absorbance at substrate pH 6.8/ absorbance at substrate pH 6.0) was more useful than the activity itself.

Restoration of depressed ALAD activity of red blood cells would not occur for a long time after the cessation of lead exposure, even if the lead level in the blood returned to its normal value. With delayed regeneration of ALAD in blood, Haeger-Aronsen claimed that this enzyme is also useful for revealing past exposure. However data were still lacking on the regeneration of ALAD after cessation of lead exposure.

In order to clarify the usefulness of ALAD of red blood cells in the diagnosis and treatment of lead poisoning, we observed the effect of lead of 30 albino rabbits on ALAD activity and activity ratio in terms of intensity and duration. And we also checked the alteration of these parameters during treatment with CaEDTA after cessation of lead exposure in order to confirm the effect of the chelating agent on this enzyme.

Materials and Methods

Thirty Korean albino rabbits which weighed 1.7 – 2.3 kg were equally divided into 3 groups of 10 rabbits each.

Lead acetate was injected subcutaneously 6 times a week for 6 weeks with doses of 50 μg/kg/day (group I), 500 μg/kg/day (group II) and 2000 μg/kg/day (group III) respectively. After the termination of lead exposure each of these groups was divided into CaEDTA treated and untreated groups. 5% CaEDTA solution was injected intramuscularly with a dose of 50 mg/kg/day 3 consecutive days a week for 8 weeks.

Erythrocyte ALAD activity and activity ratio was measured in duplicate according to the modified Bonsignore method described by Tomokuni (1974). But as we got the highest absorbance at substrate pH 6.6 in non-exposed rabbits and at substrate pH 5.8 in lead exposed rabbits from previous experimental study, we chose pH 6.6 and 5.8 as optimum pH of lead exposed and non-exposed rabbits respectively. For calculations, the following two formulas were used:

ALAD activity (μmol PBG/hr/ml rbc)

$$= \frac{OD_{60} - OD_0}{Hct(\%)} \times 152.2$$

OD_{60} : optical density after 1 hour at 37°C
OD_0 : optical density at 0 time

$$152.2 = \frac{1}{1000} \times \frac{\overset{\text{(blood dilution)}}{3.5 \times 4 \times 100}}{\underset{\text{(blood vol.)}}{0.2} \times \underset{\text{(PBG ext. coeff.)}}{0.046}}$$

$$\text{Activity ratio} = \frac{\text{Absorbance at pH 6.6}}{\text{Absorbance at pH 5.8}}$$

Lead in blood and urine was analyzed by dithizone method. We also measured ALA in urine by the method of Tomokuni and Ogata, and coproporphyrin in urine by the modified method of Askevod.

Each parameter was determined at the end of the week during the lead exposure (except that ALAD activity and activity ratio were checked once more at the 3rd day after exposure), and on the day after the consecutive CaEDTA injection after the cessation of the lead exposure and 10 days after the final CaEDTA injection.

Results & Comments

The mean concentration of blood lead of 3 different groups according to the during of lead exposure were given in Fig. 1. The mean concentration of blood lead of groups II and III increased gradually during the lead injection period, but that of group I showed values of below 40 μg/100 ml without significant increment by duration.

ALAD activity and activity ratio of 3 different groups during lead exposure were shown in Tables 1 and 2. The values of both parameter were decreased exponentially according to the time course of exposure. And there were signigicant differences between groups I and II, III throughout theexposure, but no differences existed between groups II and III from 3 weeks of lead exposure. In group I, whose blood lead was below 40 μg/100ml, the coefficient of variation of activity ratio was smaller than ALAD activity. So the use of activity ratio was more effective in evaluating the degree of lead exposure in the subjects with low blood concentration.

Table 1. δ-ALAD activity of 3 different groups by duration (week) of lead exposure.

Group \ Week	0	1/2	1	2	3	4	5	6
I	2.236	1.736	1.076	0.824	0.642	0.451	0.494	0.469
	(0.51)	(0.33)	(0.34)	(0.35)	(0.21)	(0.21)	(0.17)	(0.23)
II	2.581	1.429	0.779	0.409	0.236	0.176	0.146	0.160
	(0.80)	(0.57)	(0.35)	(0.15)	(0.12)	(0.12)	(0.08)	(0.13)
III	2.777	0.826	0.499	0.222	0.172	0.140	0.180	0.108
	(1.08)	(0.27)	(0.25)	(0.20)	(0.11)	(0.13)	(0.16)	(0.05)

* Parenthesis indicates the standard deviation of data.

Table 2. δ-ALAD **Activity ratio of 3 different groups by duration (week) of lead exposure.**

Group \ Week	0	1/2	1	2	3	4	5	6
I	2.107	1.549	1.307	1.076	1.042	0.920	0.829	0.809
	(0.42)	(0.40)	(0.17)	(0.24)	(0.18)	(0.17)	(0.19)	(0.12)
II	1.967	1.278	1.089	0.674	0.546	0.384	0.348	0.355
	(0.46)	(0.43)	(0.23)	(0.18)	(0.12)	(0.14)	(0.10)	(0.12)
III	1.906	0.926	0.738	0.497	0.407	0.321	0.242	0.241
	(0.44)	(0.21)	(0.22)	(0.12)	(0.10)	(0.10)	(0.07)	(0.07)

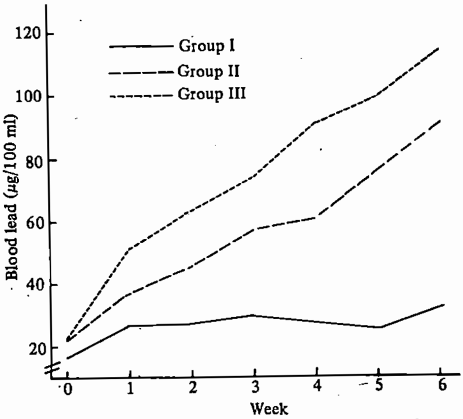

Fig. 1. Mean concentration of blood lead of 3 different groups by duration (week) of lead exposure.

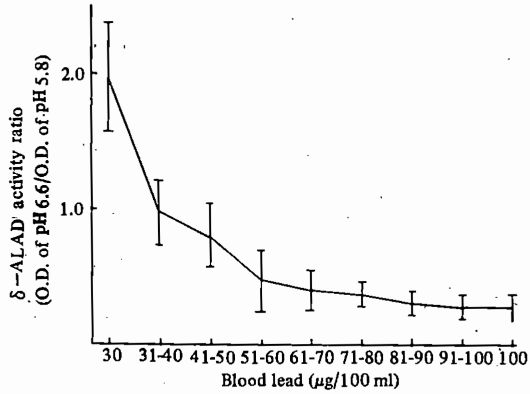

Fig. 3. Relation of activity ratio to blood lead in groups divided by blood lead levels.

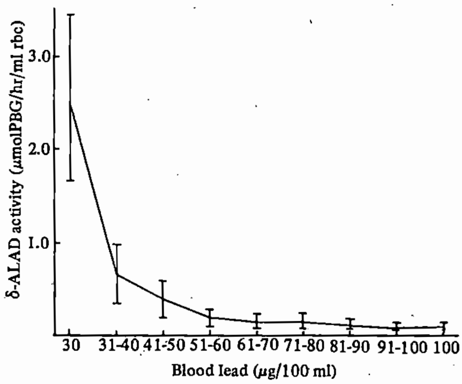

Fig. 2. Relation of δ-ALAD activity to blood lead in groups divided by blood lead levels. The mean value and standard deviation are shown for each group.

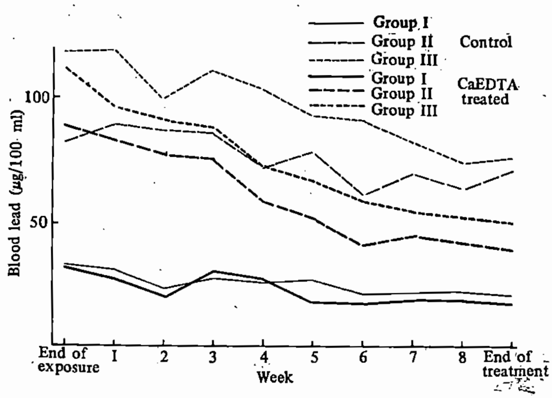

Fig. 4. Comparison of mean concentration of blood lead between control and CaEDTA treated group of 3 different groups by the duration(week) after termination of lead exposure.

The relation of ALAD activity and activity ratio to blood was shown in figures 3 and 4. As blood lead concentration increased beyond 60 μg/100ml, there was a failure to demonstrate continued decrease in ALAD activity and activity ratio according to the increase of blood lead.

The effect of CaEDTA on the changes of mean concentration of blood lead after cessation of lead exposure was shown in Figure 4. Mean concentration of blood lead of groups II and III decreased gradually according to the time course of recovery, and more significantly in CaEDTA treated group than non-treated group. But there was a failure to show a significant change of blood lead in group I in accordance with the time course of recovery and treatment of CaEDTA.

The changes of ALAD activity and activity ratio according to recovery period and CaEDTA treatment after termination of lead exposure were shown in Figures 5 and 6. In group I, there was no difference in ALAD activity and activity ratio between CaEDTA treated and non-treated group regardless of the length of recovery time. But the activity ratio increased to its normal value 2-3 weeks after the cessation of lead exposure, and ALAD activity increased only 50% of its normal value at the end of the experiment. In group II and III, ALAD activity did not increase significantly in accordance

Table 3. Comparison of δ-ALAD activity between control & CaEDTA treated group of 3 different groups by the duration(week) after termination of lead exposure.

Group	Week	End of Exp.	*	1	2	3	4	5	6	7	8	End of Tx.
I	Control	0.516 (0.308)	0.520 (0.176)	0.670 (0.219)	0.664 (0.161)	0.494 (0.178)	0.884 (0.195)	0.924 (0.145)	0.927 (0.201)	1.012 (0.271)	1.004 (0.189)	1.214 (0.111)
	Treatment with CaEDTA	0.431 (0.168)	0.515 (0.192)	0.582 (0.313)	0.843 (0.387)	0.743 (0.166)	0.954 (0.128)	0.988 (0.214)	1.208 (0.301)	1.145 (0.208)	1.042 (0.271)	1.325 (0.248)
II	Control	0.139 (0.070)	0.072 (0.040)	0.072 (0.038)	0.086 (0.048)	0.111 (0.039)	0.110 (0.054)	0.092 (0.050)	0.115 (0.052)	0.103 (0.025)	0.119 (0.015)	0.178 (0.037)
	Treatment with CaEDTA	0.209 (0.126)	0.109 (0.052)	0.203 (0.083)	0.185 (0.100)	0.345 (0.110)	0.344 (0.253)	0.298 (0.170)	0.422 (0.171)	0.450 (0.060)	0.421 (0.178)	0.397 (0.143)
III	Control	0.110 (0.066)	0.055 (0.026)	0.074 (0.053)	0.065 (0.036)	0.069 (0.031)	0.084 (0.043)	0.092 (0.021)	0.104 (0.034)	0.098 (0.042)	0.128 (0.026)	0.172 (0.043)
	Treatment with CaEDTA	0.089 (0.005)	0.084 (0.030)	0.056 (0.040)	0.080 (0.021)	0.129 (0.070)	0.097 (0.020)	0.118 (0.030)	0.162 (0.020)	0.152 (0.050)	0.165 (0.020)	0.180 (0.023)

* One day after a single injection of CaEDTA.

Table 4. Comparison of activity ratio between control & CaEDTA treated group of 3 different groups by the duration(week) after termination of lead exposure.

Group	Week	End of Exp.	*	1	2	3	4	5	6	7	8	End of Tx.
I	Control	0.834 (0.129)	1.767 (0.399)	1.952 (0.325)	1.958 (0.311)	2.128 (0.260)	2.328 (0.270)	2.542 (0.262)	2.434 (0.243)	2.672 (0.432)	2.582 (0.412)	2.544 (0.282)
	Treatment with CaEDTA	0.811 (0.138)	1.701 (0.604)	1.866 (0.309)	2.044 (0.520)	2.431 (0.542)	2.524 (0.483)	2.480 (0.345)	2.521 (0.314)	2.584 (0.321)	2.662 (0.284)	2.623 (0.262)
II	Control	0.343 (0.124)	0.432 (0.197)	0.345 (0.167)	0.435 (0.089)	0.409 (0.126)	0.496 (0.190)	0.528 (0.241)	0.465 (0.186)	0.528 (0.299)	0.438 (0.196)	0.441 (0.097)
	Treatment with CaEDTA	0.392 (0.123)	0.640 (0.476)	0.947 (0.405)	1.104 (0.421)	1.377 (0.352)	1.494 (0.548)	1.580 (0.602)	1.600 (0.532)	1.649 (0.235)	1.890 (0.321)	1.486 (0.217)
III	Control	0.254 (0.073)	0.340 (0.049)	0.501 (0.126)	0.420 (0.036)	0.339 (0.078)	0.384 (0.092)	0.482 (0.096)	0.342 (0.102)	0.368 (0.081)	0.348 (0.076)	0.372 (0.084)
	Treatment with CaEDTA	0.290 (0.089)	0.312 (0.064)	0.781 (0.075)	0.770 (0.103)	0.736 (0.058)	0.940 (0.028)	0.983 (0.030)	1.174 (0.212)	1.428 (0.135)	1.489 (0.439)	1.125 (0.213)

* One day after a single injection of CaEDTA.

with the length of the recovery and CaEDTA treatment, but activity ratio of CaEDTA treated group increased markedly according to the length of treatment compared with the non-treated group whose activity ratio didn't show any increment. Therefore, the use of activity ratio is desirable in evaluation of lead treatment with chelating agent.

As the usefulness of activity ratio was better than ALAD activity throughout this experiment it's more reliable to use the activity ratio rather than ALAD activity itself in evaluating the effect of lead on health.

Conclusion

With 30 Korean albino rabbits we investigated the effect of lead on δ-ALAD enzyme and other parameters used in the diagnosis of lead poisoning during and after lead exposure.

There were no significant changes in the parameters at the concentration of blood lead below 40 μg/100ml, except the significant alteration of ALAD activity and activity ratio which diminished even during the 1st few days.

As the coefficient of variation of activity ratio was smaller than ALAD activity itself and the treatment of CaEDTA only made progressive restoration of activity ratio according to the time course of treatment, we concluded that the determination of activity ratio is more reliable than ALAD activity in diagnosis and treatment of lead poisoning.

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LEAD INTAKE FROM FOOD AND BEVERAGE AS A BACKGROUND OF BODY BURDEN OF LEAD

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Introduction

Lead occurs naturally in plants, in soils and in air throughout the world. Foods, water, and other beverages are the major sources of lead intake in general environment. It is very important for humans to obtain fundamental information available for the prevention of lead poisoning.

Late professor K. Horiuchi and his coworkers[1-3] in our department first reported lead contents in various foodstuffs in 1952. Since that time, there have been an increase in environmental pollution and changes in dietary life in Japan.

The purpose of our present study is to obtain up-to-date information about lead content of food and beverage, and at the same time to provide a background informationessential for the studies of environmental pollution, food contamination, nutrition and so forth.[4-7]

Materials and Methods

Materials: As materials, daily foods and beverages on market in Osaka City were used. Cereals, pulses and vegetables were used after washing with water. Potatoes and fruits were used after washing with water and peeling or paring. Fishes were used after gutting and removing heads and bones. Canned foods were used after homogenizing.

Methods: A certain quantity of the test material was put into a chemically clean quartz vessel. After weighing, the test materials were dried at 110°C and carbonized at slow heating on a gas burner. The carbonized material thus obtained was heated again in an electric furnace at 500 °C for 15 hours to give ashes. The ash material was treated with a small amount of nitric acid and heated. The product was dissolved in 1 to 2 ml of hydrochloric acid and diluted with 30 to 40 ml of water. The solution was extracted with dithizone-cholroform. The lead-dithizone complex in the organic layer was decomposed and extracted with 3 to 5 ml of 1 N-hydrochloric acid. Lead in hydrochloric acid was subsequently determined by atomic absorption spectrophotometry (Japan Jarrell-Ash model AA-1).

Results and discussion

Results obtained are shown in Table 1 to 3.

For the approximate estimation of the total daily amount of lead taken into the body from foods, the lead contents of various foods shown in Table 1 were multiplied by the daily intake amount of each food group based on the standard menu of a Health Center in Osaka.

The daily intakes of lead from foods are estimated at 50 to 180 μg per day.

In this case, however, the lead intake of 4.2 to 8.2 μg from water (1ℓ) used for cooking and 7.4 to 12.1 μg from tea infusion (1ℓ) are not taken in account. Then, total daily intake of lead is calculated at about 60 to 200 μg per day.

The daily intakes of lead of a hard worker and a heavy worker are estimated at 95 to 274 μg per day based on the menu of the Self-Defence Forces. These values are found to be comparable to the value of 1950's.

By applying the lead content of each food group to the data of food consumption on National Nutritinal Survey, the daily intake of lead from foods is estimated at 148 (39.8 to 513) μg per day as shown in Table 3.

The rate of contribution of each food group to the intake of lead is 22% from cereals, 17%

Table 1. Lead contents of foods by food groups.

Food group	No. of samples	Pb (μg/kg) Range	Pb (μg/kg) Average
Cereals	53	36.4– 326	92.9
Seeds and nuts	5	114.0– 285	170.0
Potatoes	34	38.5– 133	64.3
Sugers	7	45.7– 251	140.0
Confectioneries	21	66.0– 600	140.0
Oils and fats	7	95.7– 172	134.0
Pulses	39	17.0– 487	148.0
Fruits	30	7.2– 464	72.0
Vegetables	139	1.9– 249	65.3
Fungi	6	23.2– 59.3	38.6
Seaweeds	16	176.0–1070	667.0
Seasonings and others	14	19.2– 353	119.0
Beverages	39	6.8– 356	70.9
Fish and shellfish	126	47.3–1290	279.0
Meat, poultry and whales	113	110.0– 429	208.0
Eggs	26	69.4– 212	133.0
Milk	28	16.5– 209	77.9

Table 2. Lead contents of standard menu.

		Cal.	Protein	Fat	Pb (μg/day) Range
The standard menu of a Health	(1)	2144	81.7		77–146
Center in Osaka	(2)	2072	76.0		61–138
The standard menu of Japanese	(1)	2280	81.6		64–163
adult	(2)	2153	76.0		46–149
	(3)	2165	77.8		78–180
The menu of the meal survice center	(1)	2588	92.7	45.0	78–143
	(2)	2475	92.5	30.6	76–145
The menu of the Self-Defence	(1)	3237	141.1	59.2	95–274
Forces	(2)	3460	117.8	48.9	117–264

Table 3. Intake of foods and Pb from food groups.

Food group	Foods(g)	Pb (μg/kg) Range	Pb (μg/kg) Average
Cereals	347.7	12.5–111.0	31.9
Seeds and nuts	1.6	0.2– 0.5	0.3
Potatoes	61.7	2.4– 8.2	4.0
Sugars	15.1	0.7– 3.8	2.1
Confectioneries	28.0	1.9– 5.6	3.9
Oils and fats	16.2	1.6– 2.8	2.2
Pulses	67.0	1.1– 32.6	10.0
Fruits	183.6	1.3– 85.2	13.2
Vegetables	249.2	0.5– 62.3	16.3
Fungi	7.2	0.2– 0.4	0.3
Seaweeds	4.7	0.8– 5.0	3.1
Seasonings and others	29.8	0.6– 10.5	3.6
Beverages	84.4	0.5– 11.1	6.0
Fish and shellfish	91.0	4.3–117.0	25.4
Meat, poultry and whales	62.8	6.9– 27.0	13.1
Eggs	41.1	2.9– 8.7	5.5
Milk	96.5	1.6– 20.1	7.5
Total	1395.5	39.8–513	148

from fish and shellfish, and 11% from vegetables.

The lead in feces of normal healthy Japanese adult is 174 (21.2 to 399) μg per day. The amount is roughly equal to that taken daily.

References

1) Horiuchi, K., Tamori, E. and Takada, I.: On the lead content of Japanese daily foods (1) The lead content of fresh food. *J. Sci. Labour*, 28:240 (1952) (in Japanese).
2) Yamamoto, T.: The lead content of daily food in Japan. *J. Osaka City Med. C.*, 4:308-332 (1955) (in Japanese).
3) Horiuchi, K., Yamamoto, T. and Tamiro, E.: Studies on the industrial lead poisoning, 1. Absorption, transportation, deposition and excretion of lead, 2. A study on the lead content of daily food in Japan. *Osaka City Med. J.*, 3:84-113, (1956).
4) Kurono, T., Ninomiya, K., Teramoto, K. and Horiguchi, S.: Lead content of daily foods in Japan at present (part 1) - (part 4), (part 6) - (part 7), Seikatsu Eisei, 17:157-158(1973), 18:12-13(1974), 19:179-181(1975), 21:197(1977), 22:190(1978) (in Japanese).
5) Horiguchi, S., Kurono, T., Ninomiya, K. and Teramoto, K.: Lead content of daily foods in Japan at present (part 5) Seikatsu Eisei. 20:233(1976) (in Japanese).
6) Horiguchi, S.: Uptake and metabolism of metals in so-called general Japanese – lead – Igaku no Ayumi, 99:29-33 (1976) (in Japanese).
7) Horiguchi, S., Teramoto, K., Kurono, T. and Ninomiya, K.: The arsenic, copper, lead, manganese and zinc contents of daily foods and beverages in Japan and the estimate of their daily intake, Osaka City Med. J.,24:131-141, (1978).

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RECOVERY OF SLOWED NERVE CONDUCTION VELOCITIES IN LEAD WORKERS

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and Koichi USHIO, *Japan*

Introduction

The delay in peripheral nerve conduction velocities has been regarded as one of the critical effects of lead (5). A significant slowing of peripheral nerve conduction velocities was reported in 26 percent of lead workers with blood lead concentrations (PbBs) between 0.14 and 0.35 μmol/100 g (1) and in 27 percent of those with PbBs between 2.9 and 3.3 μmol/*l* (4). Significant correlations of peripheral nerve conduction velocities with PbBs were also found by some authors (1, 3, 4). This study aims to examine whether the delay in peripheral nerve conduction velocities is reversible or irreversible.

Subjects and Methods

PbBs and maximal motor nerve conduction velocities (MCVs) of the median nerve were concurrently measured twice to nine times in fourteen male lead workers. Their ages, specific occupations, observation periods, numbers of PbB and MCV measurements and changes of PbB values during the observation period are listed in Table 1. Occupational exposure to lead had ceased or been reduced in nine subjects during the observation period; but it had not changed in the remaining five subjects. Calcium disodium ethylenediaminetetraacetic acid (Ca-EDTA) was injected into all but two subjects (Subjects 9 & 11) with the total dose from 2.7 mmol to 558 mmol (1 g to 209 g) (median 77 mmol) during the observation period in order to enhance urinary excretion of lead or to assess the body burden of mobilizable lead. None of the subjects had ever suffered from diabetes mellitus, or neurological or renal diseases. There was no significant correlation between age and PbB values when this study was started ($r = -0.164$, $p > 0.24$).

The MCV and PbB were measured by the same method as reported previously (1). The PbB was measured by atomic absorption spectrophotometry (Perkin-Elmer 403) with wet ashing, chelation by ammonium pyrrolidine dithiocarbamate and extraction to water-saturated methylisobutyl ketone.

Results

The MCV correlated significantly with the PbB with its range between 0.03 and 0.40 μmol/100 g (Fig. 1). When the MCV was divided into three groups according to the corresponding PbB level, the MCV was significantly delayed in the PbB range from 0.20 to 0.40 μmol/100 g (mean 0.28) on a group basis (Table 2).

The change of the PbB value (ΔPbB) in two successive measurements in each subject ranged from -0.22 to +0.25 μmol/100 g with an average of -0.03 μmol/100 g. Similarly, the change of the MCV value (ΔMCV) ranged from -26.4 to +19.0 m/sec with an average of +1.4 m/sec. In these ranges, ΔMCV inversely correlated with the ΔPbB (Fig. 2).

Discussion

The delay in peripheral nerve conduction

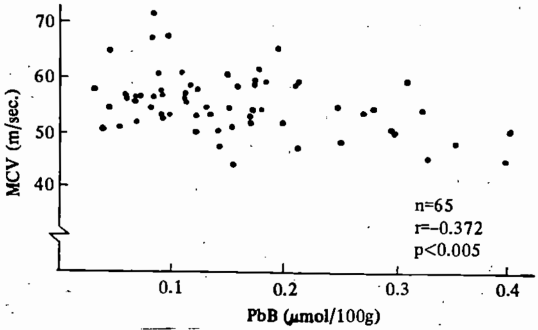

Fig. 1. Blood lead concentrations (PbBs) and maximal motor nerve conduction velocities (MCVs) in the median nerve for fourteen subjects.

Table 1. Subjects, blood lead concentrations and observation periods.

Subjects			Lead in blood (μmol/100g)[a]		
No.	Age (yrs)	Occupation (yrs)	No. of measurements	Range during observation period	Observation period[b]
1	45	Temperer (1.5)	3	0.11–0.40	3 m.
2	30	Lead smelter (7)	5	0.16–0.40	5 m.
3	57	Brass founder (16)	2	0.21–0.35	3 y.
4	44	Stereotype founder (23)	5	0.08–0.33	1 y.
5	44	Temperer (6)	3	0.08–0.31	3 m.
6	53	Lead smelter (28)	9	0.11–0.29	4 y.
7	50	Lead smelter (27)	2	0.17–0.27	3 m.
8	37	Stereotype founder (18)	3	0.11–0.25	1 y.
9	24	Stereotype founder (4)	3	0.15–0.25	2 y.
10	55	Welder (26)	9	0.06–0.21	4 y.
11	25	Stereotype founder (4)	2	0.17–0.21	3 y.
12[c]	58	Type founder (21)	6	0.05–0.15	7 y.
13[d]	59	Paint maker (1)	8	0.07–0.18	7 y.
14[e]	58	Dye maker (2)	5	0.03–0.07	7 y.

a : 1 μmol/100g = 2.1 x 10^2 μg/100g.   b : Expressed by months(m.) or years(y.)

c, d and e: Retired for one year, 8 years and 7 years, respectively, when this study was started.

Table 2. Maximal motor nerve conduction velocities (MCVs) in the median nerve corresponding to different blood lead concentration (PbB) levels.

PbB (μmol/100g)	MCV (m/sec.)			Level of significance	
	No.	Mean	SD**		
0.03–0.12 (0.08*)	28	57.4	5.2	$p<0.10$	$p<0.01$
0.13–0.19 (0.15*)	21	54.9	5.0	$p<0.10$	
0.20–0.40 (0.28*)	16	52.0	4.5		

* Mean value. ** Standard deviation.

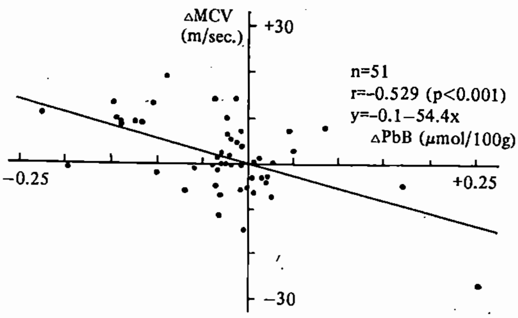

Fig. 2. Relationships between the change of blood lead concentrations (△PbB) and the change of maximal motor nerve conduction velocities (△MCV) in fourteen subjects. The two values with the highest and the secondarily highest △PbB represent the PbB change by the cessation of intensive CaEDTA administrations.

velocities in lead workers was reversible in correlation with the change of PbB in this study. The PbB, therefore, is useful as an indicator of the dose of lead in the peripheral nerves as shown in some reports (1, 3, 4).

The extent and recovery time of delayed nerve conduction velocities depend generally on the histopathological changes of the peripheral nerves in toxic neuropathy; the delay in nerve conduction velocities is more striking and the recovery is more rapid in the form of segmental demyelination than axonal degeneration (2). The axonal degeneration with rather long time of delayed nerve conduction velocities is likely to occur by long-term exposure to lead in man. In this study, the observation period was 3 months to 4 years in most of the subjects; the recovery time of delayed nerve conduction velocities might have been accelerated to some extent since certain amount of CaEDTA was administered. Further studies without administration of CaEDTA would disclose the recovery time of delayed nerve conduction velocities in lead workers.

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References

1. Araki, S. and Honma, T.: *Scand, J. Work Environ. & Health* 4(1976) 225-231.
2. Gilliatt, R.W.: In: J.E. Desmedt (ed., New Developments in Electromyography and Clinical Neurophysiology. *Karger, Basel,* 1973, Vol. 2, pp. 2-18.
3. Landrigan, P.J. et al.: *J. Pediat.* 89(1976) 904-910.
4. Seppalainen, A.M.: *Z. Gesamt, Hyg. Grenzgeb.* 23(1977) 644-646.
5. Zielhuis, R.L.: *Int. Arch. Occup. Environ. Health.* 39(1977) 59-72.

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EFFECT OF LEAD ON OSMOTIC RESISTANCE OF RED BLOOD CELLS DETERMINED BY COIL PLANET CENTRIFUGE

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Hematologic alterations have been studied as most important problem in chronic lead poisoning.

These include anemia, basophilic stippled cell, and changes in osmotic resistance and mechanical fragility of red blood cell (RBC). Changes in osmotic resistance of RBC are common in patients with lead poisoning and comparable changes can be produced in vitro by incubation of RBC with lead. We reported an increase in osmotic resistance of RBC determined by coil planet centrifuge (CPC) systems (1973, 1974, 1979). CPC is a precise and well reproducible device for measuring osmotic resistance of RBC with a minute of blood. Mechanism of an increase in osmotic resistance has been debated for many years. Cooper[5)6)] has shown that osmotic resistance of RBC in liver disease is attributable to a characteristic increase in free cholesterol to phospholipid ratio (surface area to cell volume ratio), sphingomyelin to lecithin ratio and total lipid to protein ratio. This time, we report the effect of lead of RBC osmotic resistance of workers exposed to lead, rabbits administered lead, and that in vitro experiment of human RBC.

Methods

1. Lead exposed workers: We obtained blood samples from 33 male workers who had been employed in lead refinery factory (mean age 46 years, range 30-72 years). As controls, we chose 70 male workers who had been employed in railway construction (mean age 46 years, range 28-65 years).

1) RBC count: Coulter Counter (Coulter Electronics) was used.

2) Hematocrit measurement: Capillary tube method was used.

3) Hemoglobin measurement; Cyanmethemoglobin method was used.

4) Measurement of intracellular Na^+ and K^+: 20μl of blood was washed well with isotonic $MgCl_2$ solution. After hemolysis of the blood in 4ml of 0.1mg/ml lithium solution, the intracellular Na^+ and K^+ were determined by flame photometer. (Hitachi 205D) Then the concentration of intracellular Na^+ and K^+ were estimated

by the value above and hematocrit. Mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) were calculated.

5) Measurement of RBC osmotic resistance: 5μl of the blood was incubated at 37°C for 10 minutes and centrifuged by CPC.

6) Measurement of blood lead: After hemolysis of 50μl in 1ml of pure water, blood lead concentration was determined by Hitachi Zeeman effect atomic absorption spectrophotometer.

7) Measurement of phospholipid of RBC membrane: Thin layer chromatography was used. Hemoglobin-free red cell membrane was prepared by Post's technique modified by us. Lipid was extracted from the membrane with 20 volume of chloroform-methal (2:1). The plates were prepared with Silica Gel G. Spots of the phospholipid were quantified by Shimazu dual wavelength chromatoscanner.

2. Administration of lead to rabbits: Solution of lead acetate (analytical grade) was given intramuscularly to four adult male rabbits in daily doses of 8.2mg/kg for period of 25 days. Four rabbits (male) were prepared as control

3. In vitro experiment of several metals (Pb, Hg, Cd, Cu, Zn, Mn, Cr): Adding 10μl of metal contained water, 1ml of normla heparinized human blood was incubated at 37°C for 2 hours with gentle agitation, and centrifuged by the CPC for 10 minutes. Then, intracellular Na^+, K^+ and MCV were measured.

Results

1. Lead exposed workers:

1) Intracellular Na^+ of lead exposed group was higher than that of control group and intracellular K^+ of the former was lower than that of the latter (Table 1).

2) MCV of lead group was similar to that of control group (Table 1).

3) Osmotic resistance of RBC was increased in comparison with control group (Table 2).

4) Different pattern of thin layer chromatograph was obtained.

Sphingomyelin to lecthin (S/L) ratio was markedly increased (Table 3).

2. Rabbits:

There were no differences in RBC count, MCVand MCHC between two groups. Fig. 1. shows an increase in blood lead concentration and Fig. 2. shows an increase in osmotic resistance of RBC in lead administered group.

3. In vitro experiment of human blood addition of Pb and Cd to blood caused a marked increase **in osmotic resistance of RBC (Fig. 3).**

Table 1. Hematological findings.

	Workers	Controls
RBC ($10^4/mm^3$)	453±44	451±35
Hematocrit (%)	43.7±3.4	43.6±3.5
MCV	94.7±6.3	94.7±5.2
Intracellular Na^+ (mEq/l)	26.6±3.4	17.0±1.8
Intracellular K^+ (mEq/l)	82.5±3.8	85.6±3.0
Blood Pb (μg/dl)	68.4±19.8	15.4±4.6

Table 2. Osmotic resistance of RBC by CPC system (mOsm)

	Workers	Controls
Start point of hemolysis	91.9±6.3	94.4±5.6
Maximum point of hemolysis	72.3±4.7	74.5±4.6
End point of hemolysis	56.1±5.1	57.6±3.8

Table 3. Phospholipid of red blood cell membrane.

	Workers	Controls
Lysophosphatidyl choline	2.3%	1.0%
Sphingomyelin	37.0	30.1
Phosphatidyl choline	7.4	28.4
Phosphatidyl serine	34.7	20.5
Phosphatidyl ethanolamine	18.6	19.9
SM/LC ratio	4.93	1.06

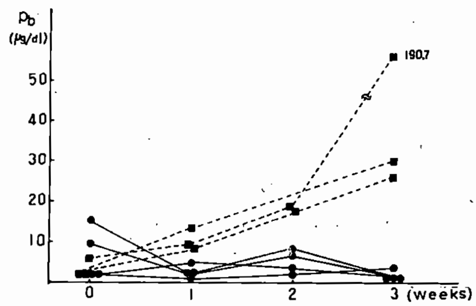

Fig. 1. Changes in blood lead concentration. Lead acetate was given intramuscularly to adult male rabbits in daily doses of 8.2 mg/kg.

● = control group □ = lead group

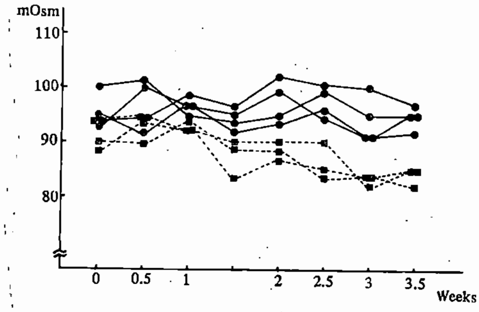

Fig. 2. Changes in osmotic resistance of RBC by CPC (maximum point of hemolysis).
Lead acetate was given intramuscularly to adult male rabbits in daily doses of 8.2 mg/kg.

● = control group □ = lead group

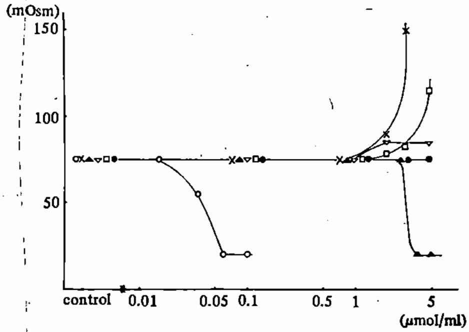

Fig. 3. Changes in osmotic resistance of RBC by CPC (maximum point of hemolysis).
Normal human blood was incubated with heavy metals for 2 hours.

○ = Pb X = Hg ▲ = Cd ▽ = Zn □ = Cu ● = Mn

Hg caused a marked decrease in osmotic resistance of RBC and Cu caused a little decrease (Fig. 3). Cr, Mn and Zn caused no significant changes (Fig. 3). Pb and Cd caused a decrease in intracellular Na^+ and MCV, but made no change in intracellular K^+ (Fig, 4. 5). Hg and Cu caused a decrease in intracellular Na^+, but an increase in K^+ and a slight increase in MCV. Cu, Mn and Zn caused no changes in intracellular Na^+ and K^+, and MCV.

Discussion

The increased resistance to osmotic lysis was seen in both the in vivo and in vitro experiments. These results indicate that more water could enter the cell before the critical spherical form was reached and lysis occured. The decrease in MCV (in vitro) shows that treatment of human RBC with lead results in a leak of K^+ from the cell. As to the in vitro experiment,

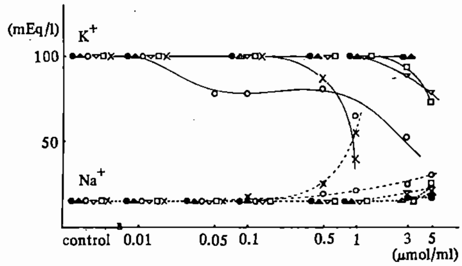

Fig. 4. Changes in intracellular Na^+ and K^+.
Normal human blood was incubated with heavy metals for 2 hours.
(Solid line = K^+ dotted line = Na^+)

○ = Pb X = Hg ▲ = Cd ▽ = Zn □ = Cu ● = Mn

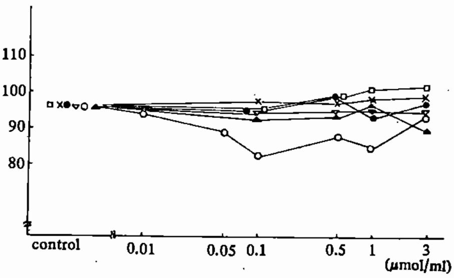

Fig. 5. Changes in MCV.
Normal human blood was incubated with heavy metals.

○ = Pb X = Hg ▲ = Cd ▽ = Zn □ = Cu ● = Mn

K^+ leakage seems to be important in an increase of osmotic resistance of RBC. There seems, however, to be different mechanism between in vitro and in vivo (both humans and animals). Because no change of MCV in vivo (humans and animals) and a decrease of MCV in vitro are observed.

We obtained interesting result from analysing RBC membrane, i.e., a marked increase in S/L ratio. This is the same results of Cooper, that he demonstrated an increase in S/L ratio in patients with abetalipoproteinemia. These red cells resembled to spur cells with an increase in osmotic resistance. We are now continuing study on cholesterol/phospholipid ratio and lipid/protein ratio.

References

1. Vincent, P.C. and Blackburn, C.R.B.: Effect of heavy metal ions on the human erythrocyte. I. Comparisons of the action of several heavy metals,

Aust, *J. Exp. Biol. Med. Sci.* 36:471, 1958.
2. Post, R.L., et al.: Membrane ATPase as a participant in the active transport of sodium and potassium in the human erythrocyte, *J. Biol. Chem.* 155:274, 1961.
3. Ito, Y., et al.: The coil planet centrifuge, *Nature,* 212:985-987, 1966.
4. Horiguchi, S., et al.: Relationship between osmotic fragility of red blood cells by coil planet centrifuge and peripheral blood findings in lead workers, *Osaka City Med. J.,* 21:55-58, 1975.
5. Cooper, R.A., et al.: Modification of red cell membrane structure by cholesterol-rich lipid dispersions. A model for the primary spur cell defect, *J. Clin. Invest.* 55: 115-126, 1975.
6. Cooper, R.A. et al.: Decrease fluidity of red cell membrane lipids in abetalipoprotenemia, *J. Clin, Invest.* 60:115-121, 1977.

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Session 9.
Work Physiology

HEALTH MONITORING OF SHIFT WORKERS

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With the rapid industrialization of our country, an interesting number of our workers are being assigned to shift work. This is the result of industry being forced by growing market demands and the high cost of machinery to operate continuously 24 hours a day. Workers are therefore shifted periodically from day to night work. Since human systems function according to biological circadian rhythms this periodic shifting of the sleep-work cycle produce alterations of these rhythms resulting in physiological and emotional disturbances.

To prevent the deleterious side-effects of rotational work shift, management and labor have tried to keep workers on a permanent work shift. After a short period of adjustment specially for a night shift worker, the body adapts itself to the new cycle and no serious health problems result in most individuals. This system of permanent shifts however is not acceptable to most workers due to the previously mentioned social and family dislocations. So pressure is brought to bear for a system of rotation. In this paper we will discuss some of the problems resulting from such a system rotation.

Circadian Rhythms or Biological Clocks

In a normal person there is no organ or bodily function that does not show some form of daily rhythmicity. Examples of this cyclical changes are:

1. body temperature — it is well-known that our basal body temperature rises towards evening and is lowest in the early morning hours.
2. menstrual period
3. heart rate
4. secretion of digestive enzymes
5. flow of urine, etc.

Most of these rhythms are patterned on a 24-hour day, hence the name "circadian" after the Latin "Circe Dies" or about a day. Periodic environmental factors called "Zeitgebers" (German for time-givers) affect these rhythms. Examples are light, environmental temperature and even social interactions.

When one of these factors or Zeitgebers changes as for example when the light-dark cycle is disturbed, two things may result. The circadian rhythms either shifts with the Zeitgebers or a desynchronization of the system occurs. The latter results in various disturbances in the relationship between bodily systems, producing all sorts of both vague and precise symptoms felt by the patient. The different systems re-adjust themselves on different time frames.

Effects of Shift Work on Circadian Rhythms

The most significant effect of shift work particularly to a workers is *fatigue.* This is due to the prolonged stress brought about by the disturbances of circadian rhythms as well as the result of an accumulating sleep deficit. Kogi, et al. reported increased fatigue in female workers even in the two-shift system without night work. EEG studies also showed that sleep during an atypical time (such as sleep during the day) is usually shortened and disturbed thereby contributing to the further development of fatigue in the workers.

The effects of shift work on the health of the worker are mainly due to disturbance of sleeping patterns, changes in the eating habits, the previously mentioned fatigue and the stress produced by disturbances of the biological clocks. The organ systems most affected are;

1. digestive system
2. cardio-respiratory system
3. nervous system
4. urinary tract
5. endocrine system

Finally, particular interest to the occupational medical practitioner is the effect of shift work on productivity and safety. Various studies in Europe and Japan have shown distinct circadian variations in performance at different times of the day. Grandjcan studied air controllers and found their alertness to be better at certain periods of their work schedule. Browne in a study of switchboard operators found that performance was improved between 9-12 A.M. but declined after 5 P.M. Industrial accidents were found to occur more frequently between 10 P.M. and 2 A.M.

Kinds of Shift Work and Optimal Shift Systems

There are many different systems as there are companies in the Philippines but most of them can be categorized into the following headings:

1. Shift system without night work — two teams that work on 2 shifts usually from 6 A.M. to 10 P.M.
2. Shift system with night work
   a) two teams that work 12-hour shifts
   b) three teams that work 8-hour shifts
   c) four teams that rotate three 8-hour shifts with 2-3 consecutive days off after a work period of from 5-7 days.
   d) irregular with varying number of work teams and work-cycle length.

Devising a shift system that is optimal for everybody is next to impossible. Certain guidelines and criteria based on studies on shift work, however, can be followed for selecting a system that is less onerous for the health and well-being of shift workers. There are:

1. In continuous shift work, the length of a cycle should at least be four weeks to enable the workers' biological clock to adapt and stabilize satisfactorily before being required to re-adjust to a new schedule. The system should be regular to enable the worker to plan for his family and social life.

2. Permanent assignment to a particular shift is best for the health of the workers on shift work but disastrous for his social life especially if assigned to the night shift.

3. In continuous shift work, arrangement for long weekends at periodic intervals, as in the case of the four-team systems, will go a long way to help alleviate family and social dislocations.

4. Ideally a 24-hour period of rest should be allowed when shifting from the night to day work.

Lastly, each company has to adapt a shift system based not only on what is best for employees' health and morale but also taking into consideration its own production targets as well as its safety programs.

Selection, Screening and Health Maintenance of Shift Workers

At present, there are no positive criteria available to serve as guidelines in the proper selection of shift workers. At best the criteria in use now are mainly negative based on results of numerous studies on shift work in the industrialized countries. Occupational health workers should screen prospective shift workers for *conditions* which are adversely affected by alterations in circadian rhythms such as:

1. digestive tract disorders like peptic ulcer

and severe hyperacidity.

2. diabetes
3. thyrotoxicosis
4. epilepsy
5. bronchial asthma and respiratory disease with impaired pulmonary function
6. severe hypertension
7. chronic renal disease
8. insomnia and sleep difficulties
9. psychiatric symptoms, depression and severe emotional problems
10. psycho-social problems.

Individuals vary in their ability to adapt to changes in circadian rhythms. There is however no accurate system of screening tests which will seek out those best suited for shift work. At best, the EEG can show depth and calmness of sleep, so that individuals with disturbed sleep during reversed sleep/work cycle can be advised not to go on rotational shift work. Occupational health workers should also prepare shift workers for the problems they may meet and instruct them how to cope with the situation.

Sickness-Absence Experience of Shift Workers

A group of one hundred shift workers were monitored for one year on the following parameters:

1. incidence of consultations and clinic visits;
2. sickness-absence record;
3. incidence of illness referrable to the following systems:
   a) respiratory
   b) cardio-vascular
   c) gastro-intestinal
   d) genito-urinary
   e) neuro-psychiatric

A control group of fifty workers whose work assignments were always in the daytime were similarly monitored during the same period of time (daytime workers).

The shift workers were rotated on three 8-hour shifts namely 6AM-2PM, 2PM-10PM, and 10PM-6AM shifts. They stayed on each shift from 4-6 weeks with no day off in between transfers from one shift to another. The daytime workers worked from 7:30AM-4:30PM.

The incidence of consultations and clinic visits for both groups were as follows:

	Total Consultations & Clinic Visits	Average/Employee per Year
Shift Workers	1,109	11.1
Daytime Workers	389	7.8

The difference of 3.3 consultations more for shift workers was found to be highly significant by standard deviations calculations. Shift workers therefore visit the clinic more often for bodily complaints than daytime workers.

The sickness-absence record of the 2 groups are shown below:

	Sick Leave Cases	Average/ Worker	Total No. of Days Taken	Average/ Employee
Shift Workers	639	6.4	937	9.4
Daytime Workers	228	4.6	382	7.6

There were on the average 1.8 more sick leave cases among shift workers who take 1.8 days more per illness than the daytime workers. Both deficiencies were also found to be significant.

The ratio of sickness-absence cases to non-lost time illness for the two groups were practically the same as shown by the tabulation below:

	Sick Leave Cases	Total Consultation & Clinic Visits	Ratio
Shift Workers	639	1,109	0.57
Daytime Workers	228	389	0.59

There is therefore no difference in the number of sick leave cases in proportion to the clinic visits among the two groups.

The incidence of illness referrable to various systems most affected by disturbances in circadian rhythms are shown below:

	Shift Workers		Daytime Workers	
	No. of Cases	Ave.	No. of Cases	Ave.
Respiratory	654	6.5	232	4.6
Cardio-vascular	3	–	–	–
Genito-urinary	26	0.3	14	0.3
Gastro-intestinal	330	3.3	109	2.2
Neuro-psychiatric	121	1.2	47	0.9

The figure show that there is a highly significant increase in the incidence of respiratory and gastro-intestinal case among shift workers. The number of neuro-psychiatric complaints though a bit higher among shift workers was not found to be significant when compared to that of the daytime workers. The incidence of genito-urinary tract problems were about the same for the two groups. As expected, we did not expect too many cardio-vascular problems among these workers because of their relatively young age.

Summary and Conclusions

Health problems related to rotational shift work are discussed including the various mechanisms by which various organ systems are affected most by alterations in the circadian rhythms. The effects of shift work on these rhythms produce a variety of symptoms and disturbances in the health of the worker. It is therefore imperative for the occupational health practitioner to be aware of these problems so that he can screen out potential bad risks for shift work and advise shift workers on how best to adapt and cope with these problems.

A report on a study of shift workers and a control group in a factory is presented. It showed significant increases in sickness-incidence and absenteeism among shift workers. There was also a marked increase in the incidence of gastro-intestinal and respiratory disease among these workers.

Finally, employers should adapt a system of scheduling shifts which allows enough time for the circadian rhythms to adapt and stabilize satisfactorily before requiring them to readjust to a new time schedule. Further studies, both in the experimental physiological laboratory and in the factories are needed to increase our knowledge on health problems related to shift work.

References

RUTENFRANZ, J., et al. Biomedical and psychosocial aspects of shift work. Scand. J. Work Environment and Health, 3, (1977).

TASTO, D.L., et al. Health consequences of shift work. NIOSH technical report, March 1978.

WINGET, C.M., et al. Physiological effects of rotational work shifting: A review. J. Occ. Medicine, March 1978.

MARTINEZ-O'FARRELL, J.A. Circadian rhythms. J. Occ. Medicine, June 1968.

Occupational Health and Safety, ILO publication.

KOGI, K., et al. Chronic effects of the double-day shift system on young female workers. Proceedings, 8th Asian Conf. Occ. Health, September 1976.

RUTENFRANZ, J., et al. A retrospective follow-up study of disease of day and shift workers. Proceedings, 19th International Cong. Occ. Health, September 1978.

KOLLER, M., et al. Psychosocial problems and psychosomatic symptoms of night and shift workers. Proceedings, 19th International Cong. Occ. Health, September 1978.

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BEHAVIORAL SKILL OF SHELLFISH DIVERS IN AN OKINAWAN COMMUNITY

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Introduction

Work skill is a less-argued, but fundamental component in occupational activity. A prominent feature of work skill links with person-to-person difference in work efficiency. According to M.E. Mundle, an industrial engineer who published "Motion and Time Study" (1960, 3rd ed.), skill in industrial work process appears to be assessed by a single measure of work pace. Considering simplified industrial work settings, such an assessment may be of considerable validity. However, subsistence activities, especially hunting and fishing both aiming at animals *ferae naturae,* are characterized by freeing from a stereotyped work process and composing simultaneously of various components, either physically or psychologically (or intellectually) oriented; thereby they tend to produce a greater inter-individual variation of skill as well as of work efficiency. Individual person's work pattern in such subsistence activities is thus not only an essential information in itself but also would contribute to a better understanding of human work skill.

The qualitative and quantitative study relevant to subsistence work pattern has been carried out by anthropological or human ecological fieldworkers rather than occupational health scientists. The findings have come from time study in such fieldworks, which may be classified into time-allocation study and "input-output" study. Especially the input-output study dealing with quantitative balance between output and labor input fulfills our problem concerned; although any studies, e.g. Carneiro's (1957) in the shifting cultivators of Latin American Indians, Lee's (1957) in the hunting-gathering Bushmen in Kalahari, and Rappaport's (1968) in the highland New Guinea horticulturists, have overlooked person-to-person difference in the work pattern and work efficiency. Some human ecologists of Japan have paid a great attention on this problem, taking output per labor input as a central measure, like in the prevailing input-output studies. In order to grasp individual worker's skill conveniently, such studies treated of working populations, in each of which the whole work process is accomplished by each individual's labor input, labor implements are virtually identical, and the work places and time are freely selected by each individual.

Previous Findings

Of the several studies concerned, two examples are presented here. The investigation of hand-line fishing population in the Inland Sea of Japan (Ohtsuka 1975) revealed a great individual variation in terms of catch (yen) per work-day, the highest being nearly four times greater than the lowest (Fig. 1). This index was negatively correlated with the fishermen's age ($r = -0.535$, $p<0.05$), while younger fishermen were not involved in this working population. In my view, more emphasized is the age-independent variation, within which

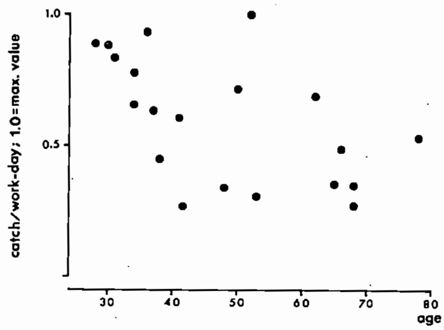

Fig. 1. Fishing productivity and age among Japanese hand-line fishermen.

the values of the older fishermen over sixty years of age are comparable to those of a lower half of the remainder. Perhaps, this reason stems from the fishing strategy not requiring a heavy work load by means of the use of motorboat and, on the other hand, depending largely on the intellectual skill such as selection of fishing spots in accordance with always-changing environmental conditions.

The other fieldwork among a lowland Papuan population, individual hunting productivity (Fig. 2) shows a greater variation with a peak in age of around thirty (Ohtsuka 1977a). Judging from the measurements of grip strength and visual acuity, the younger less than 15-16 years of age being behind in the muscle strength while the older over fortyfive were behind in both of the measurements. These physiological features condition very low productivity of the two groups of different extremes in age. Because the hunting activity concerned requires energy-consuming travel in the forest and savanna and qualified sensitivity of recognizing the existence of animals. Another implication

Fig. 2. Hunting productivity and age among Oriomo Papuans.

is also appropriate for the productivity of the unmarried male lower than that of the married male. This may come from the experience which increases in accordance with aging and elaborates the searching ability as well as selectivity of hunting spots.

An emphasis is commonly placed on the great person-to-person variation, and the individual work efficiency may be conditioned by physiological capability and experience, or physical skill and intellectual skill (Ohtsuka 1975). It is reasonable to suppose that the heavier the work load in physiological sense the greater the inferiority of the aged worker, and that the more complex the activity the longer the time needed to attain skillfullness. Also conceivable is that in age range except for the older and the younger, individual variation in skill tends to be great. According to these implications, I proposed a hypothetical model of work efficiency as a function of age, as shown in Fig. 3 (Ohtsuka 1977b). However, these previous studies treated of an activity without dissecting it into components, and focused exclusively on the relation between work efficiency and age. *Tridacna* shellfish gathering activity which is the target of the new study is favorable not only because it relates to physical capability and experience but also because it can be traced in detail to grasp separately several components of a diving activity. I have just started this project so that the data of my preliminary survey will be presented.

Tridacna Diving and Divers in Kubasaki Community

The selected community in the 1978 survey

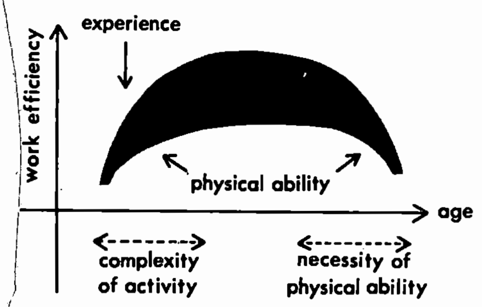

Fig. 3. Schematic relation between work efficiency and age.

was Kubasaki community in the Kohamashima Island (24°20'N, 124°E) of Okinawa. A large reef-flat develops in the region, and the island is surrounded by shallow water zone up to several meters in depth which is the habitat of *Tridacna* shellfish. The work places are located within three kilometers from the settlement. While sea-going work time in a single day varies to some degree according to such environmental conditions as tidal cycle, it ranges from five to seven hours. Judging from the sales records in July and August of 1978 of our investigation period, the full-time divers worked three fourth of the total days on the average. Their off-days were determined mainly by such severe environmental conditions as typhoons. The Kubasaki consisted of a dozen of households only and it involved eight divers. *Tridacna,* genus of a group of bivalve shellfish, inhabit inside of corallite with only its lid thrusting into the coral surface. The normal size of *Tridacna* is around 10 cm long.

The divers individually sail out by motorboat and when he arrives at the spot as he prefers, he anchors the boat there. He usually wears shirt, shorts and hydroscopes only, and the shellfish storing vessel which floats on sea surface is tied with his waist by rope. The first procedure of gathering is to swim around sea surface to search the *Tridacna.* The recognition of them leads to the second procedure, dividing towards the shellfish. Then the third procedure commences; the diver, usually in the slanting figure with arms and head just over the sea bottom and legs in the opposite direction, strikes and scratches the corallite surrounding the shellfish with a hammer, and he picks the released shellfish up. After this he will rise to sea surface to repeat the same process. The usual depth of diving is two to three meters, and except for searching time, the duration of a single diving activity normally ranges from 10 to 25 seconds.

Results and Discussion

The eight divers consisting of five full-time divers and three part-time divers were studied. Our investigation for each diver was to trace by the three investigators for about successive half an hour while the first investigator directly observed his in-water behavior and the second took 8 mm movie film in water. The observation record was conveyed to and recorded by the third investigator on the boat. The film study was not yet completely analyzed to be involved in this presentation.

Their diving activity and its output were expressed as five components or variables, (1) number of shellfishes obtained per work time, (2) in-water duration per dive, (3) number of hammer operations per dive, (4) number of dives per work time and (5) number of shellfishes obtained per dive, as shown in Table 1. Besides the tracing survey, we obtained the sales records in July-August period. They made clear of per day per head catch, which is regarded as an appropriate measure of the work efficiency for the subsistence activity. This measure and number of shellfishes per work time (the first variable mentioned above) showed a very parallel relation ($r = 0.99$, $p<0.01$), thereby the validity of the latter for assessing the work efficiency would be high.

The other four are regarded as explanatory variables, and implications of them are shortly given as follows, (2) most attributable to physiological capability, (3) determined by the strength of hammer strike and the accuracy of striking point depending on the manual dexiterity, (4) attributable to the searching ability of the schellfish, and (5) reflecting success versus failure proportion, since a usual diving aims at obtaining one shellfish. While a large range of every variable is noteworthy, shellfishes per time, which indicates work efficiency, is the most common variable, the highest being more than four times greater than the lowest.

To examine the interrelationship of the above five variables and diver's age and diver's work specialization, full-time or part-time, the sample correlation coefficients are shown in Table 2. Statistically, significant relations exist between four combinations. Of the seven variables, in-water duration and hammer operations have no significant correlation with any other variables. Regarding age vs dives per time and specialization vs shellfishes per dive, the former is judged to derive from the tendency that the experience has elaborated searching ability to raise number of dives per work time, while the latter is the product of the full-time diver's superiority in success rate. Apart from these, it should be more noticeable that the measure of shellfishes per time is significantly correlated with two variables. The calculation of partial correlation made clear that this still significantly correlated with dives per time, but not with age. This suggests that the work efficiency is mostly attributable to number of dives per time, which couples with the searching ability, an experience-oriented skill more than physiologically oriented skill.

Concluding Remarks

Comparing with industrial labor, free-paced subsistence activity tends to bring about a large

Table 1. Diver's attributes and itemized diving activity

Indiv. No.	Age	Full-time vs. part-time	No. of shells obtained per work time	In-water duration per dive	No. of hammer operations per dive	No. of dives per work time	No. of shells obtained per dive
1	17	part	13.4	17.2	10.1	15.1	0.89
2	23	full	10.7	27.3	8.9	8.5	1.27
3	28	part	8.2	17.9	16.3	15.7	0.52
4	29	part	8.5	13.5	7.0	11.6	0.73
5	35	full	17.2	19.2	12.5	17.2	1.00
6	49	full	27.2	11.0	8.6	27.8	0.98
7	57	full	19.9	16.5	9.1	20.6	0.97
8	62	full	19.6	17.7	13.3	20.8	0.94
Mean			15.59	17.54	9.37	17.16	0.91
S.D.			6.61	4.76	3.06	5.98	0.22

Table 2. Simple and partial correlations among diving activity components and diver's attributes

	No. of shells obtained per work time	In-water duration per dive	No. of hammer operations per dive	No. of dives per work time	No. of shells obtained per dive	Age
In-water duration	−0.448					
Hammer operations	−0.163	0.180				
Dives per time	0.904**	−0.674	0.085			
Success rate	0.375	0.516	−0.462	−0.048		
Age	0.730*	−0.362	0.058	0.733*	0.116	
Full vs part	0.696	0.233	−0.110	0.419	0.757*	0.643

1 : No. of shells obtained per work time. $r_{12\ 3} = 0.793$*
2 : No. of dives per work time. $r_{13\ 2} = 0.232$
3 : Age

person-to-person variation which greatly depends on individual work skill. Each activity without dissecting it into components relates with worker's age. The extremely younger and older are inferior to the remainder because of their weak physiological capability, while in the age range in between the individual worker's skill is attributable partly to the physical skill and partly to experience or non-physical skill. In the study of *Tridacna* shellfish divers in Okinawa, the age factor significantly correlates with the labor efficiency, but the partial correlation analysis between the variable of labor efficiency, and the two variables of age and number of dives per work time reveals the stronger effect of dives per time than that of age. The variable of dives per time is mostly attributable to the searching ability which might be determined by the experience or non-physical skill. Though our data were very scarce, the individual work efficiency should be studied more earnestly, and the assessment of non-physical skill in addition to physiological capability or physical skill will occupy the significant place in it.

References

Carneiro, R.L. (1957) *Subsistence and Social Structure.* Ph.D. dissertation, Univ. of Michigan.

Lee, R.B. (1957) What hunters do for a living, or, how to make out on scarce resources. In *Man the Hunter.* ed. by R.B. Lee and I. DeVore, pp. 30-48. Chicago: Aldine.

Mundel, M.E. (1960) *Motion and Time Study: Principles and Practice* [3rd ed.]. New York: Princeton-Hall.

Ohtsuka, R. (1975) Fishing time and catches among hand-line fishermen. *Proc. 18th Intnl. Congr. Occupat. Health,* 241-242. Brighton.

Ohtsuka, R. (1977a) Sago eaters: An ecological discussion with special reference to the Oriomo Papuans. In *Sunda and Sahul.* ed. by J. Allen, J. Golson and R. Jones, pp. 465-492. London: Academic Press.

Ohtsuka, R. (1977b) Individual variation in the fishing activity of Nasake Islanders. In *Human Activity System.* ed. by H. Watanabe, pp. 41-59. Tokyo: Univ. of Tokyo Press.

Rappaport, R.A. (1968) *Pigs for the Ancestors: Ritual in the Ecology of a New Guinea People.* New Haven: Yale Univ. Press.

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ATTITUDE TOWARDS SHIFTWORK AT COTTON MILL TOHPATI

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Introduction

Shiftwork is not a new problem. Ramazzini in 1700 mentioned the bakers working by night "when it was natural for man to sleep."

Since then, in industrialized countries, with the increase used of shiftwork systems, more and more studies were and all being done in this field with the objective to achieve the most healthiest, safest, effective and efficient way in conducting this system of work, particularly seen from the worker's point of view.

In Indonesia, actually shiftwork is not also a new problem, because it already existed since the first hospital was built in this country. But due to development, especially in these last years, shiftwork became more and more popular and conducted actively within various sectors of development, particularly within the industries. As consequences, some problems were also emerged among the workers which attract to be studied. And as a study on shiftwork is always challenging and interesting and also is relevant to the successful of the development goal, an effort has been started, it is by conducting a preliminary survey in this system of work in Indonesia.

In regard to this, an aspect of shiftwork, it is on the attitude of workers to such a work, in this case at the Cotton Mill Tohpati, was carried out.

Methods

The investigation was carried out by means of questionnaires, consist of 27 items, which are divided into:

- 7 items on personal data
- 5 items on attitude toward shiftwork
- 6 items on state of health
- 9 items on attitude toward work and working environment.

As samples, were used 184 workers, consist of 173 male and 11 female workers, from which 71 were in night shift, 48 in morning shift, 33 in afternoonshift and 32 in holidays.

Results and Discussion

From 184 workers, in fact 151 were already married, from which 122 are having 1-3 children and 27 are having more than 3 children.

Most of these workers (170 workers) have been working for 6 years or more in this shiftworksystem, and practically got acquainted with this work since they started to work in this factory, 6 years ago.

As the opinion on shiftwork is concerned, in fact 66.42% are liking this shiftwork, while the rest dislike it, or have difficulty to say something and give no answers at all. The above opinion is supported by their attitude toward the type of work, in which 48.86% prefered shiftwork, 35.64% said it is just about the same, 14.04% choosed day work and 1.62% gave no answer.

From the above data it seems that some of the workers do consciously like the shiftwork, some of them did not, and the rest considered it just about the same whether the job is conducted on shiftsystem or not, and the most important is they have a job for their living, without taking care how the condition of the job is, how it is should be done.

Other reasons for their liking to shiftwork are as follows: 39.42% considered it of having much time off, 16.20% due to financial reasons, 23.22% as having varied working hours; and 28.08% of having no benefit at all and gave no answer as the reasons for their dislike to the shiftsystem.

Toward the implementation of the shiftsystem, 77.76% of workers prefered the recent system in comparison to the weekly system, and 18.9% said it is about just the same. And how it was done, 65.88% said it was already good, 29.70% said had difficulty to say something and only 1.08% considered it as a bad one.

In regard to their state of health, 50.22% said that they are feeling healthy in conducting this work, although in fact 55.62% loss their appetite, 17.28% having pains in stomach, 11.48% flatulence, 11.34% nausea and vomiting, and 7.02% diarrhea, in carrying out this shift-system of work. In addition 42.12% are always having dizziness, 36.72% of headache, 36.18% of weakening of concentration, 19.98% felt fatigue more than usual, 12.96% of hand tremor.

With such a data, it is rather difficult to believe that they are really do like the shiftwork and that the shiftsystem is really gave benefit to them, and also that they are really healthy in doing the job. It seems that their answers are depended mostly upon their adaptation to such kind of a job after 6 years of working, and also of having no comparison particularly of better quality, to what they have faced daily. It might be good also to predict that they are so afraid to say the truth, with the consequence of losing their job, in a country where a job is too difficult to be found.

In such a condition, the most important thing is, to have a job without taking care, how bad the condition is and how much you get in doing the job.

In carrying out this shiftsystem, 73.44% said of having sleepiness always in conducting night shift, 41.58% are having difficulty in falling asleep, 24.3% are always awakening in the middle of the sleep, and 65.34% slept between 1-4 hours only after night duty. In addition only 50.76% could sleep well without disturbances after night duty at home.

This data showed that shiftsystem, especially the night shift, is actually not a suitable work, because it creates practically sleeping deficit among the workers. And to have a favourable environment and condition for somebody to be able to have their sleep well after night duty, while the others have to do their social life in form of activities is really a very serious and difficult task in such a community likes we have to day.

Liking the job is not always means satisfaction in doing the job, as it was shown by the following data: although 65.34% of the workers like the recent job, only 40.50% satisfied with the job, 20.52% did not and 36.72% had difficulty to say something. Further study should be done to solve the problem.

In regard to the salary they received up to now, 42.12% said it was sufficient, 29.70% said insufficient and 17.82% had no answers. Here again, to say the truth is still difficult among workers.

Concerning their opinion to the atmosphere of the working environment, in fact 55.08% said it was pleasant, and 32.40% had difficulty to say. While 19.44% said it was too noisy, about 67.50% said that they can adapted the situation. So is also, if 8.84% said it was too hot, 75.06% said it was alright for them. Obviously these data showed again the effect of 6 years adaptation of workers to their opinion of the environment. The right answer will be achieved if the impacts of the environment to the workers can be measured, for examples data on hearing loss, and so on.

In relation to the family opinion toward shiftwork, particularly their wives, data collected showed that 69.66% had to accept the condition as it is or without reserve, and 71.28% of their wives have nothing to say and accepted the situation, every night, if their husband say goodbye for carrying out night duty. Yes, nothing to say, because they have no choice. If it is needed, especially for the sake of the whole family, they have to accept also of loosing their social life too, in this case for not being together with the whole family during night time.

And this will creates complex things afterward, from one case to more other cases as the siftwork is continuing worked out, particularly in regard to the social life of the workers due to the among other to sleeping deficit among the workers.

Conclusion

Due to development, shiftwork in Indonesia became more popular and applied in various sector of industries. Although from economical point of view and employment purposes, shiftwork is indeed a beneficial method or system to be pursued, some impacts emerged as consequences of this new system of work, **parti-**

cularly the night shift, have to be taken into consideration before exaggerating this system in every sector of activities in industries.

Data collected from the workers at the textile mill Tohpati might be of useful in relation to that purpose above, although it was based only to a preliminary study and only covered one aspect of shiftwork.

From data collected it was shown that:

1) Although 66.42% of the workers are linking the shiftwork, it is practically due to their adaptation to such a kind of work, and having no other choices or other alternatives to be chosen. For them, the most important thing is to get a job, and try to like it, whether the condition is bad or not, or the salary is sufficient or not.

2) This opinion was supported by their opinions on the type of wórk they prefered, on the reason of liking and disliking the shiftwork, and on not telling the truth by giving no answer or saying just about the same, which illustrate their real opinion of neutrality.

3) Shiftwork, especially nightshift, gave many impacts to the worker's state of health, which consequently will be decreasing the effectiveness and efficiency of the workers.

4) Shiftwork, particularly the nightshift, will create sleeping deficit, which will be accumulated day by day, if steps to face the problem are not feasible to be conducted, especially in developing countries, as for example managing a favourable environment after night duty for the workers.

5) Adaptation of workers to the working environment is not a guarantee that there is not any problem still existing at the place, therefore further study should be done, for example on the environment impact to the worker's physiological capacity.

6) Due to the difficulty in getting a job in Indonesia, sometime they have to trade-off their social life, just for the sake of having a job, from which the whole family is depended upon.

With all those informations collected from the preliminary study, it seems that the role of Indonesian Government in managing the worksystem which should be pursued by the industries became so important, it is in one side to keep the development is economically sound, and in other side to open new employment opportunities in which built-in already their prevention and maintenance of the workers.

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WOMEN WORK AT SAND EXCAVATION SECTOR IN BALI

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Introduction

Due to development in Indonesia, particularly these last years, demand on building materials is increasing significantly, not only in form of imported goods but also those which can be made and supplied in the country itself.

One of these materials is sand, which is mostly collected from the river and is usually conducted by woman workers, especially in the island of Bali.

In doing this task, obviously identified by observation that such a job can be considered as a very heavy one, particularly in comparison with the unbelievable salary accepted until now in doing such a task.

A heavy subsequent job has to be performed by a woman worker in collecting this sand, and this cycle must be carried out several times a day.

A cycle can be systematically divided into parts as follows:

1) With a basket on her head and another small basket or a shovel in her hands, she has to fill her basket with sand lifted from the bottom of the river. Apparently in doing this task, several body positions should be performed,

it is from standing erect up to stooping position, and this must be done several times until the basket is full of sand. This heavy job become more heavier due to another burden has to be faced in form of cold water environment and also the stream of the river, which is sometime hard enough in rainy seasons.

2) With a load on her head, sometime up to 35 kg, she has to walk to the bench of the river, and then climbing it to the place where sand has to be collected before transported to other places. Here again, she has to face an additional load due to the steeply path in climbing the bench, which is usually became slippery after several cycles of works, due to water brought along by the workers and their sand. Understandable that in such a condition of work, accident is not an uncommon thing.

Such a cycle has to be worked out several times a day, and because the salary of the workers is depended upon the amount of baskets can be lifted a day, it is understood that most of the workers only want to stop from working if they already felt exhausted and followed by spontaneous rest.

An additional job is performed also at the sand collection place, if a truck has to be filled for transportation of sand to needed areas. Here again, we shall see that the work was conducted in an unefficient way, which is certainly will wasting the energy of the workers as consequences, and also is not economically done, too much time comsuming.

With this illustration, we can assumed that sand excavation work is really a heavy work, and to confirm this, a prdliminary study has been done in one of these activities, from ergonomically approach.

Methods

From 270 women work daily in that place, 90 were taken randomly as samples.

Notes had been done on personal data, daily working hours, weekly working days, their nutrition, and other informations related.

The average load being carried and the amount of salary received daily were also became our attention.

Heart rate fluctuations was noted during one hour work, which was measured at the end of every cycle, it is just after the content of each basket being thrown away to the collection place by the workers. The measurement was done through radial artery by using a stopwatch.

Results and Discussion

Data collected have shown that 21.11% of these workers are under 14 years old, and nearly a half of them (48.80%) are derived from the 14-21 years old workers. It means that they are actually belong mostly to our young generation who are very anxious and need very much a more better quality of life in facing the future. And in efforts to achieve this goal, actually by improving their working condition, for the time being it contributes already to this objective.

In regard to their education, 60% of these workers are still illiterate, and only 10% had passed the elementary school. Most of them had already been working in this sector for nearly 1 year, and practically they are working for 6.9 hours a day and 6.8 days a week.

Beside this job, some of them have to do other works at home, as for instances, 41.11% are cooking, 34.44% are cleaning the house, and 18.88% are taking care of their relatives (sisters and brothers).

In relation to their main food, only 16.60% are eating rice, the other 72.22% are eating rice mixed with sweet potatoes and 11.11% are eating rice mixed with corn. Beside that they eat fish and vegetables as well. About 81.11% took their meals twice at the working place and the rest eat usually at home.

Most of the workers are living in the surrounding villages and come to the work place by walking (78.88%).

After working, 50% practically felt very fatigue, 38.80% have pruritis on their feet, 18.88% felt heavy on their feet, 8.88% felt stiff at shoulder and 7.77% felt pains at their waist. All these complaints can be refered to their characteristic of jobs, from which we can already assumed before by observing their work.

There are 3.33% accidents have been reported ever since beside many minor injuries of course.

The most symptoms reported, ,which are very usual in developing countries, are fevers (86.66%), and due to this 51.11% went to the

Health Centre and 43.30% to the medical auxiliaries. Further studies should be conducted to find the real reason of this symptom, is it just a common communicable disease or due to the working condition? Or else?

The average load being carried is 16.11 kg and a day an average of 50.44 baskets can be lifted. And for each basket the worker will be paid Rp 10.00, or a day each worker will received on the average Rp 500.00 or nearly US$0.80. An unbelievable thing, but it still happened in Bali. And of course, for the 21.11% under 14 years old workers, 16.11 kg is already beyond their maximum capacity.

Concerning the heart rate fluctuations and their relation to time consumed for conducting each cycle of work within one hour-work, can be seen at Table 1.

Table 1. Heart rate at the end of each cycle per minute and time elapsed in minute for each cycle of work

Cycles	Heart rate per minute	Time elapsed
I	100.54±0.10	–
II	115.89±0.81	5.44 minutes
III	122.89±0.14	6.10
IV	130.17±0.43	6.20
V	149.56±0.31	6.70
VI	165.20±0.45	7.80
VII	167.67±0.37	7.80
VIII	167.44±0.37	8.40
IX	171.56±0.34	8.60

From Table 1 some conclusion can be noted as follows:

1) The continuous inclination of heart rate from the first cycle to the last cycle within one-hour of work, showed clearly that the work can be considered as a fatiguing one.

2) This is strongly supported by the fact that for each next cycle, a longer time is needed to accomplish the cycle, as we can see from the time elapsed for each cycle.

3) Heart rate value above 130/minute in most of the cycles, and achieved 171.56/minute at the last one, is obviously an identification of a very heavy work.

Conclusion

As it was assumed before, sand excavation work in Bali, which was done mostly by women workers, is really a very heavy work.

This was confirmed by data which showed that:

a) The heart rate in conducting this job are mostly achieved "heavy work" levels.

b) The heart rate characteristic can be considered as an identification that the work is a fatiguing one.

c) Due to this fatigue, time elapsed for each next cycle became longer and longer.

The reasons for these are might be as follows:

1) For the under 14 years old workers, a load of 16.11 kg is already can be considered as a maximum load.

2) Working method and environment which are not ergonomically sound.

3) Steeply and slippery path as additional loads.

4) Additional works at home could be considered also as additional source of fatigue.

Steps done for improvement are:

A) Standardizing the basket use in this sector, particularly seen from the worker's benefits: healthy, safety, comfort and efficient.

B) The same efforts for tools (shovel, table as supporting means instead of worker's head) and job organization.

C) Constructing ergonomic steps, instead of recent steeply and slippery path.

D) A more better collection place for sand, for a better and efficient work, in filling the trucks.

E) A more better food intake, not only quantitatively but also qualitatively.

F) A more better salary, through a more better work methods and a more better understanding from both side, the worker and the manager.

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Session 10.

Ergomics in Agriculture

APPLICATION OF ERGONOMICS IN AGRICULTURAL MACHINERY DESIGN

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Introduction

In view of the fect that recent development of agricultural machinery has brought about higher frequencies of accidents and increased mental strain on the operators, a series of field studies were undertaken with the aim of illustrating how and in which aspects ergonomic principles should be applied to design of such machines. Attention was paid to compatibility between machines and operators, especially in terms of outward visibility of in operating the machines.

Methods

A series of field studies were carried out. They included application of a specially designed ergonomic checklist for evaluation of a combine harvester and a tractor, measurement of the outward visibility of tractor operators by means of fish-eye-lens phototechnique, eye movement analysis by film techniques during tilling work, and link analysis of the work dealing with a tractor. Continuous measurement of heart rate was done during the tilling work.

Results

The first field study was carried out for comparative evaluation of ergonomic aspects of a large combine harvester and a tractor. A corrective ergonomic checklist consisting of nine chapters and 339 items was used by 12 ergonomists to evaluate the two machines. Table 1 gives the number of items checked by more than 80% of the checkers or by 50% or more as required to be ergonomically countermeasured. The frequency of checked items was higher in the case of the combine harvester than in the case of the tractor, major areas where ergonomic countermeasures were considered to be taken were work space, controls, information displays, working environment and working posture. Major common items for both harvester and the tractor were foot steps for entrance, position of major controls within easy reach, control displacement of pedals and levers, visibility obstacles, adequate use of a mirror for visibility improvement, distinguishable coding of controls, installation of the driver cab to avoid uncomfortable environmental exposures to heat radiation, wind and dust, and lastly absorption of seat vibration and noise. Improvement of visibility included not only instrument panel visibility, but also tracking visibility for better tilling performance.

Since the combine harvester was designed for European population, all dimension of operating controls were too big for the Japanese population to handle, so that the operator was obliged to stand continuously to see the spot where crops are processed and the lane for tracking. However, since there was no enough space of standing between the fixed seat and the console for the operator, unnatural postures, occurred very often. Uncompatible control arrangement and counter pressure of pedals were also causing unnatural postures.

The visibility projection chart on the ground surface comfirms poor design of machine for tracking performance. Figure 1 shows a visibility characteristic in various driving position in the case of a tractor. The lower and more forward the driving position was taken, the wider the area of invisibility became, whereas the longer the lower visibility limit

Table 1. Number of items which were checked by 10 checkers or more (A;80% or more) and by 7 checkers or more (B;50% or more) of 12 checkers in combined harvester work and tractor work.

Chapter	Number of items	Harvester A	Harvester B	Tractor A	Tractor B
1. Work space	22	2	15	0	3
2. Seat and foot rest	25	0	7	0	6
3. Controls	56	9	19	0	10
4. Information displays	37	9	17	0	9
5. Combination of displays and controls	37	3	12	0	6
6. Working environment	55	12	27	7	27
7. Posture and static work load	39	1	17	0	9
8. Dynamic work load	35	0	6	0	1
9. Hours of work and work performance	33	2	8	0	1
Over all	339	38	128	7	72

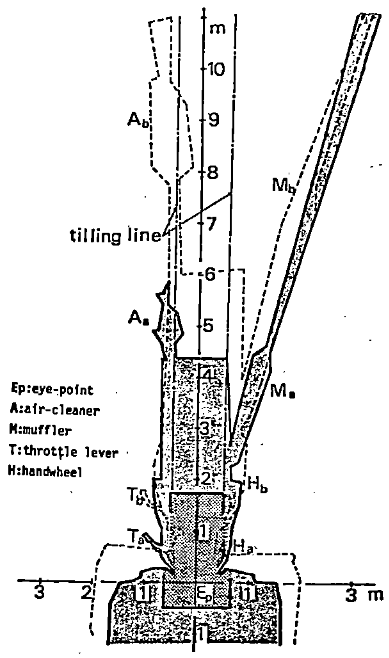

Fig. 1. Visibility projection chart on the ground surface of tractor by high-backward eye-position (a: ——) and low forward position (b: - · - - -) with vertical difference being 121mm, and frontal difference 247mm. Lower visibility limit (L) for a-position was 4.4m and 6.1m for b-position. Invisible projection area on the ground surface for a-position was 8.8m² and 14.9m² for b-position. Area □ shows direct projection of tractor on the ground.

became. The lower visibility limit was the distance from the operator's eye-level to a position of the tractor body which ground surface comes in sight. The lower visibility limit and the invisible area on the ground in case of higher and backward driving position were 4.4 m and 8.8 m^2 respectively, while they were 6.1 m and 14.9 m^2 respectively in case of low and forward driving position. So, it is clear that small difference in driving position in vertical and in frontal direction gives great difference in visibility. And it is also clear from the visibility projection chart that regardless of driving position, tilling lines which were the most important clue for the operator in driving the tractor straight forward are hidden by the main front portion of the tractor. This leads to the operator's unnatural forward and side bent leaning posture.

Figure 2 shows the eye movement pattern for 15 seconds in operating a tractor, the bold line indicating that of a skilled operator and the thin line indicating that of an unskilled operator. The unskilled operator showed more frequent and widely spreading movements of the eyes. This was due to the unskilled operator's visual search activities in getting proper clues for controlling properly the movement of the tractor.

If the mean rate of the eye movements of

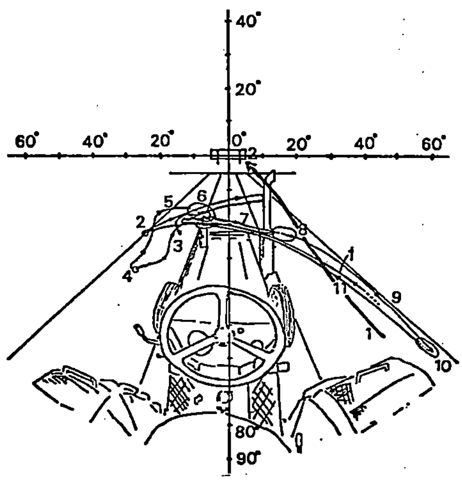

Fig. 2. Head movement frequency of skilled operator (—) and unskilled operator (—) in tilling work by tractor during first 15 seconds operation after start.

Table 2. Frequency and rate of head movement, and time composition of vision direction for three different operators

Operator	Number of operations observed	Mean frequency of head movement per one operation	Rate of head of movement	Mean time of vision	Time composition of left and right in vision direction Left	Right
			sec^{-1}	sec	%	%
1 Skilled	4	16.0	0.16	99.6	5.8	94.1
2 Fairly skilled	2	36.0	0.41	88.2	6.1	93.9
3 Unskilled	4	33.8	0.39	87.5	34.9	65.1

more than 15 degrees per second and their time composition are compared between operators with different levels of skillness, as shown Table 2, the eye movement rate by an unskilled operator was more than the double of that of a skilled operator.

The skilled operator tended to watch primarily the remote target on the right side of the machine, making use of it as a clue for tracking, but the unskilled operator obviously changed his direction of visual search to the left and to the right looking around the machine. The reason for the unstable visual search activities of the unskilled would be the poor visibility of the operating part and the land being tilled. This kind of differences between the skill and unskilled operators in terms of eye movement rates was especially significant in case of turning the machine at the end of a lane. It should be noted that the operator was heavily load with outward visual search rather than vision toward penal instrumentation.

Fig. 3 shows the levels of heart rate during tilling work for skilled, fairly skilled and unskilled operators. The heart rate level of the unskilled operator was much higher than that of the skilled, while in the case of the skilled operator, temporary increase of heart rate while turning the tractor was quickly reduced to a low level similar to a resting level. The unskilled operator tended to continue the enhanced heart rate by turning, implying that the unskilled operator was subject to higher mental strain in association with the poor visibility situations.

The results of the link analysis reveal, as shown in figure 4, that the unskilled subject had generally higher link values, or higher frequencies of operating individual controls, for

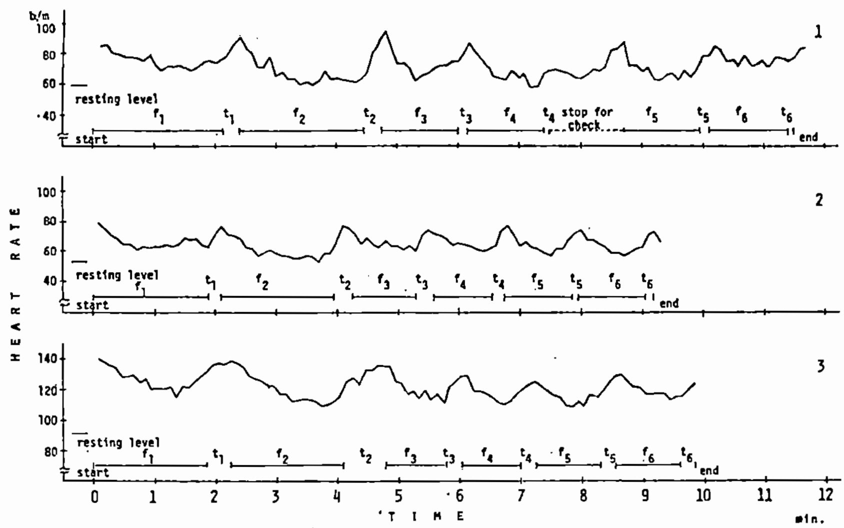

Fig. 3. Heart rate variation of skilled operator (1), fairly skilled operator (2) and unskilled operator (3) during tilling work. Forward processing operation is shown as f_1-f_6, while turning at the end of a field of shown as t_1-t_6.

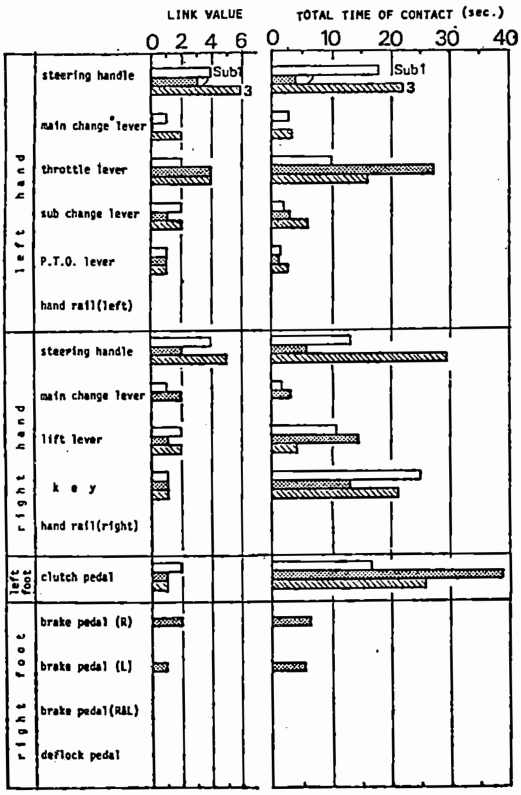

Fig. 4. Link analysis of tractor for starting operation.

both the left and right hands as well as for operating foot pedals. As a result, the total time of contacting controls was longer for the unskilled operator. The higher frequency and longer duration of contracting a control in case of an unskilled worker were especially dominant for the steering wheel operation. This was presumably related to the ergonomically poorly designed position of the steering wheel, as indicated in Figure 5.

The operator was forced to take a forward bending sitting posture to reach the wheel. This apparently disturbed the outward visibility, which otherwise would have been better from a natural sitting posture. Our results were suggestive of re-positioning the steering wheel about 20 cm near to the seat, so that the operator could maintain a more natural sitting posture.

Conclusion

In summarizing the results, an integrated

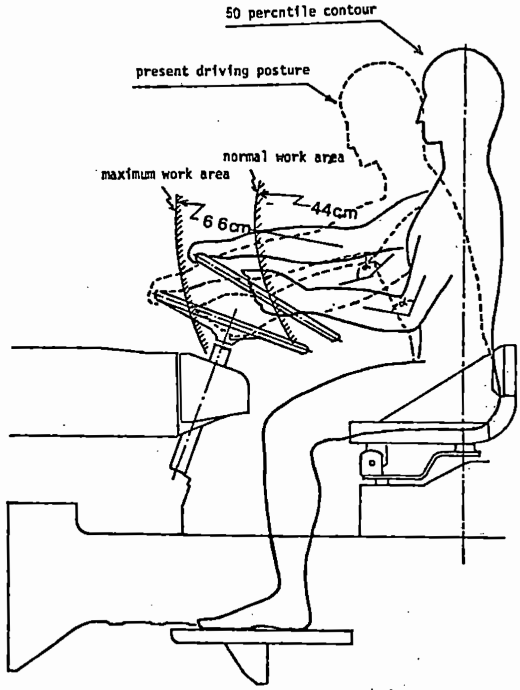

Fig. 5. Work area and hardwheel location.

approach to tractor design seems necessary, paying more attention to the effects of poor visibility toward the front view of such a machine. The techniques of measuring the range outward vision and analyzing the visual search activities need be developed on the basis of field studies.

Design of tractor and similar agricultural machines incorporating a control console within easy reach of the seated driver and a streamlined engine hood would greatly improve the operator's vision and performance.

According to our experiences, information gained from practical field studied seems indispensable in working up a new design of machines. An effective application of ergonomic principles should always be in situ analysis of the operator-machine interrelationship such as dependence of serial operations on the visibility-related over all machine structure.

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WORKLOAD ANALYSIS ON AGRICULTURAL MACHINERY OPERATION

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Abstract

In the present paper, changes of work burden to farmers caused by agricultural mechanization will be shown on the basis of work physiological investigations especially on the rice plantation work. The rice cultivation is still nucleus of agricultural activities in Japan and mechanization took place with nation-wide during the last two decades.

Conclusions are summerized as follows:

1) Muscular work or sweat labour especially due to keeping deep bending posture for long working hours appeared characteristically in seeding transplantation in paddy field and crop harvesting. An improvement in workload by mechanization was recognized in a great deal, and productivity was increased several times.

2) In the stage of self-removing machineries such as tiller type cultivator or powered reaping and binding harvester introduced in replacing animal powers, it was remarkable in increment of complaints of mental stress of farmers caused by machinery operation, although it was not remarkable in decrement of energy consumption of farmers per working hours.

3) Almost every type of machine generates intensive noise and vibration. In case of harvester, the amount of dust inhaled by farmers harmfully increased to their health.

4) The mechanization caused farmers to suffer more frequent and more serious accidents. Today, machinery injuries become the biggest menace against farmers health.

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RECENT AND FUTURE ERGONOMIC PROBLEMS IN AGRICULTURE

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Introduction

Agriculture will continue to occupy a weighty role in the development for some years to come in Indonesia. One of the most prominent programme is to increase the production of rice through efforts of intensification and extensification of rice cultivation.

Intensification is being done through the use of new varieties or quick yielding of rice, more used of fertilizers and pesticides, and last but not least the more used of two-wheeled hand tractors to substitute the animal traction implements. These endeavours are mostly done in Java and Bali, the two most populated islands of 13,000 islands in Indonesia, since about 80 from 140 millions inhabitants of Indonesia are living in those two islands. In the meantime, due to some circumstances, traditional way in rice cultivation still existing in some parts of the islands.

In regard to extensification programme, the transmigrant farmers who owned larger land in the new settlement outside of Java and Bali, in the near future, due to the situation and condition at the place, have to use semi and full mechanization in working out their lands. Rare of inhabitants and relatively big land to be worked out, are reasons of this step.

Since through those efforts, new technology will be used by the farmers, it will be understood, that beside some advantages, there will be also some negative impacts, particularly in form of ergonomic problems. And, in order to achieve the Government's goals optimally, these problems have to be solved properly. In so doing, learning from other countries experiences, especially in regard to the impacts of mechanization, will be very useful and efficient.

Identification of ergonomic problems

Actually in carrying out the traditional rice cultivation, the Balinese farmers already used "ergonomic" tools and working method through trial and error experiences for years. Good body position in working with hoes and plough, in cutting the paddy during harvesting, in pounding and transporting, are proofs of those opinions. The weight of load carried, 20 kg for female and 40 kg for male farmers, could be considered as reasonable loads and within or meeting the ILO recommendation.

This does not mean that improvement is not needed, because some improvements are strongly required in planting rice, which is usually done in stooping body position. So is also with other working methods, if greater result will be achieved, for example by using better technology in doing the same task.

In relation to intensification effort, in face, beside some advantages, new ergonomic problems emerged among the farmers. The introduction of two-wheeled hand tractor, creates impacts in form of unsafe situation in operating the tractor due to unsufficient adjusted controls; high physical workload due to the strain of walking on a rough surface in combination with handling the machine; noise and vibration of the machine which are exceeding the tolerance limits. In tropical countries, the climatic conditions became an extra load too.

In harvesting, stooping body position was found due to shorter stem of the new varieties. Threshing became an additional task which need extra physical energy. In so doing, the farmers have to face also dust and the possibility of a grain of rice has accidently entered the nose or the ear. A load up to 100 kg will be carried either by female and male farmers as well, in transporting the paddy with sacks or baskets. This was done due to the difficulty in binding the new varieties.

Pounding work by women not exist anymore, and substituted by the rice mill. Here again, bad working conditions are found in form of dust, noise, vibration and unsafety working methods, in most of the rice mills operated up to now.

In regard to the use of pesticides, several kind of sprayers, are imported. Fortunately, in comparing all those sprayers from ergonomically point of view, practically they have the same values, except for the machine one, which can creates temporary deafness to the operators.

Although new varieties have been used, bad body position still existing in planting rice, which needs attention to be improved, since three crops instead of two a year were found now with the new varieties of rice.

Considering the working hours, if in the traditional rice cultivation, the farmers adjusted their working hours to the natural clock, practically with the new varieties, especially in operating the two-wheeled tractor, they work nonstop for hours a day. Although as a whole they will be able to finish the task in a shorter time, but practically they have lost their valuable social life, as a trade-off to their economic thinking.

In the near future, if full mechanization will taking place in extensification rice cultivation at the islands outside of Java and Bali, new ergonomic problems will be faced by the farmers at those regions, especially due to the impacts of the tractor's cabin. In this case, learning beforehand the experiences faced by the farmers in the established countries will be very useful and efficient, before taking any decision in this direction.

As it is already known, that most of the tractors nowdays are having cabin in order to prevent the driver from dust, sunlight, cold climate, noise, odour and etc. But in fact, due to this design, sometime the temperature in the cabin is so high, up to 52°C, which creates a discomfort environment to the driver. Endeavour to pump air to the cabin, decrease the temperature only to 35°C, and it is still warm. And by so doing, sometime dust get into the cabin too. Efforts in using air condition cabin seems to be considered as a very expensive one, because it raised the tractor's price, up to 20%. In order to prevent the driver from blindness due to sunlight glare, the use of colour glasses are recommended. But this design creates difficulty in driving the tractor on the road, or the same will also happened during cloudy days, it is became too dark in the cabin. Another design was proposed, it is by using double glasses, the colour one outside and can be removed. But in fact, such a design is apparently very expensive one. In endeavour to decrease the temperature within the cabin, water vapour is pumped to the cabin, but due to this, the humidity is increasing to some level. Beside the influence of sunlight, among big tractors, the machine itself will increase already the temperature in the cabin up to 6-7°C. So, it is clearly indicated, that there is still a vicious circle problem to be solved by the established country in using the four-wheeled tractors.

And if Indonesia will import four-wheeled tractors in the near future for the extensification purposes, a right policy and steps should be taken in doing so, for the sake of our foreign currency shortages. If needed, a suitable tractor for Indonesia, particularly seen from ergonomically point of view, can be designed properly.

A Comprehensive approach

The main goal of our development in Indonesia is the development of man as a whole, and one of the step to be proceeded is to increase the production of rice. In so doing, several endeavours have been taken, among others to intensify and extensify the rice cultivation. In our efforts to implement these steps, baside achieving the objective, in fact, some negative impacts, especially in form of ergonomic problems, were also emerged.

In facing all these circumstances, and back to the goal of our development objective, a comprehensive approach should be taken into consideration in solving the problem. Particularly in Bali, the most important thing is to find a policy that balance efforts to preserve and enrich Balinese culture on the one hand against those to carry out modernization on the other hand, for the exclusive benefit of Bali and the Balinese.

In the implementation, development could not be evaluated only whether it is economically efficient or not, but should also be seen if it is also technically feasible, ergonomically acceptable, and having also social relevance. Such a comprehensive approach should always be taken into consideration in conducting any development policy in Bali especially, in Indonesia in general. Otherwise, what is became our main goal in the development will be not achieved properly.

And such an approach has to be carried out at the planning stage of any development process, and not after a desicion has been taken. An example of this comprehensive approach can be seen in trying to make any desicion of using two-wheeled hand tractor as substitution to the plough pulled by cows, as follows:

	Tractor	Plough pulled by cows
Ergonomic:	– no physical energy except for moving it	– the same except in transporting it
	– noise, vibration, accident	– none and rare
	– working hour shorter	– longer
	– in operating have to walk, physical strain	– sitting & walking, none
	– fatigue	– ?
Economic:	– beyond reach to buy, only rental basis	– most farmers have
	– need fuel (energy crisis?)	– cows energy
	– maintaining cost high needing skill	– grass everywhere skill is there
	– not economical sound due to small size ownership and used twice a year only	– as given work
	– for isolated region difficult	– no difficulty
	– investment and saving?	– saving
Social:	– as a new tool needing adaptation	– for years as part of daily life, culture and religion
Technical:	– feasible	– lower, but still could be improved

In weighing and comparing the foregoing factors, we believe the technical aspect should be put in the lowest priority for selecting, adapting and improving an agricultural tool. The technical aspect demands advanced skills, higher education, equipments and workshops and also spare-parts. The existing indigenous tools have all those requirements in place, for instance blacksmiths, etc. For the time being the ergonomic aspect should become the first in line of consideration, then the social value, followed by the economic aspect.

And this has been done in Bali, as for examples in studying the most suitable pacul/hoes for Balinese farmers, on farmer's clothing, on sprayers and also last but not least on two-wheeled hand tractors. If in the beginning, an analytic approach in ergonomic has been done since several years ago, a system ergonomic in which already built-in the economic, technical and social approach have been carried out through the Regional Development Planning Board of Bali Province.

Although, it is still within an embryonic level, as a start if shows already on optimistic future for our development in the island.

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SOME CONSIDERATIONS ON RURAL HEALTH PROBLEMS FROM THE ERGONOMICS ASPECT IN KOREA

Myung Ho KIM, *Korea*

Looking at the national economic development, Korea is on the move to becoming a developed rather than developing country. The nation has maintained an annual average economic growth rate of 8.7 percent. This outstanding achievement has raised the economic potential in the rural areas and has resulted in remarkable increases in rural investments, four times as great as that in the previous decade. Furthermore, a series of rapid changes have been made and ambitious development projects are undertaken in order to accomplish the goals earlier than the target date. The targets are to reach a per capital national income of $1,200 and an annual farm household income of 1.4 million Won ($2,860), by the end of 1981.

Therefore, Korean Farmers in rural villages are using more machines in their agricultural tasks now compared with two or more decades ago as a part of the Saemaul Undong (New Village Movement) which is a new community movement in which people work together in order to construct better and richer villages, and, as a consequence, a richer and stronger nation.

From the point of view of ergonomics in agriculture, such as using cultivators (tillers), insecticide sprayers and other light machines for additional jobs besides farming, some health problems have emerged.

Before discussing these problems, it will be helpful to look at some necessary figures as follows:

Table 1. Cultivated Land of Korea

1. Area of cultivated land : 2,241,252.8 ha.
   - Paddy field : 1,262,637.0 ha.
   - Dried field : 978,615.8 ha.
2. Area of cultivated land per household : 91.5 a.
   - Paddy field : 51.5 a.
   - Dried field : 40.0 a.

As of the end of September of 1979, farmers are now using various kinds of agricultural machines (total no. 937,530 nationwide). In Koyang-Gun (county) which is located in the vicinity of Seoul, farmers own and are using machines as follows:

Through the above tables, it is easy to see the shortage of agricultural machines in rural area. In addition to this shortage, in order to solve health problems, the following measures

Table 2. Distribution of Farming Tools in Goyang-Gun(County), Kyonggi-Do, Korea

Classification / Region	No. of household	Area (ha.)	Cultivator			Thresher		Insect Control				
								Manual		Power		
			Plough	Tiller	Tractor	Manual	Power	SprayerI	SprayerII	SprayerI	SprayerII	Higherpower
Shindo-Eup	242	150	8	40	–	33	24	239	24	42	2	–
Wondang-Eup	750	500	183	88	9	93	63	14	289	222	2	–
Jido-Myun	816	640	82	127	–	43	69	10	368	138	22	–
Joong–Myun	1,884	840	212	237	1	172	110	55	1,159	119	28	–
Songpo-Myun	1,658	1,110	367	186	–	138	128	147	370	360	53	3
Byugjae-Myun	1,667	630	75	158	–	–	80	31	500	307	1	–
Hwajeon-Branch	184	100	71	25	–	5	6	3	202	10	–	1
Total	7,201	3,970	998	861	10	484	480	499	2,912	1,198	108	4

Goyang-Gun Population: 141,478
Households: 29,559
Size: 266.26 km²

are recommended not only for better usage or operation of machines to overcome the shortage but also for the safety and prevention of diseases in farmers:

1. Teaching safe and skillful operation of agricultural machines.

   It is easy to find injuries of fingers and other parts of the body due to unsafe and unskillful operation due to lack of previous training and carelessness in using or handling machines.

2. Teaching safe ways to use insecticides.

   In rural areas, acute and chronic poisoning by insecticides of farmers and especially children from ignorance or carelessness in handling insecticides can be seen.

3. Teaching how to protect health from possible accidents when handling agricultural machines.

   To prevent accidents from agricultural machines, it is important to have farmers recall and remember safe ways of handling machines through regular or periodic training or notice.

4. Providing facilities and equipment for emergency care in case of accidents using machinery and for preventing illness.

   Unexpected accidents have occurred by various reasons such as the multipurpose usage of machines (e.g. tiller); ploughing, rotatilling, transportation, pumping, spraying, crushing, hulling, seeding and fertilizing, cultivating, ridging and threshing.

5. Providing maintenance and repair shops of machines.

There are only 770 repair shops nation-wide for 937,530 machines. This means one repair shop for 1,220 machines, in spite of the fact that 500 machines should be the maximum. It is understandable that the shortage of repair shops could cause a shortening of the life of many machine and also, accidents are often result from inadequate maintenance of machines.

There is no doubt that the more economic development is achieved, the greater the usage of machines will be seen in rural areas in Korea. Therefore it is recommended that firm and effective measures be developed from the point of view of administration as well as public health (industrial health).

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A MEASURING METHOD OF WORK POSTURE OF FARMERS AND LOCALIZED FATIGUE

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Introduction

As to bad body posture when farming in Japan, loads from bowing postures when transplanting and mowing rice has been decreased by mechanizations. But during these 20 years, farming under greenhouse has spread in different part of Japan, because income from the farming is relatively high. The farmers frequently complain of localized fatigue relevant to bad work posture. In the present study, localized fatigue complaints of female farmers cultivating strawberry under greenhause were compared with those of female farmers cultivating eggplant under greenhause. Furthermore, two types of goniometer were devised to evaluate the loads from bowing posture and others.

Methods

A questionnaire for checking localized fatigue complaints and others was completed by the following two groups;

1) Strawberry Group: 49 female farmers engaged in strawberry culture under greenhouse (age: 28-60 yrs. meam ± s.d. = 44 ± 8 yrs).

2) Eggplant Group: 53 female farmers engaged in eggplant culture under greenhouse (age: 23-55 yrs. mean ± s.d. = 40 ± 8 yrs.).

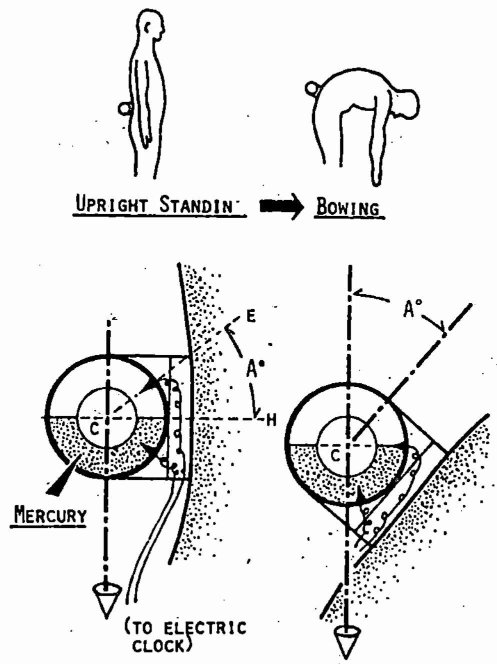
Furthermore, a questionnaire, for checking parts of the body where fatigue feeling appears during picking strawberries or egg apples in greenhouse, was completed by the two groups.

The angle formed by vertical line and tangent line of low back seems to be an useful parameter to evaluate bowing posture. Goniometer Type A (Fig. 1) was devised for that purpose. Using Type A, we can get information about how long a farmer worked with his waist bowing deeper than the set angle. Goniometer Type B (Fig. 2) is very simple, and is useful to get information about how long a farmer worked with his upper arm sustaining higher than horizontal line. In the present study, Type A was used to evaluate the bowing posture load in the picking of strawberries or egg apples in greenhouse as a pilot survey.

Results

1. Incidence of localized fatigue complaint

As shown in Fig. 3, incidence of waist pain in the Strawberry Group was higher than that of the Eggplant Group. More than 50% of the both groups complained of waist pain and shoulder stiffness.



If angle ECH is set as A° in upright standing, the two electrodes are connected by mercury when the subject bows deeper than A°, and electric clock is set going.

Fig. 1. Illustration of goniometer type A.

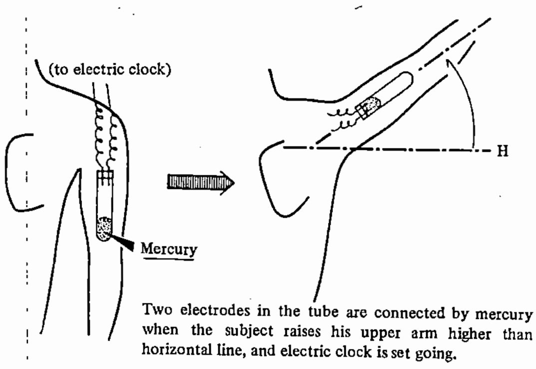


Fig. 2. Illustration of goniometer type B.

2. Parts of the body where fatigue feeling appears

As shown in Fig. 4, important part of the body where fatigue feeling appears during picking fruits were waist and shoulders in the Strawberry Group; and shoulders, waist and legs in the Eggplant Group.

3. Relation between the height of fruits and the bowing posture when picking them

From the above-mentioned results, loads upon the waist of the Strawberry Group seem to be larger than that of the Eggplant Group Therefore, relation between the height of fruits and bowing posture when picking them were surveyed using Goniometer Type A. As shown in Fig. 5, a clear relation between work space

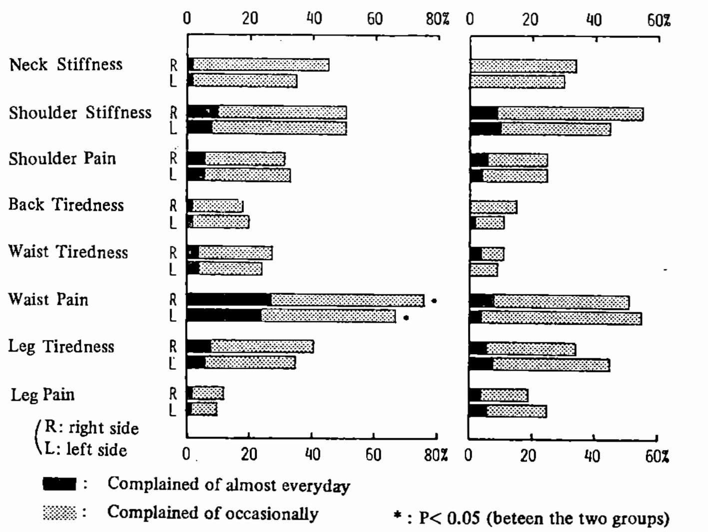


Fig. 3. Localized fatigue complaint of strawberry group and eggplant group.

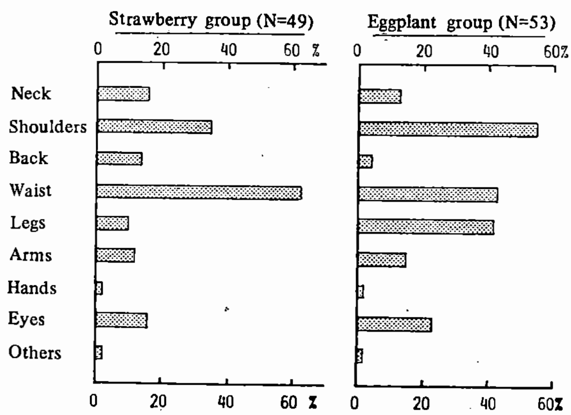


Fig. 4. Part of the body where fatigue feeling appears during picking fruits.

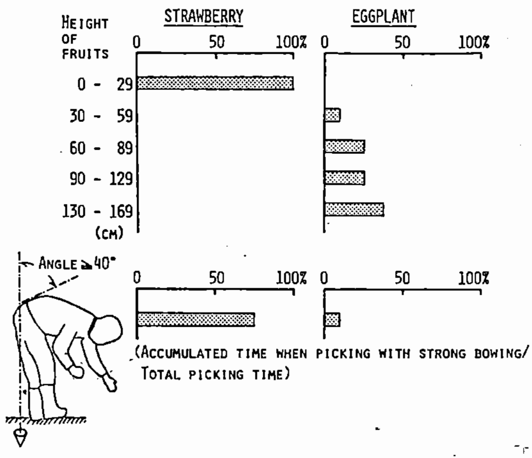


Fig. 5. Relation between height of fruits and bowing posture

and body posture was notice.

Discussions

From the obtained result, waist pain of the Strawberry Group seems to be related to the deep bowing posture when picking strawberries. And the posture is proved to be resulted from work space.

Bad posture of farmers seems to be their fate because farming is strongly conditioned by nature, and ergonomic improvement of work space is very difficult. Main interest of farmers is sometimes high productivity and not healthy; this is frequently noticed in Japan because of economical conditions. We think this situation must be changed. For the purpose, health education is very important and our results is available to that. Besides, accumulation of the ergonomic analysis on relations between work space and work posture and localized fatigue is necessary to improve farmer's working conditions.

Conclusions

1) More than 50% of strawberry and eggplant farmers complained of fatigue in the waist and shoulders.

2) Incidence of waist pain in the strawberry farmers was higher than that in the eggplant farmers. This is probably related to deep bowing posture of the strawberry farmers when picking strawberries.

3) The newly devised goniometer is useful for the analysis of bowing posture.

References

Mitsuo Morioka and Ruriko Maru (1977), Experimental studies on local fitigue due to the deep bending posture: Posture (Proceedings of the 2nd symposium on Posture), pp. 171-180, Shisei-Kenkyosho (Institute of Posture), Tokyo, Japan.

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Session 11.

Occupational Toxicology

A STUDY ON THE CONTENT OF TOTAL MERCURY IN THE HEAD HAIR OF DENTAL PERSONNEL

Dong Hun SOHN and Taik Seung LEE, *Korea*

Introduction

It has been well known that the Minamata disease was caused by the mercury which had been disposed into the sea from an industrial plant located at Minamata City, Japan.

Determinations of the mercury content in the human body may be done using blood, serum, hair, or nails. Among them hair is probably the best because of its easiness in sampling.

There are many reports on the mercury content of human hair in foreign countries (Hoshino, 1966). In Korea, however, practically no data have been reported so far except a few papers dealing with the content of trace metals in the hair (Sohn, 1977).

The present paper deals with the total mercury content in the hair of dental personnels who handle mercury amalgam very frequently.

Methods

Dental personnels (dentists, dental nurses and dental technicians) were randomly sampled from the Chong-ro area of Seoul, Korea. For the control group, 210 Seoul citizens were also randomly selected.

The mercury content was determined with a Mercury Analyses System, Sugiyama-Gen Environmental Science Co., Ltd., Japan. Calibration curves were made with aliquots (20, 40, 60, or 80 μl) of 1 ppm mercury standard solution mixed with 0.1 g of $Ca(OH)_2$.

Test Procedure

About 10 mg of the hair is placed, accurately weighed, in a quartz boat and put in the combustion tube of the apparatus shown in Fig. 1. It is then heated in a stream of oxygen flowing at a rate of 1ℓ/min to effect combustion for 4 minutes. The temperature of the second furnace is kept at about 850°C during this time.

Atomic mercury coming out of the hair is collected on the collector (in Fig. 1) as gold amalgam. Upon completion of combustion, the collector is heated rapidly to decompose the amalgam and the mercury vapor released is introduced to the optical cell of a flameless atomic absorption spectrophotometer for determination of the absorbance.

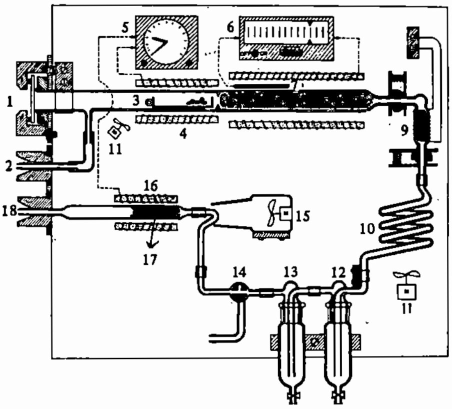

Fig. 1. Sample Combustion System

Results and Discussion

Table I shows mean and median values of the total mercury contents in the hair of dentists, dental nurses, dental surgery assitants and Seoul citizens.

The mean value of dentists (8.57 ppm) is much higher than that of Seoul male citizens (2.57 ppm) and so is th median value (5.92 ppm vs. 2.39 ppm). Dentists are respectively 3.3 and 2.5 times higher than the mean and median values of Seoul male citizens.

Dental nurses have a mean value of 5.79 ppm and a median value of 4.62 ppm, which are respectively 2.7 and 2.5 times higher than the mean and median values of Seoul female citizens (2.11 and 1.86 ppm).

Table 1. The Total Mercury Content in Head Hair of Dental Personnel and Seoulites

	Sex	No. of samples	Mean±S.E.	Median	Lowest – Highest
Dentists	M	57	8.57±1.48	5.92	2.40 – 84.62
Dental nurses	F	26	5.79±1.17	4.62	2.26 – 33.00
Dental surgery assistants	M	4	5.72±1.44	5.84	2.08 – 9.11
Seoulites	M	85	2.57±0.14	2.39	0.55 – 8.50
	F	125	2.11±0.10	1.86	0.58 – 7.42
Total		210	2.29±0.08	1.98	0.55 – 8.50

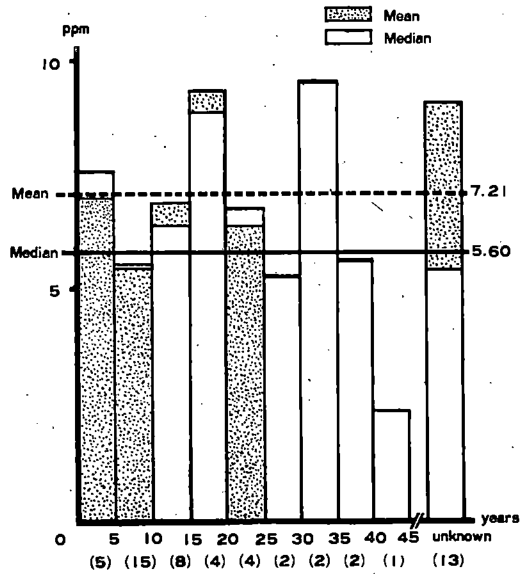

Fig. 2. Histogram of the mercury content in the head hair of dentists as classified by their length of dental surgery experiences.
( ): No. of samples

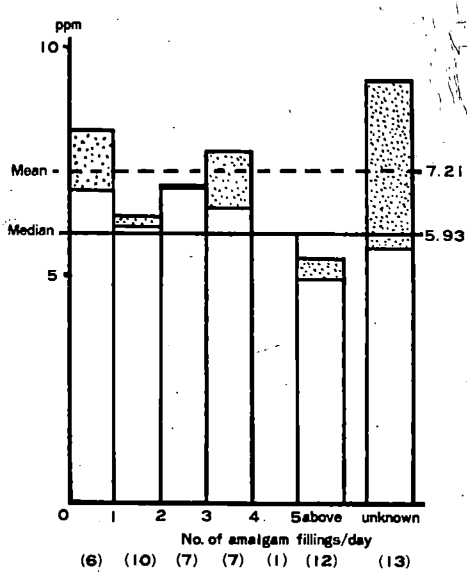

Fig. 3. Histogram of the mercury content in the head hair of dentists as classified by the frequency of amalgam fillings per day.
( ): No. of samples.

By this test it has been found that the difference in mercury contents between dentists and Seoul male citizens is significant (P < 1%) and the difference between dental nurses and Seoul female citizens is significant (P < 1%).

There was one dentist who had an exceptionally high mercury content (84.62 ppm). This case was excluded in the calculation of the standard deviation and in other statistical treatments in Table II and Figs. 2 and 3.

Table II. The Mercury Content in the Head Hair of Dentists as Classified by Their Length of Dental Surgery Experiences and the Frequency of Amalgam Fillings per Day. (ppm)

No of amalgam fillings/day / Length of exp. (yr)	Less than	1	2	3	4	Above 5	Un-known	No. of samples	Mean	Median	Lowest-Highest
Less than 5		3	1			1		5	7.18	7.71	3.33–11.11
5–10		2	1	3		9		15	5.55	5.64	3.08– 9.38
10–15	2	3	1	2				8	7.05	6.46	3.21–11.83
15–20	1		1	2				4	9.53	9.02	4.64–15.46
20–25			1		1	2		4	6.49	6.87	3.24– 8.97
25–30	1	1						2	5.32	5.32	5.21– 5.44
30–35	1	1						2	9.67	9.67	7.23–12.10
35–40	1		1					2	5.80	5.80	5.67– 5.94
40–45			1					1	2.39		
Unknown							13	13	9.25	5.51	2.84– 5.94
No. of samples	6	10	7	7	1	12	13	56			
Mean±S.D.	8.12	6.26	6.96	7.68	5.92	5.32	9.25		7.21±4.41		
Median	6.81	6.05	6.91	6.40		4.87	5.51			5.93	
Lowest-Highest	5.21 12.10	3.21 11.11	2.40 10.42	3.13 15.46		3.08 9.38	2.84 28.72				2.40–28.72

Table II and Figs. 2 and 3 show the mercury content in the hair of dentists as classified by their length of dental surgery experiences and the frequency of amalgam fillings per day, respectively. From these table and figues, the mercury content of dentists seems to have neither direct relationship with the length of dental career nor with the daily average number of amalgam fillings. This is probably due to the tendency that many dentists do not handle amalgam themselves and leave the job to their technicians and that the application of amalgam is decreasing nowadays.

Fig. 4 shows the distribution of the mercury contents of dentists. The median value is found at the middle part of the histogram. On the other hand, the mean value lies in much higher part of the histogram due to extremely high contents of a few samples. It seems, therefore, to be better to take the median value when one considers the problem of environmental pollution.

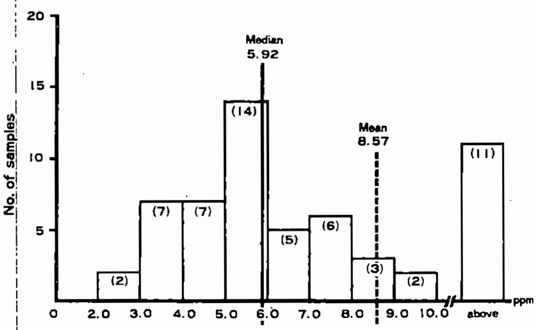

Fig. 4. Histogram of the total mercury content in the head hair of dentists.
( ): No. of samples

of environmental pollution.

The median value of Seoul citizens is 1.98 ppm and this is only about half of that of 101 citizen of Tokyo, Japan, which has been reported to be 3.9 ppm (Noushi et al., 1972).

According to a recent report of Fujita and Takabatake (1977), the mean total mercury level in the hair of young mothers in Tokyo, Japan was 3.3 ppm. This value is still higher than that of Seoul female citizens (2.11 ppm).

Lenihan *et al.* (1973) reported that the mean mercury content in the hair of 87 British dentists was 9.84 ppm and the median value was 9.57 ppm. These are obiously higher than those of Korean dentists.

Summary

The total mercury content in the head hair of 87 dental personnels and 210 Seoul citizens was determined and the results are as follows:

1. The mean value of mercury content in dentists (8.57 ppm) was about 3.3 times that of Seoul male citizens (2.57 ppm) and the median of the former (5.92 ppm) was higher than that of the latter (2.39 ppm) by approximately 2.5 times. (P < 1%).

2. The mean value of mercury content in dental nurses (5.79 ppm) was about 2.8 times that of Seoul female citizens (2.11 ppm) and median of the former (4.62 ppm) was higher than that of the latter (1.86 ppm) by approximately 2.5 times. (P < 1%).

3. The mean value of mercury content in Seoul citizens was 2.29 ppm and the median was 1.98 ppm.

4. There was no correlation between the mercury content in the head hair of dentists and the length of dental surgery experience or the frequency of amalgam fillings per day.

5. In general, the mercury content of Seoul citizens was higher in the male than in the female.

6. It seems to be more meaningful to employ median values rather than mean values when the environmental pollution is considered.

References

Fujita, M & Takabatake, E. (1977). Mercury Levels in Human Maternal and Neonatal Blood, Hair and Milk. Bull. of Environmental Contamination & Toxicology, *18*, 205-209.

Hoshino, O. et al. (1966). Differences in Mercury Content in the Hairs of Normal Individuals depending on their Home Environment (In Japanese). Jap. J. Hyg. Chem. *12*, 90-93.

Lenihan, J.M.A. (1973). Mercury Hazards in Dental Practice. Brit. dent. J., *135*, 365-369.

Noushi, H. et al. (1972). On the Contents of Mercury, Lead and Cadmium in the Hair of Tokyo Citizens (In Japanese). Jap. J. Hyg. *27*, 50.

Sohn, D. H. et al. (1977). A Study on the Content of Trace Elements in the Hair of the Head in Korean. J. of the Chung Ang Pharmacy Sci. Ed. *21*, 49-52.

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STUDIES ON LEVELS OF ZINC IN BLOOD, URINE AND FECES AND ESTIMATE OF ZINC INTAKE FROM FOODS AMONG THE JAPANESE POPULATION

Kusuko NINOMIYA, Keiko TERAMOTO and Shunichi HORIGUCHI, *Japan*

The purpose of our study is to elucidate absorption, distribution and excretion of zinc based on up-to-date information on Japanese. First, in order to establish normal levels of zinc in blood, urine and feces, secondly in order to estimate daily intake of zinc from the air, foods and beverages, and lastly in order to estimate excretion of zinc from urine and feces, we determined zinc in the above materials by atomic absorption spectrophotometry (A.A).

Materials and Methods

1) Determination of zinc in the air; Air sample was collected by filter paper (Toyo GE-100R) using high volume air sampler for 24 hours at 4 points in Osaka. After sampling, the filter paper was taken out, put into Kieldahl flask, and 5ml of sulfuric acid and 100ml of nitric acid to it was added, and it was ashed for about 10 hours until the filter paper turned white. After cooling, sample solution was filtered by suction. The filtrate was evaporated until white smoke appeared and water was added to it to 100ml. Then, it was analyzed for zinc by A A.

2) Determination of zinc in food; Zinc in many kinds of common foods in Japan was determined. After determination of zinc in each food, each value of zinc was put into each food group and then average of zinc content of each group was estimated. Cereals, seeds and nuts, sugars, confectionaries and so on were used without pre-treatment. Potatoes, fruits, vegetables and so on were used after washing and paring or peeling. Fish and shellfish were used after gutting and removing heads and bones. Eggs were used after removing shells. Then, samples were put into quartz beaker, weighed exactly, dried well at 110°C and then ashed at 500°C for 15 hours in electric muffle furnace. After cooling, the residue was dissolved with small amount of hydrochloric acid. To it water was added at a fixed volume and then it was analyzed for zinc by A A.

3) Determination of zinc in beverages; Most samples were directly analyzed for zinc by A A.

4) Determination of zinc in blood, urine and feces; Whole blood (1ml), urine (spot sample) and feces (total daily amount) were collected from urban healthy habitants in Osaka. Blood samples were diluted 20 times with 0.1-N hydro-Chloric acid, and then analyzed for zinc by A A. Most samples of urine were directly analyzed without pre-treatment. Fecal samples were put into the mixer with 1.5 times amount water and mixed well. Then, the mixture of 1 to 5g was taken and put into quartz beaker. Consequence procedure was almost the same as determination of food.

5) Instrumentation

All measurements were made with model AA-1 (Japan Jaller- ash Co., Ltd.).

The instrumental conditions were as follows:

Zinc lamp current		10 mA	
Zinc wave length		213.9 nm	
D_2 lamp current		30 mA	
Burner		5 cm slot burner	
Fuel	C_2H_2	0.8 L/min	0.5 kg/cm
	Air	7 L/min	1.4 kg/cm

Results

The results obtained were shown in Fig. 1-6 and Table 1 and 2.

Conclusion

1) Zinc in blood was 5.90±0.80mcg/ml in

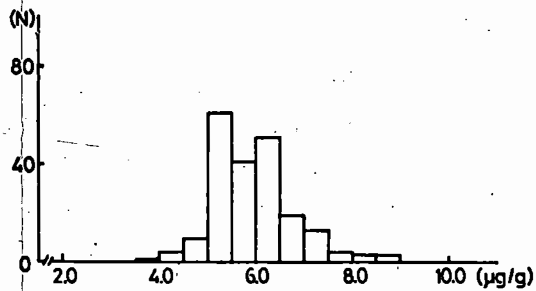

Fig. 1. Zinc in whole blood in healthy urban habitants (male): N=209, mean±S.D.=5.9±0.84μg/g, med. =5.8μg/g

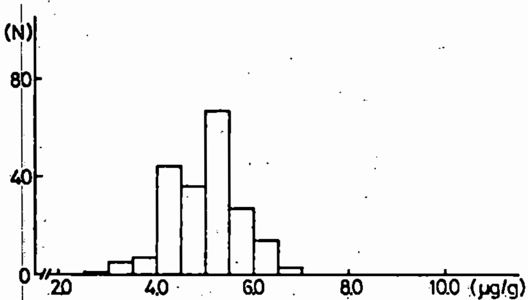

Fig. 2. Zinc in whole blood of healthy urban habitants (female): N=203, mean±S.D.=5.0±0.70μg/g, med. =5.0μg/g

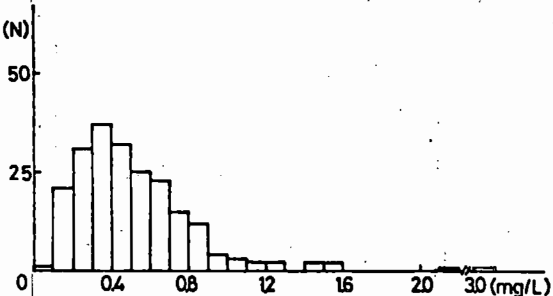

Fig. 3. Zinc in urine of healthy urban habitants (male): N=212, mean±S.D.=0.50±0.34mg/L med.=0.42 mg/L

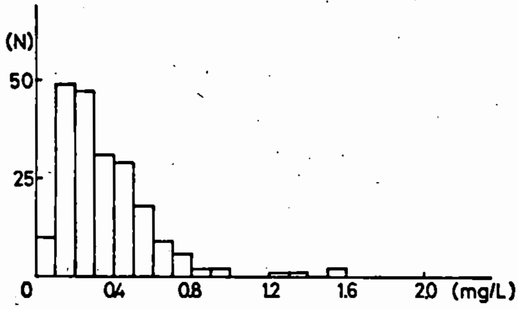

Fig. 4. Zinc in urine of healthy urban habitants (female): N=206, mean±S.D.=0.35±0.26mg/L, med. =0.29mg/L

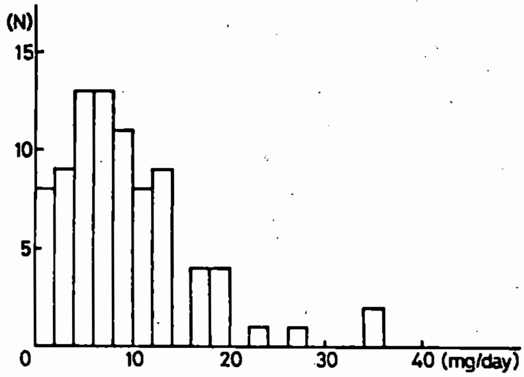

Fig. 5. Zinc in feces of healthy urban habitants (male): N=81, mean±S.D.=9.3±6.9mg/day, med.=7.9mg/day

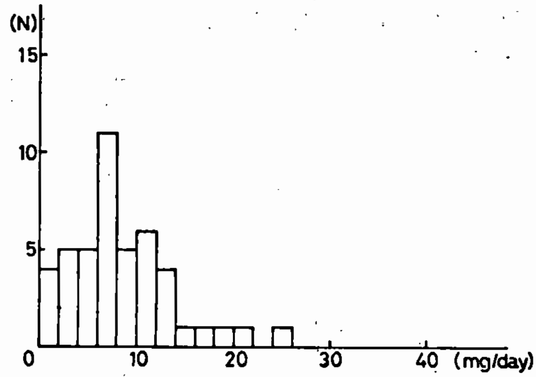

Fig. 6. Zinc in feces of healthy urban habitants (female): N=45, mean±S.D.=8.4±5.4 mg/day, med. =7.0mg/day

male (N=209) and 5.0±0.49mcg/ml in female (N=203).

2) Zinc in urine was 0.50±0.30mg/L in male (N=196) and 0.35±0.26mg/L in female (N=206).

3) Zinc in feces was 9.3±6.9mg/day in male (N=81) and 8.4±5.4mg/day in female (N=45).

4) Intake of zinc from atmospheric air was estimated at about 2.5mcg/day per person.

Table 1. Zinc contents of foods by food groups.

Food group	Zn (mg/Kg)
Cereals	11.3
	0.90 – 39.6
Seeds and nuts	30.8
	4.40 – 52.5
Potatoes	2.50
	0.30 – 5.50
Sugars	2.30
	tr. – 6.00
Confectioneries	5.00
	0.10 – 14.7
Oil and fats	0.38
	0.06 – 0.63
Pulses	19.2
	3.40 – 37.7
Vegetables	3.80
	0.50 – 30.0
Fungies	7.80
	3.30 – 12.1
Seaweeds	38.7
	3.30 – 122
Seasonings and others	4.00
	0.90 – 8.20
Beverages	0.30
	0.02 – 0.52
Fish and shellfish	14.3
	2.00 – 77.4
Meat, poultry and whales	19.3
	2.40 – 44.1
Eggs	9.50
	0.50 – 20.0
Milk	10.3
	0.56 – 33.1

Upper rows : Average
Lower rows : Range

Table 2. Intake of Zn from foods by food groups.

Food group	Foods (g)	Zn (mcg)
Cereals	343.7	3380
		309 – 12400
Seeds and nuts	1.6	49.3
		7.0 – 84
Potatoes	61.7	154
		18.5 – 339
Sugars	15.1	34.7
		tr. – 90.6
Confectioneries	28.0	140
		2.8 – 412
Oil and fats	16.2	6.2
		1 – 10
Pulses	67.0	1290
		228 – 2526
Vegetables	249.2	947
		135 – 7480
Fungi	7.2	57.2
		23.8 – 87.1
Seaweeds	4.7	182
		15.5 – 574
Seasonings and others	29.8	119
		26.8 – 244
Beverages	84.4	25.3
		1.7 – 143
Fish and shellfish	91.0	1300
		182 – 7000
Meat, poultry and whales	62.8	1212
		151 – 2770
Eggs	41.1	390
		20.6 – 822
Milk	96.5	934
		54.0 – 3190
Total	1395.5	10900
		1210 – 38500

Upper rows : Average
Lower rows : Range

5) Intake of zinc from foods and beverages was about 11mg (7±15mg)/day per person.

6) Total daily excretion of zinc from urine and feces was estimated at about 9mg (3±11mg)/day.

7) It was revealed that most of zinc intake was from foods and beverages, and excretion of zinc was mostly into feces and a little into urine.

References

Ninomiya, K., Kurono, T., Teramoto, K. and Horiguchi, S.: Zinc content of daily foods in Japan (Part 1). Seikatsu Eisei, 20: 90-93 (1975) (in Japanese).

Ninomiya, K., Kurono, T., Teramoto, K. and Horiguchi, S.: Zinc content of daily foods in Japan (Part 2). Seikatsu Eisei, 22: 58-62 (1978) (in Japanese).

Horiguchi, S., Teramoto, K., Kurono, T. and Ninomiya, K.,: The arsenic, copper, lead, manganese and zinc contents of daily foods and beverages in Japan and the estimate of their daily intake. Osaka City Med. J. 24: 131-141 (1978).

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AN EXPERIENCE OF THE TREATMENT OF CHRONIC BERYLLIUM DISEASE

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Introduction

Chronic beryllium disease is a granulomatous disease in the lungs caused by the inhalation of beryllium oxide. Corticosteroid is known as the only effective drug for the disease, but the question of in what patients this drug should be used, and when used, and the problems of adequate dosage and period of administration are very difficult dilemmas that remain to be solved. Recently, we have dealt with ten cases of the disease, occuring in a ceramic factory near Kyoto since February, 1973 which were caused by exposure to beryllium oxide, a material in ceramics. We will herein present our experience of corticosteroid treatment of the disease.

Clinical Data

Patients detected by subjective symptoms

Four patients were detected by subjective symptoms, mainly general malaise, exertional dyspnea, and coughing.

All cases were treated with corticosteroid and showed an improvement of symptoms and only one case showed an improvement in chest x-ray findings. And, in three cases, the termination of the administration of steroid—after 4 years, 2 years and 5 months, and 7 years—was possible.

In these cases, oral administration of corticosteroid was done at first, and then later, intramuscular injections of once or twice a month were employed. The intramuscular injections were a better method for the administration of corticosteroid not only for doctors but also for patients.

Patients detected by mass survey

After detection of patients with chronic beryllium disease in the ceramic factory, annual mass surveys were done in all employees, and six cases without overt symptoms were detected by chest x-rays, one in 1974, two in 1975, and three in 1977.

Three cases treated with steroid: All three patients showed a disappearance of abnormal shadows. In two cases, administration of steroid was terminated upon complete disappearance of abnormal shadow, occurring after seven – month of steroid treatment, but, three month later, a worse condition of chest x-ray, general malaise, and exertional dyspnea than before appeared. For the above changes, intramuscular injection of steroid has been done. Intramuscular injection was effective in treating simp-shadows in chest x-rays. After complete disappearance of abnormal shadows in chest x-rays, continuous administration of corticosteroid was done in one case because of the possibility of withdraw symptoms. Administration of steroid for 2 years and 6 months showed osteoporosis of femur as a side effect of the steroid.

Three cases observed without steroid treatment: In two cases, subsequent x-rays showed spontaneous improvement reflected in the disappearance of nodular shadows. And, positive conversion of tuberculin sensitivity and negative conversion of a lymphocyte stimulation test with beryllium sulfate were observed, in one of the two cases after 6 months and in the other after 1 year.

Conclusion

It is strongly proposed that in chronic beryllium disease cases, corticosteroid treatment should only be attempted when overt symptoms are present.

References

U.S. Department of Health, Education and Welfare, 1972 Occupational Exposure to Beryllium: 72-10268.

Stoeckle, J.D., Hardy, H.L., and Weber, A.L. Chronic beryllium disease. Longterm follow-up of sixty cases and selective review of the literature. Amer. J. Med. 46 (4): 545-561, 1969.

Izumi, T., Kobara, Y., Inui, S., Tokunaga, R., and Jones Williams, W. The first seven cases of chronic beryllium disease in ceramic factory workers in Japan. Ann. N. Y. Acad. Sci. 278: 636-653, 1976.

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HEMATOLOGICAL AND SERUM CHEMICAL STUDIES OF STYRENE WORKERS AND STYRENE EXPOSED ANIMALS

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Styrene is widely used in the manufacture of plastics. A protection against health hazard of employees in these factories has been one of the major problem of occupational health.

In our department, a series of studies on styrene poisoning has been performed since 1971[1,2]. The purpose of the present study is to elucidate the changes in hematological test and serum chemistry on styrene workers and styrene exposed animals.

Materials and Methods

1. Styrene workers; Workers manufacturing bathtabs, sanitary tanks and so on using resin with styrene monomer in the factory A and B were tested. They had been in the work for 8-9 years and the average of their age was in their thirties. Styrene concentrations in the air of workshops are shown in Table 1. Most sections of workshop were below 50 ppm of styrene on the time weight average. Control; Office workers in the factory B and volunteers from university students were tested.

2. Experimental animals; Rats aged 8 weeks were divided into 3 groups. The first group (exposure group) was exposed to styrene vapour at about 600 ppm repeatedly for 4 hours every day except Sundays and Saturdays for 8 weeks, in an exposure chamber under the control of air flow rate 2 L/min (Fig. 1). Air in the chamber was sampled frequently, and was analyzed for styrene by gaschromatography. The second group (control-1 group) was treated in the same way as the exposure group in an exposure chamber except for the exposure to styrene. The last group (control-2 group) was kept under the routine feeding and watering. Two days after the end of styrene exposure, blood and serum tests were made. Twenty four hours before killing, rats were fed only watering. Each blood sample was divided into 2 tubes. One of them was for use in hematological tests such as specific gravity of whole blood, hemoglobin, hematocrit value and red and white cell counts. The other, serum separated from blood, was for use in serum chemistry such as glucose, insuline, total cholesterol, triglyceride, protein, alubmin globulin ratio,

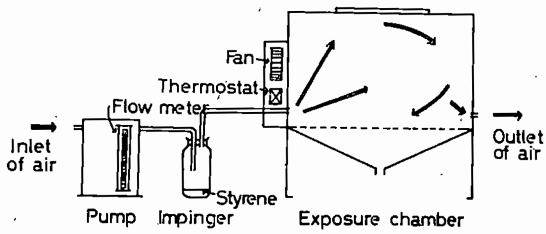

Fig. 1. Generator of styrene and exposure chamber

Table 1. Styrene concentration in the air of workshop.

Factory	Date of survey	Section of workshop	Styrene (ppm)
A	Dec. 1968	Bath forming	0.5 – 40
		Sanitary tank forming	10 – 200
		Resin mixing	10 – 25
		Hand laying-up	10 – 60
		Field office room	0.5
A	June. 1973	Bath forming	1 – 20
		Sanitary tank forming	10
		Resin mixing	10
		Performing	nd
A	Nov. 1973	Bath forming	1 – 100
		Sanitary tank forming	1 – 100
		Resin mixing	20 – 30
		Finishing	0.8 – 1
A	Nov. 1974	Bath forming	tr. – 1
		Water proof pan forming	tr. – 1
		Resin mixing (non-operating time)	0.5
		Hand laying-up	20 – 40
B	Dec. 1971	Bath forming	18
		Resin mixing	57
		Sanitary tank spraying	16 – 91
		Sanitary tank assembling	0.5

Table 2. Results of hematological tests and serum chemistry of styrene-exposed workers.

Factory	Date of survey	Number	Sex	Age	Duration exposure (years)	G B	Hb (g/dl)	Ht (%)	RBC (10^4/ mm^3)	WBC (/mm^3)
A	12. 1975	18	Male	32	9	1.057	14.8	44	434	6090
B	11. 1976	18	Male	37	8	1.057	15.0	45	454	6230
B	9. 1977	15	Male	37	8	1.058	15.2	–	438	6900
B(Cont.)	9. 1977	11	Male	32		1.059	15.3	–	443	6830
(Control)	–	19	Male	–		1.058	15.3	44	441	6460

	Glucose (mg/dl)	T.Chol (mg/dl)	T G (mg/dl)	T P (g/dl)	A/G	TTT (MU)	ZTT (KU)	T. Bil (mg/dl)	ALP (KAU)	Ch.E (pH)	GOT (KU)	GPT (KU)
A	93.3	185.3	116.9	7.6	–	2.4	6.3	1.1	7.5	0.97	19.6	19.0
B	95.4	–	88.7	7.7	–	1.9	5.3	0.9	7.9	0.98	16.0	16.8
B	97.4	181.0	98.1	–	1.6	–	6.2	–	–	–	20.6	18.8
B(Cont.)	93.7	179.5	135.7	–	1.7	–	5.9	–	–	–	20.9	20.9
(Cont.)	95.0	196.4	140.6	7.9	1.7	2.9	5.9	0.9	6.4	1.05	16.8	17.9

Table 3. Results of hematological tests and serum chemistry of styrene-exposed rats.

	Styrene (ppm)	Number	Age (week)	Duration of exposure (week)	Weight (g)	G B	Hb (g/dl)	Ht (%)	RBC (10^4/mm^3)	WBC (/mm^3)
Exposed group	600	10	8→16	8	358	1.060	16.6	50	654	12870
Control-1	0	6	8→16	8	374	1.060	16.8	51	673	9920
Control-2	0	5	8→16	–	383	1.058	15.7	51	676	8580

	Glucose (mg/dl)	Insuline (μv/ml)	T.Chol (mg/dl)	T G (mg/dl)	TP (g/dl)	TTT (MU)	ZTT (KU)	T.Bil (mg/dl)	ALP (KAU)	Ch.E (pH)	GOT (KU)	GPT (KU)
Exp. G.	150.5	18.1	57.7	17.2	7.4	0.2	0.7	0.5	17.4	0.23	126.6	38.6
Cont.1	141.0	21.8	53.3	19.5	7.4	0.2	0.8	0.5	17.2	0.23	124.5	32.8
Cont. 2	167.4	20.3	61.0	22.0	7.2	0.3	0.7	0.4	21.0	0.22	127.6	34.8

Each figure shows the average value in each section.

TTT, ZTT, bilirubin, alkaliphosphatase, cholinesterase and transaminase (GOT and GPT).

Results

The results obtained were shown in Table 2 as the value of each test on styrene workers and that on non-exposed persons, and shown in Table 3 as the value of each test on animals. The review by Oltamare[3] indicates that there are no opinions in agreement on the effect of styrene on hematological and liver function tests in both humans and animals. As far as the items studied by us are concerned, the results show that exposure to styrene has not caused any significant changes in hematological tests and serum chemistry on both humans and animals.

References

1) Teramoto, K.: Studies on styrene poisoning from the stand point of occupational health (I) and (II), Osaka City Med. J., 27: 249-277 (1978).
2) Teramoto, K. and Horiguchi, S.: Absorption, distribution and elimination of styrene in man and in experimental animals, XIX International Congress on Occupational Health Abstract, 169 (1978).
3) Oltamare, M., Desbaumes, E., Imhoff, C. et Michiels, W.: Toxicologie du styrene monomer. Editions Medicine et Hygiene, Geneve (1974).

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TOXIC SUBSTANCES AND HEALTH HAZARDS IN THE PAINT INDUSTRY

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Introduction

Various chemical substances have been used for paint solvent, pigment, resin and others in the paint industry. However, many of these substances are toxic and occasionally affect the health of workers engaged in paint manufacturing and paint using factories.

Recently, a number of field surveys has been conducted to investigate the state of health of such workers with the principal object of learning about the effects of the above mentioned chemical substances, the use of which are wide spread in many factories.

Accordingly, this study was undertaken to determine the effects of toxic substances on the health of workers at a number of factories in Japan.

The following results were obtained:

Field Survey

Case I. Intoxication by organic solvents:

This factory makes many kinds of tanks. Ethyl acetate and toluene are used in diluting paint and thinner (toluene 60%, methanol 20%, acetone 10%, methyl acetate 10%) in cleaning the surface of a tank.

The inside of the tanks in which paint handlers use the organic solvents in high concentrations.

According to our measurement, toluene concentrations in the air inside the tank were between 1,000 and 5,000 ppm, and ethyl acetate were between 2,000 and 2,500 ppm. The paint handlers usually work in a tank with paint for several hours. However, these workers did not usually wear a protective mask. We found that they often suffered from nausea and headaches after work.

One day an office worker, who entered a tank to measure the concentrations of the organic solvents in the air without taking precaution, because the paint handlers did not wear a protective mask, felt dizziness after 1-2 minutes and soon became unconscious due to the high concentration of the organic solvent vapors. He was immediately evacuated by other workers but suffered from headaches and nausea for several hours although he had almost completely recovered by the next day.

Case II. Skin decolorization and dermatitis of paint workers:

Case II-1. Age: 31, Sex: male, Period of work: 15.5 years

This case had been handling paint for a long period. As a symptom of the incipient stage, he felt itching on both antibrachiums during the summer season. After a while, dermatitis was found on his hands, and subsequently skin decolorization occurred. When his hands became sunburnt, the dermatitis became worse, melanin decreased and leucoderma was found obviously.

Case II-2. Age: 19, Sex: male, Period of work: 1.5 years

This case carried out the same work as case II-1, soon after he had started working with paint, he felt itching on one hand and dermatitis was found on both hands. Subsequently, the same symptom as case II-1 was observed. It seems that the skin lesions of these 2 cases were both due to the handling of paint and to the organic solvents used for removing paint.

Case III. Lead and chromium exposure in a pigment manufacturing factory:

The principal purpose of this study was to determine whether any adverse effects attributable to Pb and Cr could be detected in exposed employees.

The study was conducted at a paint manufacturing factory between 1973 and 1977.

Lead and chromium concentrations in the air are shown in Table 2 (Factory No. 4).

Data were obtained from employees engaged in crushing, drying and packing operations using the personal air sampling method.

The TWA (Time Weighted Average) of the employees engaged in crushing operation was higher than those engaged in drying and packing.

Analyzing the data, both concentrations were found to be significantly high between September 1973 and June 1975 but their concentration levels decreased gradually after December 1975.

Figure 1 shows Pb concentration in the blood and urinary Cr concentration of the workers.

Lead concentration in the blood and urinary Cr concentration seemed to decrease as Pb and Cr concentrations in the air decreased each year.

Nevertheless, both concentrations in the blood and urine were still higher than the normal levels.

Experimental Study

Experiment 1. Testicular atrophy of mice and rats was induced by ethylene glycol mono alkyl ethers.

Toxicities of six ethylene glycol mono alkyl ethers administered by oral and inhalant methods were studied. Mice were given vari-

Table 1. Atmospheric organic solvents concentrations in the paint industry.

No	Type of factory	Kind of work	Place	Vapor concentrations (ppm) Toluene	Xylene	Note
1	Tank manufacturing	painting	inside of tanks	1000 – 5000		Stylene 10 ppm Ethyl acetate
	July 1970					2000 – 2500 ppm
		painting	outside of tanks	170		Stylene 1 – 2 ppm
2	Prefabricated house	painting with spray		3 – 10	3 – 5	
	manufacturing	spread panel with adhesive agent		200 – 500		Urinary hippuric acid
	July 1970	cleaning		20 – 200		0.1 – 5.3 g/L (54 workers)
3	Machine manufacturing	painting with spray		30 – 50	200	Benzene 1 – 50 ppm
	December 1970					
4	Chemical factory	painting with spray		36 – 135		Urinary hippuric acid
	November 1971	cleaning		102 – 120		0.6 – 1.7 g/L
5	Paint manufacturing	stirring		100 – 200	3000 – 5000	2 workers were diagnosed as
	April 1972	enamel workshop			1500	industrial dermatitis
6	Prefabricated house manufacturing					
	April 1973	painting	inside of room	65 – 350	0 – 78	Urinary hippuric acid
		painting	outside of room	18 – 54	10 – 88	0.1 – 2.2 g/L (10 workers)
	April 1975	painting	outside of room			
			(personal sampling No A)	1 – 9	1 – 9	
			(personal sampling No B)	1 – 3	1 – 2	
		painting	inside of room			
			(personal sampling No C)	27	1	
7	Metal processing	painting with spray		1 – 10	0 – 10	
	April 1973		paint store	200 – 300	150	Ethyl acetate 1000 ppm
8	Car painting	painting with spray		2 – 20		
	April 1973					
9	Paint manufacturing					
	April 1973	preparation of paint	(personal sampling)	7	50	
			(personal sampling)		382	
			above of separator		5400	
			cleaning inside of tank		1000	
		preparation of varnishes	(personal sampling)	2 – 18	7 – 22	
			filling		139 – 309	
			cleaning		772	
		preparation of enamel	(personal sampling)	12	91	
			roller working		500 – 824	
			cleaning		746	
	October 1974	preparation of paint	(personal sampling A)	1	38	
			(personal sampling B)	4	9	
		preparation of varnishes	(personal sampling) (5 workers)	1 – 21	1 – 6	
10	Car equipment	painting	inside of room	5 – 544		Urinary hippuric acid
	October 1974	painting	outside of room	2 – 520		0.1 – 0.4 g/L (2 workers)
11	Car painting	painting	A workshop inside of car	6 – 56	11 – 487	ethyl acetate cellosolve acetate
	September 1974					3 – 139 9 – 59
			outside of car	2 – 22	8 – 235	3 – 139 9 – 10
			B workshop	4 – 59	17 – 302	3 – 70 0 – 20
12	Machine parts manufacturing					
	June 1977	painting	A workshop personal sampling	2 – 8		

ous doses (62.5, 125, 250, 500, 1000, 2000, 4000 mg/kg body weight) of the compounds daily for 5 days/week during 5 weeks.

High doses of ethylene glycol mono methyl ether (EGM), ethylene glycol mono methyl ether acetate (EGMA), ethylene glycol mono ethyl ether (EGE) and ethylene glycol mono ethyl ether acetate (EGEA) produced marked testicular atrophy and leucopenia. But, ethylene glycol mono butyl ether (EGB) and ethylene glycol mono phenyl ether (EGP) had slight effect on the testis and leucocytes.

EGM was more toxic than EGE. The significant difference was found in neither between

Table 2. Atmospheric Pb, Cr, concentrations in the paint manufacturing plant.

No	Type of factory	Kind of work	Place	Pb in air (mg/m^3)	Cr in air (mg/m^3)	Pb concentration in urine (μg/l)	Cr concentration in urine (μg/l)
1	Paint manufacturing September 1973	mixing of pigment		0.02 – 3.42	0.17 – 0.41	21 – 60 (N=4)	0 – 1 (N=3)
2	Paint manufacturing						
	October 1974		(personal sampling)	0.06		14 – 29 (N=7)	
	October 1975		(personal sampling)	0.13	0.17	10 – 21 (N=5)	0.09 >(N=5)
3	Pigment manufacturing						
	September 1975		A workshop	0.06 – 63.7	0.01 – 17.5		
			B workshop	1.93 – 3.64	0.08 – 0.14	12 – 132 (Av 61)	2 – 259 (Av 41)
			C workshop	0.02 – 0.04	0.52 – 48.5	(N=26)	(N=26)
			(personal sampling)	0.11 – 27.3	0.03 – 10.9		
	August 1976		A workshop	0.01 – 0.19	0.01 – 0.07		
			B workshop	0.07 – 5.49	0.01 – 0.03		
			C workshop	0.01	0.15		
			(personal sampling)	0.01 – 2.73	0.01 – 0.67		
	June 1978		A workshop	0.06 – 0.39	0.01 – 0.15		
			B workshop	0.09 – 0.48	0.01 – 0.02		1 – 13 (N=5)
			C workshop	0.01	0.29		
			(personal sampling)	0.02 – 0.16	0.01 – 0.12		
4	Pigment manufacturing						
		crushing	(personal sampling)	2.07	1.14		
		packing	〃	0.29	0.07		
		drying	〃	0.05	0.05		
	January 1971	crushing	〃	3.86	1.67		
		packing	〃	0.41 – 0.91	0.10 – 0.17		
	June 1975	crushing	〃	0.39 – 7.50	0.27 – 4.20		
		packing	〃	0.06 – 0.62	0.06 – 0.27		
		drying	〃	0.14	0.09		
	December 1975	crushing	〃	0.04 – 0.08	0.04 – 0.08		
		packing	〃	0.17 – 0.48	0.06 – 0.09		
		drying	〃	0.01 – 0.02	0.01 – 0.04		
	June 1976	crushing	〃	0.04 – 0.15	0.45 – 0.72		
		packing	〃	0.03 – 0.27	0.01 – 0.16		
		drying	〃	0.01	0.03		
	November 1976	crushing	〃	0.01 – 0.13	0.13 – 0.54		
		packing	〃	0.12 – 0.25	0.07 – 0.16		
		drying	〃	0.01 – 0.04	0.03		
	August 1977	crushing	〃	0.01 – 0.11	0.07 – 0.09		
		packing	〃	0.03 – 0.16	0.03 – 0.08		

EGM and EGMA nor between EGE and EGEA.

Rats were exposed to EGMA at three concentrations (8, 25, 75 ppm) daily for 4 hours/day, for 5 days/week during 4 weeks.

Testicular atrophy was found in the exposed group of 75 ppm EGMA.

Experiment 2. Skin and liver diseases by organic tin compounds.

Organic tin compounds are used to keep a shell fish from sticking to a bottom of a ship. The effects of organic tin compounds on mice were studied.

Prior to administration, tributyl tin oxide, tributyl tin fluoride, triphenyl tin fluoride, triphenyl tin hydroxide, triphenyl tin dimethyl dithiocarbamate were diluted at their concentrations of 20% with olive oil.

The animals were given the diluted organic tin compounds by the percutaneous absorption method daily for 5 days/week during 2 weeks. As shown in Table III, less of body weight, dermatitis and liver damage were found.

Discussion

The state of health of workers paint manufacturing and the paint using factories was investigated, and intoxication and leucoderma were found in workers handling organic solvents (particularly toluene and xylene).

From Case I, we concluded that the solvent handlers were habituated to the organic solvents

Table III. Results of Observation of Mice Given Organic Tin Compounds by Percutaneous Absorption

Compound	Body weight	Symptoms of skin
tri butyl tin oxide	significant decrease	high inflammation subcutaneous congestion
tri butyl tin fluoride	slight decrease	high inflammation
tri phenyl tin fluoride	stagnation in groth	moderate inflammation
tri phenyl tin hydrooxide	significant decrease	moderate inflammation
tri phenyl tin dimethyl dithio carbamate	stagnation in groth	slight inflammation
	Organ weight	
tri butyl tin oxide	liver, spleen increase	
tri butyl tin fluoride	liver, spleen increase	

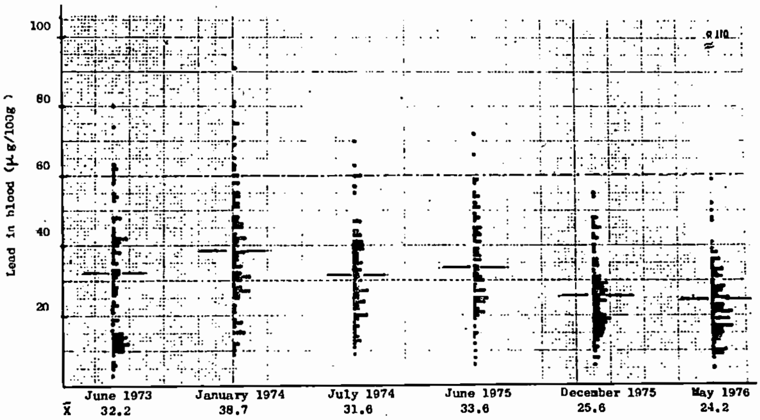

Fig. 1. Lead concentration in blood

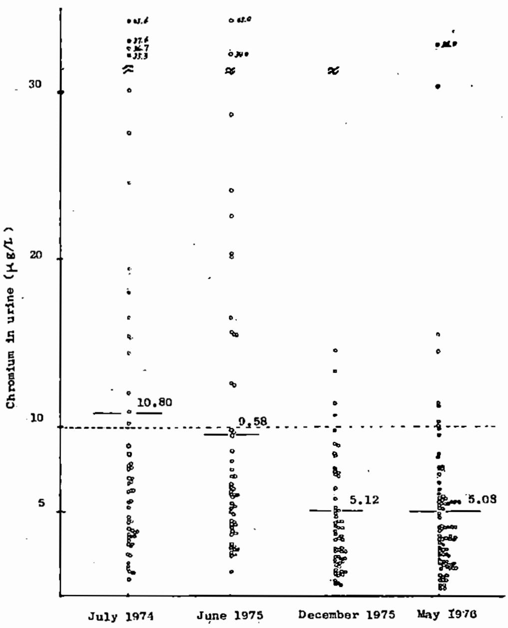

Fig. 2. Chromium concentration in urine

because they worked under these circumstances every day, but that, the office worker, who was physically unaccustomed to organic solvent, fell unconscious when suddenly exposed to high concentrations of organic solvent vapors.

After this accident, we advised the factory to improve the working conditions, to provide protective masks for its workers, and to alternate between use of high toxic solvents and low toxic solvents.

Our measurement in Pb and Cr handling factory indicated that Pb and Cr concentrations in the air apparently decreased due to improvements in working environments.

Furthermore, Pb concentration in the blood and urinary Cr concentration showed a decreasing trend.

However, the concentrations in the blood and urine were still higher than the normal levels.

From these results, it can be seen that the first condition for the protection of health of workers is the complete improvement of the working environment.

If such improvement of working conditions is impossible, the us e of a protective mask is necessary.

In the experimental study with six ethylene glycol mono alkyl ethers and five organic tin compounds, testicular atrophy and leucopenia were found to be caused by the ethylene glycol mono alkyl ethers, and skin and liver diseases by the organic tin compounds.

In recent years, the use of ethylene glycol mono alkyl ethers instead of toluene and xylene for paint thinner has increased in Japan.

While, organic tin compounds were developed and used as paint for ship bottoms.

It is considered that the use of these chemical substances will increase in future.

Therefore, it will be necessary to continue this study further in order to clarify the toxicities of these chemical substances.

References

E. Nakayama (1979) Organic solvents poisoning in the paint industry. Toso Gijutu, 18 (2) 60-72. (in Japanese).

E. Nakayama (1979) Occupational diseases in the paint industry. Roudo Eisei, 20 (4) 6-11. (in Japanese).

K. Nagano, E. Nakayama, M. Koyano, H. Oobayashi, H. Adachi and T. Yamada (1979) Testicular atrophy of mice induced by ethylene glycol mono alkyl ethers. Jap. J. Ind. Health 21 (1) 29-35. (in Japanese).

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THE RISKS FOR CARCINOGENIC EFFECTS IN CHEMICAL INDUSTRY — An Epidemiological Study of the Mortality Among Swedish Chemistry Graduates —

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Introduction

There are many good reasons for studying possible adverse health effects among chemical engineers. This group of people hold key positions in chemical industries whether it concerns inventions or development, planning or supervising the work or the processes in the multiplicity of chemical factories and industries. In our experience, the level of knowledge and understanding of chemical hazards among chemical engineers is a crucial matter in these contexts. If the chemical engineer is unaware or ignorent of possible health hazards—to himself or to other persons eventually exposed—the safety precautions taken in the laboratories or in the chemical plant risk to be minimal. A lack of sufficient knowledge among chemists seems to have occurred more often regarding possible longterm effects, that is to say that their training has at least formerly been almost completely focused on acute side-effects: explosions, fire hazards, and acute effects of involvuntary inhalations or skin penetration.

The mortality among chemists was first studied by Li et al. (1969). The found an excess mortality of malignant tumors, particularly lymphomas and pancreatic cancer. In earlier publications (Olin, 1976, Olin, 1978) we analysed the mortality in a cohort of 857 men, who graduated from two schools of chemical engineering in Sweden between 1930 and 1950 and who were followed-up to the end of 1974. For one of the two schools, the Royal Institute of Technology in Stockholm (KTH), the study of the chemistry graduates has been extended in several ways. The follow-up period has been prolonged, graduates from one more decade have been included in the study, and a cohort of graduated architects has been followed up in the same way as the chemists in order to

Table 1. Observed and expected numbers of deaths among chemists and architects, educated between 1930 and 1959, followed up to Dec. 31, 1977.

Causes of death (I.C.D. no., 8th rev.)	Number of deceased chemists		Number of deceased architects	
	Observed	Expected	Observed	Expected
All causes	83	103.8 *)	59	87.8 **)
All cancer (140-239)	32	24.2 –	11	20.5 *)
Digestive (150-159)	8	9.2 –	3	7.9 *)
Pancreatic (157)	2	1.6 –	2	1.4 –
Respiratory (160-163)	3	4.0 –	5	3.4 –
Prostatic (185-187)	3	1.5 –	1	1.4 –
Urinary (188-189)	3	1.8 –	0	1.5 –
Brain (191)	5	1.2 **)	1	1.0 –
Lymph/hematopoetic (200-209)	7	3.2 *)	0	2.7 –
Hodgkin's disease (201)	3	0.7 *)	0	0.5 –
Circulatory (390-458)	22	40.4 **)	20	35.1 **)
Accidents, suicides (E800-999)	15	21.9 –	15	17.6 –
All other causes	14	17.3 –	13	14.6 –

provide a suitable reference group. The present paper reports results from this extended study.

Study population

This study is an analysis of the mortality among the cohort of Swedish male chemists who graduated from KTH during the three decades from 1930 to 1959. The cohort was followed-up until the end of 1977. The chemists were compared in respect of mortality with a similar cohort of male architects who graduated from the same school during the same period. Another comparison was made with the general Swedish male working population. The number of chemists was 822, including two who could not be traced, and the number of architects 659, including two, who could not be traced. The average age at graduation was just less than 25 years.

Data collection

In order to find out which of the graduated chemists and architects had died during the follow-up period the individuals were traced in various registers. The follow-up was facilitated by the unique ten-digit civil-registration number that was introduced in 1947 and used as identification in most Swedish registers. For all deceased individuals in the cohort the death certificates were obtained from these sources and examined.

Results

In the comparison with the general population the SMR for total mortality was 80 for chemists and 67 for architects. Both values were significantly lower than 100. The comparison between the two cohorts did not show any clear discrepancy in total mortality. The RR was 114 and did not differ significantly from 100. The main explanation to the low total mortality that was found in both cohorts was a low mortality in circulatory diseases and also in suicides and accidents (Table 1).

When the cancer mortality was analysed, a different result was obtained. The total cancer mortality among chemists was slightly elevated relative to the general population; the SMR was found to be 132. For architects the cancer mortality relative to the general population was low and the corresponding SMR 54. The comparison between the two cohorts displayed a higher cancer mortality among chemists, and resulted in a RR that was estimated at 254. (95% confidence limits: 199-309. p= 0.006).

The excess cancer mortality among chemists could be explained in general by two types of tumors, namely by lymphatic and hematopoetic tumors and by brain tumors (Table 1). As regards the whole class of lymphatic and hematopoetic tumors, both the comparison with the general population and that with the architects gave significant results (p=0.04 and p=0.02). Only for one of the single diagnoses in this class, Hodgkin's disease, was a significant result obtained. That was in the comparison with the general population (p= 0.03), while in the comparison with the architects the numbers were too small (p=0.19). The three cases of Hodgkin's disease were organic chemists, who died 6, 10 and 29 years after their respective year of graduation. Then there were two cases of myelogenic leukemias, one of which was of the chronic type, one case of lymphosarcoma, and one case of reticulum cell sarcoma. The high frequency of brain tumors, all gliomas, gave a significant result in the comparison with the general population (p=0.01), but again the numbers were too small to provide a significant result in the comparison with the architects (p=0.10).

Discussion

In the comparison of total mortality among chemists with that of the general population, the low SMR that was found was probably due to the "healthy workers effect," in this case strengthened by the fact that these chemists belonged to high socio-economic classes. The low SMR illustrates the difficulties in the choice of a proper reference group. By comparing two groups, architects and chemists, who had their academic education at the same school, in the same city, and during the same period, the risk of confounding by socio-economic characteristics was minimized. The cohort of architects was selected because it was believed to represent a profession without any obvious physical hazards during neither educational nor professional life.

In all cancer epidemiology, one of the most important confounders to be considered is smoking. It was impossible to study this factor retrospectively, but the fact that the lung-cancer mortality was not excessive among the chemists supports the assumption that smoking is not unusually common in this cohort. It thus seems unlikely that confounding by smoking is at hand.

It was concluded that the most probable explanation to the high cancer mortality among the chemists is the exposure to chemical substances in their educational or occupational environment. This conclusion is also supported by the character of the groups of tumors with excess mortality, lymphatic and hematopoetic tumors, and brain tumors.

The lymphatic/hematopoetic group of tumors is heterogeneous. Several etiological factors are plausible but hitherto mostly inconclusively investigated. Virus infections, immunodeficiencies, irradation, and some chemical toxic substances, such as benzene, are under evaluation. Neither the theories of virus etiology nor those of genetically induced immunodeficiencies gained support in the present study. Firstly, there was no tendency for clustering in the chemist cohort of the three cases of Hodgkin's disease. Secondly, among the architects there was not one case of this disease nor of the other types of lymphatic/hematopoetic tumors that occurred among the chemists, although these two adademically educated groups presumably had much in common as for background and living conditions during their years of education. In the present retrospective mortality study it has been difficult to evaluate the presence of an occupational irradiation exposure.

As for chemicals, the ubiquitous nature of benzene is well known and its leukemogenic properties are under continuous discussion (OSHA, 1978. Cohen et al, 1978). Less observed is the association between benzene and Hodgkin's disease (Aksoy et al, 1974). Benzene has been widely used until recently in most kinds of Swedish chemical laboratories and is therefore clearly a factor of importance. But there are most certainly other chemical compounds which ought to be considered in the etiology of human leukemia/lymphoma. A group of directly alkylating agents available in various chemical laboratories has radiomimetic properties. Other lipophilic but inert substances can be metabolized into electrophilic intermediates, such as epioxides, which has probable carcinogenic properties (Gialen, 1978). The obvious multiple exposure risk for chemists to such classes of potentially carcinogenic substances available and in use in chemical laboratories is a plausible explanation to the excess cancer mortality in the group, particularly to the elevated number of cases of leukemia/ lymphoma. Contrary to the aforementioned risk indicators, chemical exposure is without doubt unevenly distributed between the chemical and the architect group. Chemistry graduates dwell in chemical laboratories during their educational period and often, also later on in their occupations. Architects have no similar education environment and their occupation is a desk job.

The etiology of primary brain tumors in the central nervous system is largely unknown. However, since the middle of the 1960th it has been demonstrated in animal research that tumors of the central nervous system can be induced selectively. Thus, following systemic exposure, the nitroso-ureas caused neuroectodermal tumors in 100% of the animals (Swedberg, 1977).

There are no similar data concerning man, but the following observation should be considered for further studies. In the prospective part of the present study we have been informed that one of the nitroso-ureas, MNU, at least up to the middle of the 1960th was used routinely in some synthesis during the elementary course in organic chemistry. Thus, the substance has been present in the laboratories used by the chemistry graduates under observation.

In conclusion, this study supports the suggestions that chemical exposure is a cause of both leukemic and hematopoetic tumors and brain tumors and thus indicates the occupational hazards in chemical work.

References

Aksoy, M., Erdem, S., Dingol, K., Hypuksel, T., and Dincol, G. (1974). Chronic exposure to benzene as a possible contributory etiologic factor in Hodgkin's disease. Blut. 28, 293.

Cohen, H.S., Freedman, M.L., Goldstein, B.D. (1978). The problem of benzene in our environment: clinical and molecular considerations. Am. J. Med. Sci. 275, 125.

Gielen, J. E. (1978). Biochemical aspects of chemical carcinogenesis. Bull. Cancer. 65, 249.

Li, F.P., Fraumeni, F., Mantel, N., and Miller, R.W. (1969). Cancer mortality among chemists. J. Natl. Cancer Inst. 43, 1159.

OSHA, (1978): Occupational Safety and Health Administration preamble to rule regulating exposure to benzene. DOL, Washington DC. 43 FR 5918.

Olin, R. (1976). Leukemia and Hodgkin's disease among Swedish chemistry graduates. Lancet II, 916.

Olin, R. (1978). The hazards of a chemical laboratory environment – A study of the mortality in two cohorts of Swedish chemists. Am. Ind. Hyg. Assoc. J. 39, 557.

Swedberg, J.A. (1977). Chemical and virus-induced brain tumors. Natl. Cancer Inst. Monogr. 46, 3.

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Session 12.

Occupational Diseases due to Physical Agents

PREVENTION OF DECOMPRESSION SICKNESS AMONG COMPRESSED AIR CONSTRUCTION WORKERS

Thomas K. NG, *Australia*

Introduction

In this paper I shall look at the prevention of decompression sickness among compressed air workers from the point of view of an occupational physician. My first involvement in this field began in 1973 when as Senior

Industrial Health Officer in Hong Kong, I was asked to prepare a drafted regulation for work in compressed air. This was followed by my serving as, at first, the medical adviser, and later on, the medical officer to the largest compressed air construction project in Hong Kong. Finally, as a university teacher, I am allowed to make use of the records accumulated in the compressed air medical centre of that construction project for research purpose.

As the research project is still going on, the emphasis of this paper is essentially on the development of decompression tables for the prevention of decompression sickness among compressed air workers and the methods used in their evaluation.

Development of Decompression Tables

The most important part of a piece of legislation governing the medical aspects of work in compressed air is on the prescribed decompression tables. To some extent, they are equivalent to the threshold limit values in chemical hazards.

There are very few comparative studies in this subject until quite recently. The first serious attempt was made by an International Working Party held at the Ciba Foundation, London, in October, 1965. R. I. McCallum, the editor of the proceedings of that working party, summed up the practice over the world beautifully in one table (ILO, 1971). The variation in practice as indicated in Table 1 reminds us how much lack of understanding do we have in this area of occupational health practice.

I am unable to trace the development of decompression tables for work in compressed air in countries other than UK and USA. I have to use the term decompression tables for work in compressed air, as they differ from decompression tables for diving.

Haldane was credited as the first person who had computed decompression table for divers based upon experimental evidence. His concept of critical supersaturation influenced greatly the subsequent thinkers until quite recently when Hills attempted to challenge it by the concept of phase equilibration (Hills, B.A., 1977). His reduction ratio of 2 to 1 remained dominant in the naval practice until Hempleman replaced it by using different ratios for different pressure ranges (Hempleman, H.V., 1952).

But the work of Haldane did not receive any attention of the civil engineering in UK for quite some time. The industry relied on a rule-of-thumb method for decompression and there were examples quoted in engineering books (Gardner, D. & Hiscox, M.E., 1902) and in medical books (Oliver, T., 1916), the latter somewhat critically. In 1936, the civil engineering industry felt that there was a need to have a uniform table to be observed by the whole industry and this was done (The Institute of Civil Engineers, 1936).

Paton and Walder found that the 1936 decompression table was inadequate to protect compressed air construction workers and persuaded the UK Government to accept a new table with legal backing (Paton, W.D.M. & Walder, D.N., 1954). This was the 1958 Regulations Table.

With research carried out by the Decompression Sickness Panel of the Medical Research Council, the problem of aseptic necrosis of bone among compressed air construction workers came into light (Decompression Sickness Panel, M.R.C., 1971). Hempleman then modified

Table 1. Comparison of decompression times for a single working shift of 6 hours at 1.8 kg/cm²

Country	Time in min.
France	29
Germany (Federal Republic)	
Statutory tables	30
Proposed tables	55
Great Britain	
Regulation tables	58
Blackpool trial tables	90
Holland	102
Hungary	
Regulation tables	26
Proposed tables	36
Italy	35
Seattle, USA	141

(Source: Table 24 of encyclopaedia of occupational health & safety) the reduction ratio and produced a new set of decompressed tables for compressed air construction workers. It was first tried in a project in Blackpool in 1966 and became known as the Blackpool Table. It was later incorporated into the Medical Code of Practice for Work in Compressed Air (Decompression Sickness Panel, M.R.C., 1973). Though without legal backing, almost all contructors in that country sought permission from the Chief Inspector of Factories to use it.

As to the practice in USA, I found that there was a decompression table in the 1912 New York State Industrial Code. This was revised in 1922 and that version was used in USA for over 40 years. Because of union demand, it worked on a split shift basis with an interval in open air, but the time to be spent for decompression at the end of the second half shift was the same as that of the first half shift. Judging it with the modern concept, it was totally unphysiological.

In 1962, Duffner prepared a new table for the Municipality of Metropolitan Seattle and for the first time, the Haldenian concept was followed (Duffner, G.J., 1962). The Washington Table was soon copied by other States in USA. It provided relatively long time for decompression, and its decompression procedure was more diving orientated than construction work orientated, rendering work of the lock attendants very difficult.

As to the decompression tables of other countries, there are two problems. First, it is difficult to get a copy of the table. Secondly, it is difficult to understand how it was computed. I conclude that case reports or project reports without presenting the decompression tables used are of no value at all, because symptomatology of the disease is based upon the nature of the work as well as the decompression procedure observed.

Observance of Decompression Tables

Decompression sickness is said to be due to faulty decompression. A decompression can be fault in two senses: either the concept of the decompression table itself is faulty or the observance of the decompression table is faulty. To be able to evaluate the underlying concept of a decompression table, one must ensure its absolute observance. It is no easy task in construction industry.

The Blackpool Table was eventually recommended for use in Hong Kong, based not only on its theoretical reasoning but also on its practicability in the field (Ng, T.K., 1975). As there is no formal machinery for the evaluation of its use in Hong Kong, it becomes my personal interest and moral responsibility for doing so.

Table 2 shows the bends rates in various tunnels under construction in compressed air, up to 26th March, 1978. It can be seen that the overall bends rate of 0.71% is meaningless because different tunnels have different bends rates which appear to be affected by the working pressure of the tunnel as well as the duration

Table 2. Bends rates and tunnel pressures in a compressed air construction site in Hong Kong

Tunnel	Date C.A. work commenced	Date C.A. work completed	Range of pressure min	max	Number of decompressions	Number of bends bands	rate
A1	12/76	3/77	13½	31½	4297	31	0.72%
B1	4/77	5/77	10	13½	2511	–	0.00%
A2	4/77	–	27	33½	43655	497	1.14%
B2	9/77	–	13½	19½	14065	2	0.01%
C	9/77	–	12	27½	9287	31	0.33%
D	10/77	–	12½	25	8208	21	0.26%
E	11/77	–	13	27	8899	48	0.54%
F	11/77	–	20	32	5527	53	0.96%
Total	12/76	–	10	33½	96449	683	0.71%

of working.

A question has been raised on how the numerators and the denominators in a bends rate should be defined. The numerator can be based on cases felt, reported or treated, and it is dependent on treatment that we compile our statistics. The better the service, the more likely will the workers come forward for treatment, but it is very difficult to convince the administrators on this issue.

As to the denominator, again there are three possibilities: counting all decompressions, counting only shift decompressions as these are the people who are likely to have decompression sickness or counting mandays as each person can have only one attack of decompression in one day. I have done a comparsion of the three different denominators and found the second most appropriate.

Out of the 683, there were 518 simple cases (Type I) and 12 complicated cases (Type II). Of the 12 cases, 10 occurred in the site and 2 occurred after leaving the site, the last two being considered as problematic. The success of treatment depends not only on the facilities available for treatment but also on the organization to ensure early treatment.

It is too early to assess the problem of chronic decompression sickness such as dysbaric osteonecrosis (also known as aseptic necrosis of the bone) and neurological as well as psychological complications, though some research workers doubt whether the former is a form of decompression sickness (Hills, B.A., 1977).

Comclusion and Recommendation

Among occupational groups of people who are likely to develop decompression sickness, the compressed air construction workers belong to the most neglected one. Seldom do we find a report written by the doctor in charge of a compressed air medical centre. Reports are usually written by research workers who are alien to the construction site.

For the advancement of knowledge and prevention, the national law should demand each site doctor to submit a detailed report at the end of the contract or on leaving the service. Such reports will be examined by a national authority in occupational health.

It is high time that both WHO and ILO should take a close look at this problem as building mass transit railway becomes a fashion in the developing countries.

References

Decompression Sickness Panel, M.R.C., 1971, Decompression Sickness and Aseptic Necrosis of Bone, British Journal of Industrial Medicine, 28, 1-21.

Decompression Sickness Panel, M.R.C., 1973, A Medical Code of Practice for Work in Compressed Air, Report 44, Construction Industry Research and Information Association, London.

Duffner, G. J., 1962, Decompression Sickness and Its Prevention among Compressed Air Workers, Prepared for the Municipality of Metropolitan Seattle, Washington.

Gardner, D. & Hiscox, M.E., 1902, Compressed Air: Its Production, Uses, and Applications, Sampson Low, Marston & Company, London.

Hempleman, H. V., 1952, A New Theoretical Basis for the Calculation of Decompression Tables, Report Prepared for the Royal Naval Personnel Research Committee, Alverstoke, Hants.

Hills, B. A., 1977, Decompression Sickness, Volume 1, The Biophysical Basis of Prevention and Treatment, John Wiley & Sons, Chichester.

ILO, 1971, Encyclopaedia of Occupational Health and Safety, Section on Compressed Air Work Written by R. I. McCallum, ILO Geneva.

McCallum, R. I., 1967, (editor) Decompression of Compressed Air Workers in Civil Engineering, Proceedings of an International Working Party held at the Ciba Foundation, London, in October, 1965, Oriel Press Limited, Newcastle upon Tyne.

Ng, T. K., 1975, An Introduction to the Hong Kong Factories and Industrial Undertakings (Work in Compressed Air) Regulations, The Bulletin of Hong Kong Medical Association, 27, 95-105.

Oliver, T., 1916, Diseases of Occupation: From the Legislative, Social and Medical Points of View, Methuen & Co., London.

Paton, W.D.M. & Walder, D. N., 1954, Compressed Air Illness, An Investigation During the Construction of the Tyne Tunnel 1948-50, Medical Research Council Special Report Series No. 281, HMSO, London.

The Institution of Civil Engineers, 1936, Report of the Committee on Regulations for the Guidance of Engineers and Contructors for Work Carried Out Under Compressed Air, London.

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A STUDY ON THE TOLERANCE OF AIR FORCE PERSONNEL TO POSITIVE ACCELERATION

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Introduction

With the marked performance improvement of modern fighter aircraft, increased aerophysiological problems have been encountered. Especially, positive acceleration G force which has become one of the most crucial parts of aviation medicine and has been studied along with dysbarism and hypoxia in various aspects throughout the world (1-8). Manned space flight has also stimulated much study in the area of G tolerance.

The first aeromedical experiment on acceleration was done on a centrifuge in France in 1918 by Dr. P. Garsaux upon dogs, since then the human centrifuge has been as a ground-based device for simulating the positive acceleration forces experienced during aircraft flight maneuvers or during launch and re-entry phases of spacecraft flight. It has also been designed to be used in the training of flight crew personnel.

There is a great deal of information concerning G tolerance in human subjects in other nations (1-8), but no information has been found in the reports concerning the human tolerance of Korean subjects.

The present investigation was undertaken to determine the human tolerance of Korean Air Force personnel to positive acceleration and evaluate the effect of +Gz on cardiovascular system, 176 pilots and 89 non-pilots were selected for exposure to positive acceleration on a human centrifuge.

Materials and Methods

A. Subjects

176 healthy pilots and 89 healthy young non-pilots without any cardiopulmonary disease were selected for this study. The mean age of pilot group is 30.0 years (S.D. ± 3.8) and the non-pilot group 22.3 years (S.D. ± 1.5). The mean height of pilot group is 170.0 cm. (SD. ± 3.40) and the non-pilot group 169.7 cm (S.D. ± 3.85). The mean weight of pilot group is 61.8 kg (S.D. ± 6.2). And the mean vital capacity of pilot group and non-pilot group are 4.39 ℓ (S.D. ± 0.42) and 4.13 ℓ (S.D. ± 0.53), respectively (Table 1).

The pilot group was older than non-pilot group. Both groups did not showed significant difference in height and weight, but the vital capacity was greater in pilot group ($P<0.05$).

B. Methods

The human centrifuge installed in our aeromedical research center is a unique aluminium structure with the 20 feet arm from the center of the mount to the center of the Gondola, in which the subjects are seated. The maximum rotation speed of the centrifuge is 47 RPM, producing 15 +Gz maximum and the highest acceleration rate (onset rate) is 1.5 G/second.

All subjects were exposed to the rapid onset profile (acceleration rate 0.7 G/second) to 6 +Gz with 30 second plateau which was started slowly to 0.56 +Gz (Bias start; time : 17 seconds) and increased rapidly to 6 +Gz (Fig. 1).

Table 1. Physical characteristics of subjects

Group	No. of subject	Age (yr)	Height (cm)	Weight (kg)	Vital capacity (l)
Pilot	176	30.0±3.8	170.0±3.40	61.8±5.6	4.39±0.42
Non-pilot	89	22.3±1.5	169.7±3.85	60.1±6.2	4.13±0.53

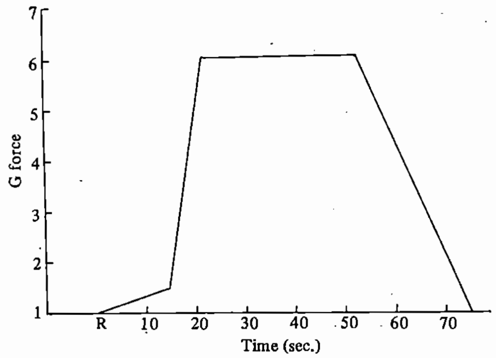

Fig. 1. Standard +Gz acceleration profile.

A second centrifuge profile (Modified +Gz acceleration profile) for the non-pilot group was stepwise running from 3 +Gz to the tolerable high +Gz (7 +Gz).

The increase of each one +Gz increment was held for 15 seconds running of +Gz. The second profile had an acceleration rate was 0.4 G/second (Fig. 2).

The centrifuge was stopped at the sign of black out phenomenon of subject.

The changes in heart rates were checked with a physio graph (Narco Bio System INC.: Physiograph® Six) in order to evaluate the cardiovascular effect of +Gz.

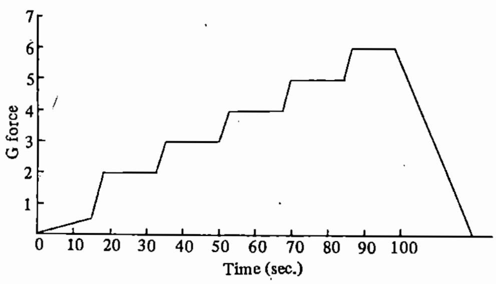

Fig. 2. Modified +Gz acceleration profile.

Results

Comparing subjects who tolerated and those who failed to tolerate 6 +Gz for 30 seconds, in the pilot group 159 (90%) tolerated and 17 (10%) failed out of 176 subjects. Among the non-pilot group 40 (45%) subjects tolerated and 49 (55%) failed out of 89 (Table 2).

Comparing subjects who tolerated and failed in the pilot's group by their rank the results from the first lieutenants to the lieutenant colonels show a trend that the failure rate decreases as the higher rank. In comparing tolerance every rank showed more than 90% toleration rate, except the first lieutenant group who tolerated 84% while the results of second lieutenants and the colonels do not show great significance because of the small number of subjects (Table 3).

Table 2. Comparison of tolerated & failed subjects at 6 +Gz for 30 sec between pilot & non-pilot group

Type of subject	No. of subject	Tolerated No.	Tolerated %	Failed No.	Failed %
Pilot	176	159	90	17	10
Non-pilot	89	40	45	49	55

Table 3. Comparison of tolerated & failed pilots by their rank at 6 +Gz for 30 sec run.

Rank	No. of subject	Tolerated No.	Tolerated %	Failed No.	Failed %
Second lieutenant	9	9	100	–	–
First lieutenant	50	42	84	8	16
Captain	36	33	92	3	8
Major	46	42	91	4	9
Lieutenant colonel	31	29	94	2	6
Colonel	4	4	100	–	–
Total	176	159	90	17	10

The changes of heart rate during standard centrifuge flight are summarized as follows (Fig. 3). During 30 second flight at 6 +Gz state, the heart rate increased in a straight line and became curved after the first 10 seconds. The non-pilot group showed more than 20 beats per minute elevation after 5 seconds from the beginning compared to the pilot group.

In those subjects who failed the standard centrifuge flight (6 +Gz, 30 seconds), the pilot group experienced black out phenomena after 12.9 seconds while the non-pilot group experienced black out after 7.2 seconds. Among pilots, those who could not tolerate 6 +Gz showed relatively higher heart rates, but it was not remarkable compared to those who tolerated 6 +Gz (P>0.05). The non-pilot group also showed no significant differences.

In order to establish an average positive G

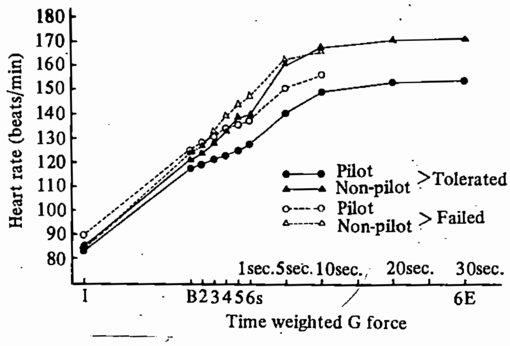

Fig. 3. Comparison of the changes in heart rates between pilot and non-pilot group on +Gz acceleration.

tolerance for ROKAF personnel, 65 enlisted men were randomly selected for human centrifuge acceleration exposure. The distribution of +Gz tolerance of non-pilot group is summarized in Fig. 4. The centrifuge flight was started from 3 +Gz for 15 seconds and gradually increased by one +Gz each until the subject experienced black out. The criteria for tolerance at each +Gz level was established as 15 seconds toleration without black out. The results were: 1 at 3 +Gz, 14 at 4 +Gz, 26 at 5 +Gz, 14 at 6 +Gz and 10 at 7 +Gz. It showed the highest number of 5 +Gz.

The tolerance to positive acceleration Gz had a mean of 5.3 +Gz, standard deviation ± 1.02 and range was 3 to 7 +Gz (Table 4).

Table 4. Positive Gz tolerance of non-pilot group

Number of subject	65
Mean	5.3
S.D.	1.02
Range	3 – 7

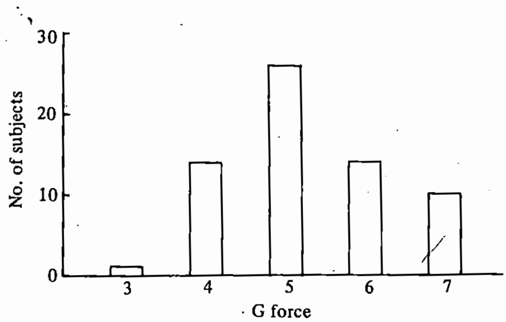

Fig. 4. The distribution of +Gz tolerance of non-pilot group.

The changes of heart rate in non-pilot group according to intensity of +Gz showed linear increase up to 105-116 beats/min. at 1.56 +Gz (Bias start) and to 114-124 beats/min. (beginning), 126-145 beats/min.(ending) at 3 +Gz; 133-147 beats/min., 142-159 beats/min. at 4 +Gz; 146-162 beats/min., 156-171 beats/min. at 5 +Gz; and 158-173 beats/min., 166-172 beats/min. at 6 +Gz. The higher +Gz tolerance group showed relatively lower heart rate compared to other groups (Fig. 5).

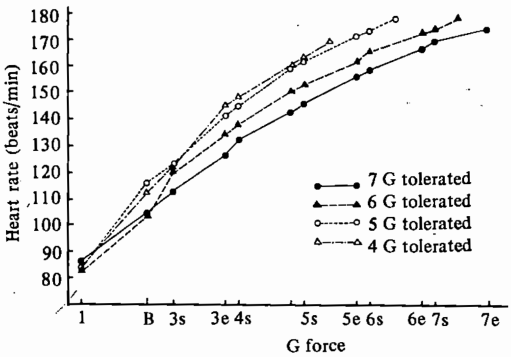

Fig. 5. Changes in heart rate of non-pilot group according to the intensity of +Gz.

Discussion

The positive acceleration (+Gz) occurs when G force acts in a head-to-foot direction as when we stand or sit erect and is commonly seen during flight. The negative acceleration (–Gz), inverse to +Gz is produced when G force act from foot-to-head. More than 3 -Gz cause temporary displacement of blood into the head resulting in red out phenomenon. The transverse acceleration (+Gx and -Gx) is when G forces act on the body in the supine or prone position. Man is most tolerant to this type of G force and can withstand up to 15 +Gx temporarily. The lateral acceleration (+Gy and —Gy) occurs when the accelerative force acts across the body at a right angle to the long axis in a side-to-side direction (9).

The effect of positive G on the human body is mainly on the respiratory system and the cardiovascular system. The latter is the most important. Fig. 6 illustrates that 120 mmHg arterial pressure in the one +Gz state is 98 mmHg in the head, which is 30 cm above the

Table 5. Comparative data of +Gz of ROKAF with other countries.

Type of subject			No. of subject	Acceleration rate (G/sec)	+Gz tolerance	
					Mean ± S.D.	Range
Korea	ROKAF	Pilot	176	0.7	6.0 ≦	6
		Non-pilot	65	0.4	5.3±1.02	3 – 7
U.S.A.	Naval aviation cadet		1000	1.0	5.4±0.9	3.0 – 8.4
Japan	Non-pilot		21	0.1	5.7±0.3	4.1 – 6.0

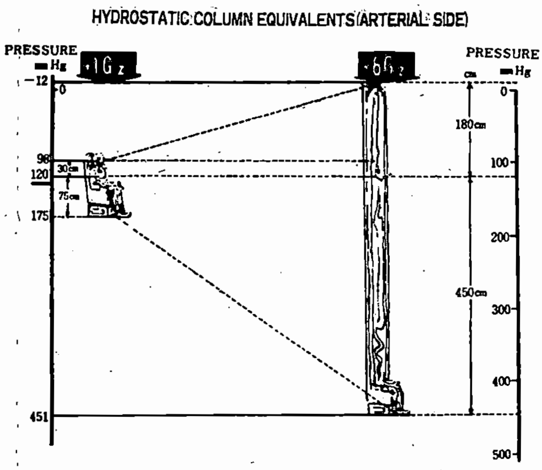

Fig. 6. Hydrostatic pressure and systolic arterial pressure of a man seated in the upright position at +1 Gz and + 6 Gz. (From Burton, Leverett, and Michaelson, 1974)

heart and it is 176 mmHg at the foot, which is 75 cm below the heart. When a force of 6 +Gz is exerted on the body a standing blood column of 30 cm exerts a pressure of 120 mmHg upon its base. As this is equal to the normal arterial systolic pressure it will balance out the arterial pressure and cause cerebral blood perfusion to cease. This result is unconsciousness. When +Gz forces are sufficient to reduce the systolic arterial pressure in the head to 20 mmHg, intraocular pressure causes collapse of the retinal arteries, since the static intraocular pressure is about 20 mmHg. As arterial collapse progresses insufficient blood flow causes loss of peripheral vision, the so called "Gray out phenomenon," and at slightly higher acceleration, black out phenomenon occurs and the individual can no longer see. Black out and gray out are critical point for G tolerance since they occur shortly before loss of consciousness.

The onset of these symptom vary in individuals because of cardiovascular compensation and other factors which affect tolerance. Frequent exposure to +G forces in flying and centrifuge training enhance G force tolerance (3). This study confirmed this phenomenon since the pilot group showed a much higher tolerance during 30 seconds flight at 6 +Gz compared to the non-pilot group.

As acceleration +Gz force is exerted on the body peripheral pooling of blood, the reduction of circulation blood volume stimulates the stretch receptor in the carotid sinus and the aorta causing an increase in heart rate and vascular constriction (10). The results of our study showed, the pilot groups heart rate increase to 150 beats/min. at 6 +Gz during standard flight and its mean increasing rate per one G recorded as 11.3 beats/G. Compared to the study of Lambert et al. (12.6 beats/G.) (9) on +Gz tolerance, the pilot group was lower at 11.3 beats/G, while 14.7 beats/G of non-pilot group was higher respectively. This indicates that flight experience enhances the tolerance to +Gz acceleration and possibly reduces cardiac stress. Experienced pilots had increased +Gz tolerance compared to the less experienced lower rank group.

In comparative data of +Gz of ROKAF with other countries, the type of Korean subjects were 176 pilots and 65 non-pilots, the U.S.A. 1,000 Naval aviation cadets, and Japan 21 non-pilots. The acceleration rate or so called onset rate for the Korean subjects was 0.7 G/second for the pilots and 0.4 G/second for the non-pilots. The U.S.A. study used 1.0 G/second and Japan study used 0.1 G/second. The +Gz tolerance of the Korean subjects was higher than 6.0 G/second for the pilots and 5.3 +Gz ± 1.02 for the non-pilots; the U.S.A. subjects was 5.4 +Gz ± 0.9, Japanese subjects was 5.7 +Gz ± 0.3. The range was (Korea)

3 to 7 +Gz, (U.S.A.) 3.0 to 8.4 +Gz, (Japan) 4.1 to 6.0 +Gz. According to this data, Korea and the U.S.A. showed almost the same acceleration rate and +Gz tolerance (7, 10, 11). The higher +Gz tolerated groups showed less cardiovascular load during the standard flight of 6 +Gz for 30 seconds.

Conclusion

In order to determine the human tolerance to positive acceleration and evaluate the effect of +Gz on cardiovascular system, 176 pilots and 89 non-pilots from the ROKAF were selected for exposure to +G forces on a Human Centrifuge.

All subjects were started slowly to 1.56 +Gz (Bias start) and increased rapidly to a 30 seconds plateau at 6 +Gz. A second centrifuge profile with the non-pilot group was a stepwise running from 3 +Gz to the highest +Gz tolerated. An increase of 1 +Gz steps was followed at 15 seconds intervals. The centrifuge was stopped when the black out phenomenon was experienced by each subject.

The changes of heart rates were checked with a physiograph in order to evaluate the cardiovascular effect of +Gz.

The results obtained were as follows:

A. Ninety percent of the pilot group tolerated the rapid onset profile of 6 +Gz with 30 second plateau and 45% of the non-pilot group.

B. More experienced pilots had a higher tolerance rate than younger pilots.

C. The changes of heart rates of pilot group at 6 +Gz with 30 seconds plateau were relatively less than those of non-pilot group. This indicates the pilot group had relatively less burden on the cardiovascular system from +Gz.

D. The average +Gz tolerance of the ROKAF non-pilot group achieved from 2nd centrifuge runs was 5.3 +Gz ± 1.02 (range 3-7 +Gz).

E. At the second centrifuge run, the changes of heart rates of highest +Gz tolerance group were relatively less than lower +Gz group at the same +Gz level.

References

Burton, R. R. and R. M. Krutz, Jr.: G tolerance and protection with anti-G suit concepts. Aviat. Space Environ. Med. (In press).

Leverett, Jr. S. D. et al: Physiologic responses to high sustained +Gz acceleration. SAM-TR-73-21, 1973.

Parkhurst M.J., S. D. Leverett, Jr. and S. Shubrooks: Human tolerance to high, sustained +Gz acceleration. Aerosp. Med., 43: 708, 1972.

Lindberg, E. F. and B. H. Wood: Acceleration. In J. H. V. Brown (ed). Physiology of man in space. New York: Academic Press, 1963.

Gauer, O. H. and G. D. Zuidema (eds.): Gravitational stress in Aerospace Medicine. Boston: Little, Brown and Co., 1961.

Stoll, A. M.: Human tolerance to positive G as determined by the physiological end points. J. Aviat. Med., 27: 356, 1956.

Iwane, M. et al.: Human tolerance to sustained radial acceleration (+Gz) indicated by Grayout Threshold in Japanese. Rep. Aeromed. Lab., 13(1): 17, 1967.

Burton, R. R., S. D. Leverett, Jr. and E. D. Michaelson: Man at high sustained +Gz acceleration: A review, Aerosp. Med., 45(10): 1115, 1974.

Lambert, E. H.: Comparison of the physiologic on a human centrifuge and in a airplane. Aviat. Med., 20(4): 308, 1974.

Gillingham, K. K. and R. W. Krutz, Jr.: Effect of the abnormal acceleratory environment of flight. Aeromedical Review 10-74, USAF SAM, Brooks Air Force Base, Texas, 1974.

Edelberg, R. et al.: Comparison of human tolerance to accelerations of slow and rapid onset. Aviat. Med., 27(6): 482, 1956.

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A MATHEMATICAL MODEL OF THE INTERACTION BETWEEN THE THERMOREGULATORY SYSTEM AND THE CHEMICAL RESPIRATORY CONTROL SYSTEM DURING COMBINED HEAT STRESS AND CARBON DIOXIDE BREATHING

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Introduction

In man, respiratory heat loss is relatively important under conditions of heat stress where sweating is limited. This is the case in mines rescue workers wearing closed circuit breathing apparatus. In this situation there is also a posssibility of CO_2 breathing due to impaired CO_2 absorbtion (Lind 1955, Hanson 1974, Bernard et al. 1979).

A quantitative dynamic analysis of the physiological mechanisms of these responses has not been previously described. The problem is one of interaction between competing control systems: chemical respiratory regulation of CO_2 concentration and thermoregulation by respiratory heat loss. A mathematical model is required to relate the various quantities as they change with time.

The Model

A two-compartment model of the body incorporating a lung compartment and a lumped tissue compartment is used. The derivation of equations for CO_2 control largely follows Milhorn and Guyton (1965). The model is shown schematically in Figure 1. The following assumptions are made:

1. Chemical regulation of respiration is by CO_2 only. This is justified only when alveolar P_{O2} is greater than 100 torr and peripheral chemoreceptor responses are relatively negligible. However, to simulate hypoxia (for example, in a coal mine) an O_2 control mechanism can be easily incorporated in the model.

2. Neural receptors involved in the regulation of respiration are ignored as the purpose of this model is to explore interactions between the chemical respiratory control system and the thermoregulatory system.

3. The lung and tissue compartments are each homogeneous for temperature and CO_2 concentration. The temperature of the lung compartment is equal to that of the tissue compartment. Thus body temperature is considered to be uniform throughout.

4. The rapid phasic changes in alveolar and blood gas concentrations with each respiratory cycle are ignored and the alveolar volume is considered constant, as is the anatomical dead space volume. Since the model is only concerned at present with predicting events on a coarse time scale (e.g. 10 minute intervals), the elimination of details dependent on a relatively fine time scale of the order of a respiratory cycle (<10 seconds) is considered justifiable.

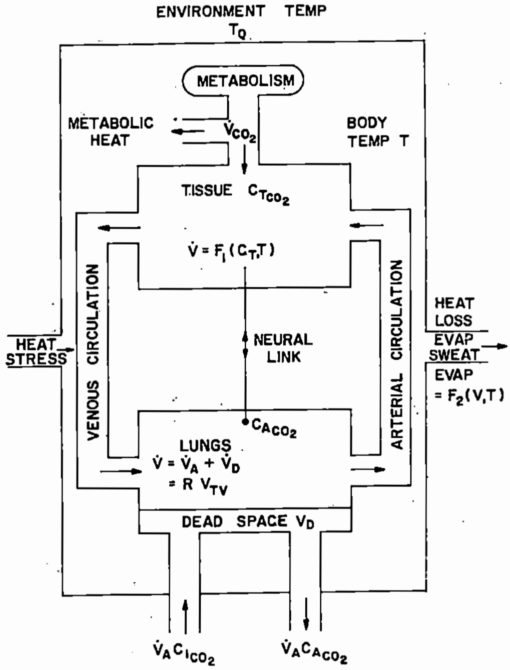

Fig. 1. Diagram of model

5. Cardiac output is considered to be constant. This is a somewhat artificial simplification in some species including man but in the sheep cardiac output does not increase significantly with heat stress (Hales 1974) and in the CO_2 range to be studied the dependence of cardiac output on P_{CO_2} is negligible in man (Grodins et al. 1954).

6. CO_2 dissociation curves are equal and linear within the range of operation of the model for arterial and venous blood and tissue. Within the order of accuracy of the model, this is justifiable from experimental data (Peters and Van Slyke 1932).

7. Venous P_{CO_2} is equal to tissue P_{CO_2}. This is justified because CO_2 exchange at the tissues is relatively very fast compared with the time scale of changes in the model variables of interest (temperature, tissue P_{CO_2}, arterial P_{CO_2}).

8. Arterial P_{CO_2} is equal to alveolar P_{CO_2} and the same justification as 7 above is used.

9. Ventilation is linearly dependent on tissue P_{CO_2}. This is justified from experimental data (Read and Leigh 1967).

10. For panting animals tidal volume is inversely proportional to the square root of respiratory rate (Hales and Webster 1967). For non-panting animals (including man) tidal volume is directly proportional to respiratory rate.

11. Under heat stress conditions radiative and conductive heat transfer is inwards only and this is lumped together as a heat stress forcing function.

12. Heat loss is solely by convection and evaporation. This includes sweating and respiratory heat loss. These mechanisms initially are lumped together and heat loss is assumed to be directly proportional to both temperature gradient and ventilation. This is justified by the experimental data of Hanson (1974).

13. Circulatory transport lags are ignored, as their time scale is much faster than that of the model variables of interest.

14. The interaction between thermoregulation and chemical respiratory regulation is expressed by a direct temperature dependence of ventilation (Barltrop 1954, Lipton 1973, Hanson 1974) and by a temperature dependence of the gain of the respiratory controller in response to P_{CO_2} changes (Cunningham and O'Riordan 1957, Kappey et al. 1962). Since the literature contains a wide range of values for these effects, including reversals in the direction of responses (Cohen 1968, Kappey et al. 1962) the model will be used to explore these.

Table 1 shows the quantities considered and their symbolic representation and physical units. The equations of the model can be written as:

$$\frac{dC_T}{dt} = \frac{1}{V_T}\left(\dot{V}_{CO_2}(T) + \dot{Q}\left((K_1 P_B C_A + K_2) - C_T\right)\right) \tag{1}$$

$$\frac{dC_A}{dt} = \frac{1}{V_A}\left(\dot{Q}\left(C_T - K_1 P_B C_A - K_2\right) + \dot{V}_A\left(C_I - C_A\right)\right) \tag{2}$$

$$\frac{mSdT}{dt} = -K_7 \dot{V}_E (T - T_I) + M(T) + F(t) \tag{3}$$

$$\dot{V}_E = G(C_T - C_{To}) + K_3 T + K_4 \tag{4}$$

$$G = K_5 T + K_6 \tag{5}$$

$$\dot{V}_A = \dot{V}_E - (\dot{V}_E K^1)^{1/2} V_D \tag{6}$$

$$\dot{V}_{CO_2} = 0.076\,(T - T_o) + 0.319 \tag{7}$$

$$\dot{V}_E = RV_{TV} \tag{8}$$

$$V_{TV} = K^1 R \tag{9}$$

Solution of Equations

Equations (1) – (3) were integrated numerically using a variable order Adams method based on Kroghs algorithm (Krogh 1973). The subroutine used was from the NAGFLIB library Mark 5 (1974). The initial step size was 0.1 min. and a mixed convergence criterion of $|E(I)| < 0.0001\,(1 + |Y(I)|)$ was used, where E(I) is the error in the I th Y variable. The FORTRAN language was used on a CDC Cyber 72 digital computer.

The initial conditions were:

$Y(1) = C_T = 0.59$
$Y(2) = C_A = 0.067$
$Y(3) = T = 37.0$

Results and Discussion

The model was first validated by its ability

Table 1. Symbolic representation and physical units (1.1^{-1})

Symbol	Name	Unit	Numerical value
C_A	alveolar wet gas CO_2 concentration	volumetric fraction (1.1^{-1})	variable
C_T	tissue CO_2 concentration	volumetric fraction (1.1^{-1})	variable
C_a	arterial CO_2 concentration	volumetric fraction (1.1^{-1})	variable
C_I	inspired gas CO_2 concentration	volumetric fraction	variable
V_E	total ventilation	litre $min.^{-1}$	variable
V_A	alveolar ventilation	litre $min.^{-1}$	variable
G	gain of respiratory controller	litre $min.^{-1}$	variable
M	metabolic heat production	kcal. $min.^{-1}$	variable
F	externally applied heat stress	kcal. $min.^{-1}$	0.55
T	body temperature	°C	variable
V_{TV}	tidal volume	litre	variable
R	respiratory rate	$min.^{-1}$	variable
V_T	tissue volume	litre	40.0
V_{CO_2}	metabolic CO_2 production rate	litre $min.^{-1}$	variable
Q	cardiac output	litre $min.^{-1}$	6.0
P_B	barometric pressure	torr	760
V_A	alveolar volume	litre	3.0
C_{To}	initial value of tissue CO_2 concentration	volumetric fraction (1.1^{-1})	0.59
To	initial value of temperature	°C	37.0
T_I	inspired air temperature	°C	variable
m	body mass	gram (g)	70000
S	body specific heat	kcal. $g.^{-1}$ $°C^{-1}$	0.001
K_1	slope of CO_2 dissociation curve	torr	0.00425
K_2	intercept of CO_2 dissociation curve	litre CO_2. litre $blood^{-1}$	0.32
K_3	slope of linear relation between V_E and T	litre $min.^{-1}$ $°C^{-1}$	2.0
K_4	intercept in V_E, T relationship	litre $min.^{-1}$	−67.0
K_5	slope in linear relationship between controller gain and temperature	litre $min.^{-1}$ $°C^{-1}$	235.3
K_6	intercept constant in relationship between controller gain and temperature	litre. $min.^{-1}$	−8000
K_7	dependence of respiratory heat loss on V_E and T	kcal. $litre^{-1}$ $°C^{-1}$	0.02
K^1	proportionality constant between V_{TV} and R	litre min.	0.035
V_D	dead space	litre	0.2

to predict experimental data in the sheep (Hales and Webster 1967). Agreement between model and experiment was fair.

Figure 2 shows the influence of inspired air temperature on predicted transient changes in tissue CO_2, arterial CO_2, total ventilation and alveolar ventilation and temperature for resting man exposed to a moderate heat stress (0.55 kcal. $min.^{-1}$). It can be seen that lower inspired air temperature lowers body temperature. At higher inspired temperatures, ventilation is increased and arterial CO_2 is reduced. Figure 3 shows the predicted effect of 3% and 6% CO_2 breathing during heat stress. 3% CO_2 breathing causes a elevation of tissue and arterial CO_2 and a lower temperature. The predicted effect of 6% CO_2 breathing is a fall in temperature, an initial rise and then fall in V_E and V_A and a rise in both tissue and arterial CO_2.

The model solutions were relatively insensitive to variations in K_3, K_5 and K_7 which are not ac-

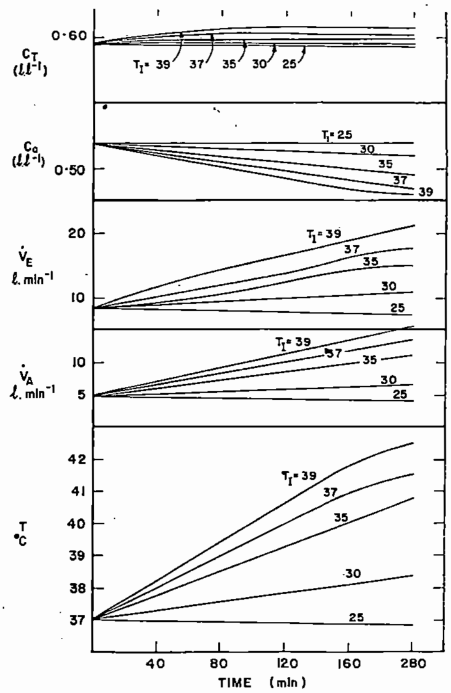

Fig. 2. Theoretical effects of variations in inspired gas temperatures on response to heat stress in man.

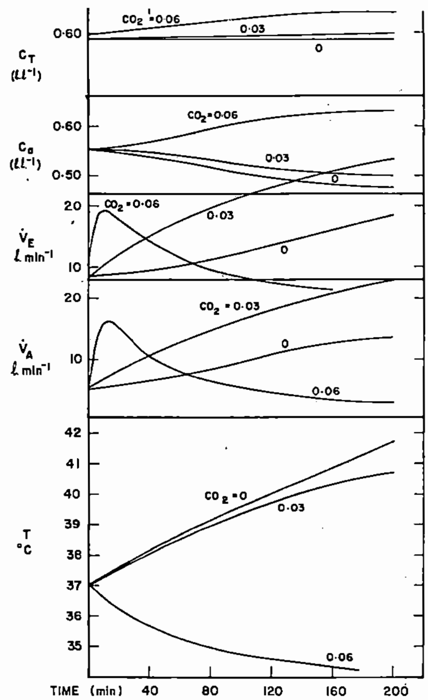

Fig. 3. Theoretical effects of variations inspired CO_2 concentration, inspired temperature 37°C.

curately known experimentally. Solutions for working man are easily obtainable by varying the constants in equation (7) and for different heat stresses by varying F.

This model can be used to estimate the changes in body temperature and arterial CO_2 which limit working time in dangerous situations, thus avoiding unpleasant human experimentation.

References

BARLTROP, D. (1954): The relations between body temperature and respiration, J. Physiol. (London) *125:* 19-20.

BERNARD, T.E., N. KYRIAZI and R.L. STEIN (1979): CO_2 absorption characteristics of mine rescue breathing apparatus. U.S. Dept. of Interior, Bureau of Mines, Report 8342.

COHEN, M. I. (1968): Discharge patterns of brain stem respiratory neurons in relation to carbon dioxide tension. J. Neurophysiol. *31:* 142-165.

CUNNINGHAM, D.J.C. and J.L.H. O'RIORDAN (1957): The effect of a rise in temperature of the body on the respiratory response to carbon dioxide. Quart. J. Exptl. Physiol. *42:* 329-345.

GRODINS, R.S., J.S. GRAY, K.R. SCHROEDER, A.L. NORINS and R.W. JONES (1954): Respiratory responses to CO_2 inhalation. A theoretical study of a nonlinear biological regulator. J. Appl. Physiol. *7:* 283-308.

HALES, J.R.S. (1967): Respiratory function during thermal tachypnea in sheep. J. Physiol. (Lond) *190:* 241-260.

HALES, J.R.S. (1974): Physiological responses to heat. In MTP International Review of Science, Physiology Series 1, Vol. 7, ed. Robertshaw, D. pp. 107-162. London: Butterworths.

HANSON, R de G. (1974): Respiratory heat loss at increased core temperature. J. Appl. Physiol. *37:* 103-107.

KAPPEY, P.F., C. ALBERS and R. SCHMIDT (1962) Die venilatorische CO_2 – Reaktion des Hundes wahrend der Wärmentachypnoe Pflugers Arch. ges. Physiol. *275:* 312-326.

KROGH, F.T. (1973): Algorithms for changing the step-size used by a multistep method. SIAM J. Numer. Anal. *10:* 949-965.

LIPTON, J.M. (1973): Thermosensitivity of the medulla oblongata in control of body temperature. Am J. Physiol. *224:* 840-897.

LIND, A.R. (1955): The influence of inspired air temperature on tolerance to work in the heat. Brit. J. Indust. Med. *12:* 126-130.

MILHORN, H.T. and A.C. GUYTON (1965): An analogue computer analysis of Cheyne–Stokes breathing. J. Appl. Physiol. *20:* 328-333.

PETERS, J.P. and D.D. VAN SLYKE (1932): Quantitative Clinical Chemistry. Vol. 1 Baltimore: Williams and Wilkins.

READ, D.J.C. and J. LEIGH (1967): Blood-brain tissue P_{CO_2} relationships and ventilation during rebreathing. J. Appl. Physiol. *23:* 53-70.

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PHYSICAL WORK LOAD AND OCCURRENCE OF LOW BACK PAIN AMONG THE GARBAGE WORKERS

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Abstract

Conditions of physical work load and incidence of low back pain among garbage workers in city areas were studied by means of questionnaire, continuous heart rate measurement, and muscle load analysis.

According to the results by questionnaire, those who had the history of low back pain after entering the company accounted for 50.7% of 276 garbage car drivers and 47.2% of 343 garbage collectors, the corresponding figure for 202 clerks being only 23.8%.

Each teams of workers, a driver and one or two collectors, ran by car 40-75 km a day collecting 5,000-10,000 kg of garbages. The workers were revealed to spend around 20-30% of the whole working time for loading the garbages, each garbage collector loading 410-664 times a day in the two-collector system and 797-1,149 times a day in the single-collector system. Heart rate at work usually reached the level of 120-150 beats/min, and unnatural postures while loading and riding the car standing on the rear-step were shown to be associated with the pain in the lower back.

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OCCUPATIONAL HAZARDS AMONG FEMALE ELECTRIC SEWING MACHINE OPERATORS IN AN AGRICULTURAL AREA IN JAPAN

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Introduction

In Japan, overcongested population in urban areas has been rapidly increasing since 1955. The urban population has increased to the present 72.2% during this twenty year period. The population decrease in agricultural areas during this period has been severe and has become a serious problem, because due to the economic and industrial progress, the labor force in agricultural areas has been drawn to cities. In underpopulated agricultural and mountain areas, various light industrial factories have been initiated as one of the mountain region's promotion projects. One of them is the sewing factory.

By operating sewing machines, workers sew uniforms, shirts, and dresses in the sewing factory. Manufacturing processes include the cutting, sewing, ironing, and finishing of products.

We believe that there are some occupational hazards in this work: These are some of the critical factors; Most of the factory workers are female. Vibrations rising from the sewing machines are transmitted to the upper and lower extremities of operators, who must remain stationary during the entire work day and sew rapidly to keep up with assembly line production. Workers only have two short breaks during each work day.

Health examinations of the female workers in a rural sewing factory have been carried out. The results obtained are reported here.

Outline of the Factory Investigated and Working Surroundings

The factory is in a rural area in Wakayama Pref. near Osaka, Japan. It was built in 1965 as one of the mountain regions' promotion projects. It has about 100 female workers, so it is a fairly small-scale operation.

The female workers generally work from 8:00 a.m. to 5:00 p.m. with only two recesses; they are given a 60 minute lunch break and a 15 minute break in the afternoon. Their salary consists of an efficiency wage added to their base wages, so they must work quickly and efficiently to earn a higher salary. They are not only wage-earners but also housewives and farmers. In addition to their daily factory work, employees must do housework and look after their children. They must also engage in farming during the farmer's busy seasons. It is evident that the total work load of female factory laborers is a very heavy one.

The floor of this factory is made of wooden boards upon which the electric sewing machines rest. Vibrations from the sewing machines were measured both on the sewing table and at the foot pedal. Vibration acceleration level (VAL) was 117.1 dB on the table (90% range; 116.8 – 117.5 dB), and 117.3 dB at the pedal (90% range; 116.5 – 118.2 dB) as indicated by All-Pass filter measurement. Fig. 1 shows the spectrum of vibration analyzed by one-third octave Band-Pass filter. VAL values showed a peak at 63 Hz both on the table and at the pedal.

Noise created by the operation of the sewing machines was also measured. Noise level as measured by the A-filter was 84.5 dB at the height of the operator's ear (90% range; 84.0 – 85.1 dB). 58.7% of all workers felt the effects of the high noise level.

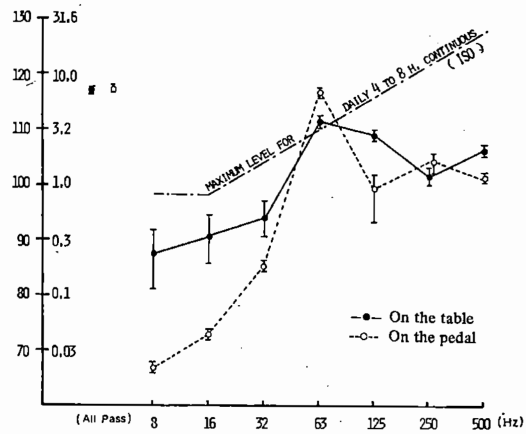

Fig. 1. Power spectrum of electric sewing machine analyzed by one third octave band analyzer.

The room temperature was kept at 18°C – 20°C during working hours. Room lighting was adequate and both the chairs and tables were at a comfortable height for sewing machine workers.

Subjects and Methods

In March 1979, reported physical symptoms of the factory workers were surveyed, and medical examinations were performed on 75 of 85 female workers in this factory. The examinations concentrated on (a) effects of vibration exposure (vibration syndrome) and (b) effects of repeated use of arm and hand (occupational cervico-brachial disorder; OCBD). The 75 subjects were divided into two groups as follows:

Operator group: consisting of female sewing machine operators. (N=64)

Control group: consisting of female workers who were mainly engaged in production management. (N=11)

Age distribution and working period of the subjects are given in Table 1.

Results and Discussion

(a) The effects of vibration exposure:

The typical symptoms of vibration syndrome are Raynaud's phenomenon (so called white-

Table 1. Distribution of the subjects by age and working period

	N	Age (Yr.)		Working period (Yr.)	
		Range	Average	Range	Average
Operator group*	64	23 – 56	44.3±7.4	1.5 – 14	7.8±3.7
Control group**	11	29 – 53	39.3±7.7	1.0 – 10	1.4± 2.1

* Consisting of female sewing machine operators.

** Consisting of female workers who mainly engaged in production management.

Table 2. Medical examinations for the diagnosis of vibration syndrome, which consist of peripheral circulatory function test (skin temperature, nail press test) and peripheral nerve function test (vibration sense threshold, pain threshold)

	Skin temperature* (°C)	Nail press test** (sec)	Vibratory sense threshold (dB)***	Pain threshold**** (gr.)
Operator group (N=64)	29.5±3.6	1.7±0.4	−1.5±6.4	1.6±0.5
Control group (N=11)	29.3±2.8	1.8±0.4	−4.8±4.0	1.4±0.5

* Skin temperature of 2nd figer.

** Hyperemia time after nail pressing.

*** By vibration sensation meter at 125 Hz; 0 dB ref, 0.3 m/sec^2.

**** By weighted needle.

colored finger), and numbness of arm and hand.

In the operator group, sixteen women (25%) reported numbness of the upper extremities; only one reported the symptom of white colored finger. In the control group, only one of them (9.1%) reported numbness of the upper extremities; None of the control group members reported the symptom of white-colored finger.

As far as prevalence rate of the subjective symptoms of vibration syndrome was concerned, there was no significant difference between the two groups. The prevalence rate of these symptoms as reported by electric sewing machine operators was lower than those experienced by vibrating tool operators such as bush cleaner operators.

A medical examination, skin temperature measurement, nail press test, vibratory sense threshold measurement, and pain threshold measurement were performed on each subject at the ordinary temperature of 20°C. The results of these examinations are shown in Table 2.

Examinations disclosed no significant differences between the two groups; neither peripheral circulatory disturbances nor peripheral nerve disturbances were considered.

The effects of vibration exposure to the upper and lower extremities of electric sewing machine operators were very slight.

(b) The effects of repeated use of arm and hand (OCBD):

OCBD developing from static or repeated use of motor extremities has long been recognized among female workers such as keypunchers. These workers subjectively reported the symptoms such as shoulder and arm pains, stiffness of the upper extremities, and numbness of the arms and hands.

This index of subjective symptoms formed the basis of questionnaires for surveying the complaints related to OCBD. This questionnaire, compiled by the Committee on Cervico-Brachial Syndrome in Japan, was administered to each subject. Fig. 2 shows the prevalence rate of subjective symptoms. As compared with the control group, complaints reported in the operator group were shoulder and neck pains, back pain and stiffness, arm stiffness, arm pain, arm numbness, motor disturbances of the hand, finger tremor, low back pain, leg numbness, and leg coldness. There was a significant dif-

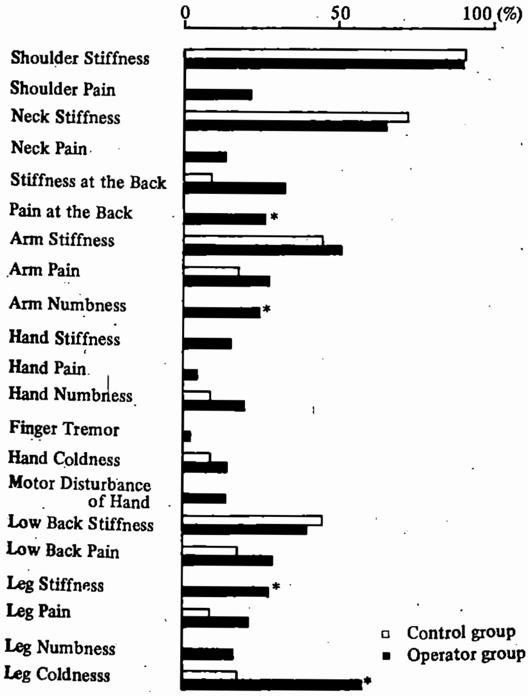

*Fig. 2. Prevalence rates of subjective symptoms about trunk, upper and lower extremities, *p<0.05.*

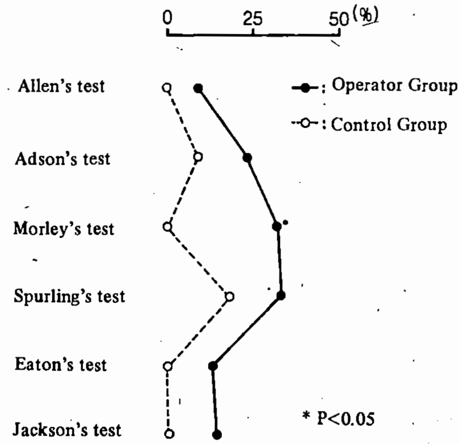

Fig. 3. Positive rates of medical examinations for diagnosis of pain problems in cervical regions and upper extremities.

ference between the two groups in reported incidence of back pain, arm numbness, leg stiffness, and leg coldness. Symptomatic complaints related to the back, shoulder, arms, and hands seemed to be higher among workers engaged in occupations such as operating electric sewing machines.

On the other hand, high prevalence rates of stiffness of the shoulders, neck, arms, and back were reported by both groups; We must consider the possibility that both types of continuous daily work may lead to chronic fatigue such as stiffness of the upper extremities.

Diagnostic examinations for symptoms of pain in the cervical region and upper extremities were also performed. The following tests were administered: Allen's test (neck hyperextension test), Adson's test (neck hyperextension rotation test), Morley's test (scalenus anterior muscle pressing test), Spurling's test (foraminal compression test), Eaton's test (neck and arm strech test), and Jackson's test (neck hyperextension compression test).

The positive rate on each test administered to the operator group was higher than that found in the control group, as shown in Fig. 3. Only in Morley's test in which the subject felt pain when the examiner pressed the scalenus anterior muscle, there was a significant difference found between the two groups.

The positive rates found in the operator group would suggest that electric sewing machine operators were suffering from symptoms of neural and vascular compression of the shoulder girdles and arms, or so called cervico-brachial syndrome.

In conclusion, it would appear that the effects of vibration exposure resulting from the operation of sewing machines are few, but it seems that the effects of repeated use of arm and hand are considerable.

To prevent such occupational symptoms, we suggest that better working conditions including more frequent breaks from work and a reduction of time spent operating machinery during working hours should be required.

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APPLICATIONS OF IMAGE INTENSIFIER AND VISC ON FOREIGN BODY REMOVALS IN THE EYE AND THE ORBIT

Jae Ho KIM, *Korea*

Introduction

The field of application of fluoroscopy as an aid to ophthalmologist has been considerably enhanced by image intensification (electron acceleration for amplification of the fluoroscopic image), which has made possible the development of practical techniques of 90 degrees rotating two planes cinefluorography, TV monitoring and recording.[1, 2]

Since year of 1974, author has been used the image intensifier for the localization, detection and forceps removals of intraocular or orbital foreign bodies.[3]

With the conjunction of image intensifier, recently vitrectomy instrument named VISC (vitreous infusion suction and cutter) which is a new advanced system for intraocular microsurgery combined three functions that are cutting tissue, removing debris from the eye ball by suction and replacing the aspirate with an infusion of Ringer's solution, was used for the removals of vitreous opacity with or without foreign bodies (FB).[4]

It is sure that the development of pars plana vitrectomy was also enhanced the success rate of visual improvement in injured eyes. The first step of operation is to removal of traumatic cataract or hazy vitreous due to hemorrhage or inflammation by use of VISC. And then the second step is to detect the retained intraocular foreign bodies (IOF) in cleared media and to removal it by a special foreign body forceps under direct visualization.

I report herein the method of radiopaque IOF removal with the image intensifier, and a modified technique of a fine FB forceps which was inserted into the canal of fiber optic illuminator (one port – one instrument system).

Methods and Results

The Use of Image Intensifier:

Every eye injury case was screened with routine X-ray and image intensifier for detection and localization of any radiopaque foreign bodies in the eye and the orbit. And another special checks including of Vogt X-view, ultrasonography and CT scanning, if necessary, were also done with careful taking history.

If intraocular foreign body is conformed as a magnetic nature, its extraction was made easily with a magnet under the direct visualization through TV monitor of image intensifier. In this study I have been used two planes C-arm image intensifier, model Siremobile 2 (Siemen, W. Germany). (Fig. 1).

Operating procedures on intravitreal radiopaque foreign body are as follows; A 3-4 mm, sclerotomy apart 4-4.5 mm from the corneal limbus was made, and 6-0 nylon mattress sutures were preplaced, and through this pars plana approach a small miniature foreign body forceps (or stapedectomy forceps) was introduced carefully into the hazy vitreous cavity (Fig. 1).

The application of the image intensifier in IOF cases, especially non-magnetic radiopaque intravitreous or orbital foreign bodies, combines the advantages of accurate localization and the ease and simplicity of direct visualization in TV monitor.

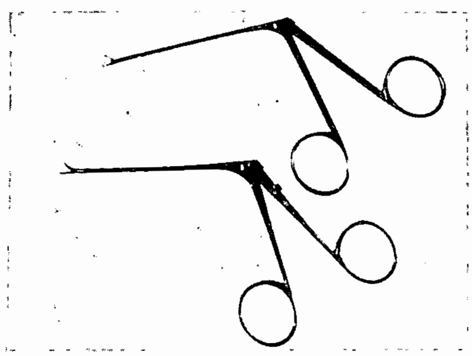

Fig. 1. Two differents stapedectomy forceps are used as the foreign body forceps.

With 90 degrees rotation, both the forceps and foreign body could be viewed in two planes 90 degrees apart; with alternating vertical and horizontal projections, the forceps could be guided to the foreign body until the foreign body was grasped.

The total fluoroscopy with in the present cases was the range of 5-15 minutes. Irradiation was estimated about 10 R. to the eye and 300 M/T maximum of secondary irradiation to the operator's hand.

Procedures of VISC and a modified technique:

Fresh perforating injuries with non-magnetic intraocular foreign body in addition to severe vitreous opacity or hemorrhages are difficult to treat with conventional methods. Therapy becomes even more complicated when a retinal detachment and a cataract have developed. Instead of simple closure of the wound and the unfounded hope that the eye may repair itself, vitrectomy offers a planned approach for removal of traumatic cataract, blood clot, retained foreign body, and an immediate retinal reattachment procedure, if indicated.

While the VISC-X (Clinitex, U.S.A.) is used in vitreous surgery, it is routinely introduced into the hazy or opaque vitreous cavity via pars plana approach (Fig. 2). If the lens has been damaged and developed to traumatic cataract, a lensectomy can be performed first and then the removal of opaque vitreous body followed. The use of fiber optic illuminator is essential with the conjunction of contact lens and operating microscope, since otherwise direct visualization in the hazy vitreous cavity would be practically nil.

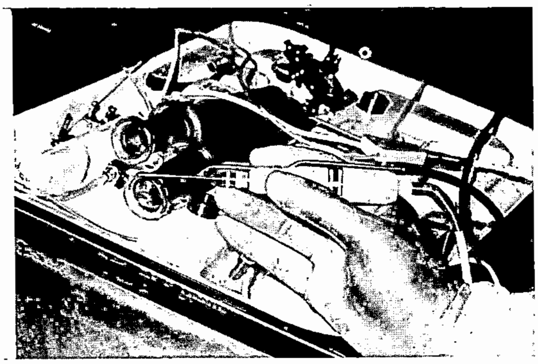

Fig. 2. The fiber optic illuminator equipped tip of the VISC. The VISC is held like a pencil and the operating hand always has support it.

All hemorrhagic vitreous is excised carefully by use of VISC or other vitrectomy instruments and, if necessary, blood is washed out. Great care must be taken to avoid possible detached retina.

Finally, the fundus situation could be seen and the location of intraocular foreign body would be easily determined.

It was a conventional routine technique to introduce a special foreign body forceps through second sclerotomy site of pars plana at an angle of 90 to 180 degrees by trying to have the forceps opposite the location of the foreign body (two ports technique).

But here author modified the conventional two ports technique to one port technique by a special fine foreign body forceps (stapedectomy forceps used) which is passed into the canal of the VISC's fiber optics (Fig. 3).

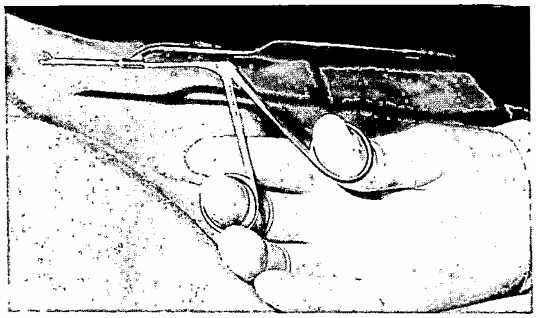

Fig. 3. The fiber optic illuminator equipped tip of the foreign body forceps.

This fiber-optics attached foreign-body forceps is then inserted carefully into the vitreous cavity through same site of sclerotomy for VISC surgery. With direct and magnified visualization of the operating microscope and the contact lens, ideal illumination conditions, and a normally shaped eye ball, the intravitreal foreign body can be grasped and pulled out of the eye. In that time the contact lens is an important role to see directly the foreign body in the posterior vitreous cavity and the retina (Fig. 4).

Eye injuries and intraocular foreign bodies:

During the last 5 years from 1974 to 1978, total 2,055 patients were admitted to the Department of Ophthalmology and among them 87 patients (4.2%) were treated because of major

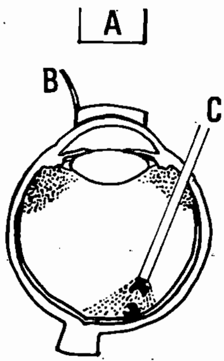

Fig. 4. Schematic drawing of an eye with an intraocular foreign body. If the media is hazy or hemorrhagic state, this should be remove out with or without the lensectomy and replaced it with the Ringer's solution. And then the intraocular foreign body could be seen in cleared media, and it is now possible to remove the foreign body with a fiber optic illuminator equipped foreign body forceps under the direct visualization (one port system technique is author's modified method)
A : Operating micrscope, B : Contact lens, C : Fiber optics.

perforating eye injuries including of intraocular foreign bodies (Table 1).

In 37 intraocular foreign body patients (39 eyes) among total of 87 major ocular injury patients, there were 25 males (94.6%) and 2 females (5.4%). In 18 patients (48.6%) the injury was in the right eye, in 17 patients (45.9%) the injury was in the left eye, and in two patients (5.4%) both eyes were injured.

Eighty seven percents of the injured patients were young age group ranging from 20 years old to 45 years old. The cause of injuries is mainly work accident (34 patients; 92%). Hammering, grinding and drilling were the most common causes of work accident.

In 18 (48.7%) of the 39 eyes involved, the site of penetrating injury together with the foreign body was in the cornea.

Thirty-one patients were treated more than a week but less than a month after injury, and six patients were admitted for treatment more than a month after injury.

Of the 87 patients, 50 (57.5%) had a perforated eye injury; 37 patients (42.5%) had a perforated eye injury together with an intraocular foreign body. All cases were found the foreign body in the vitreous cavity in this study group of IOF.

Table 1. Major eye injured patients who were admitted to St. Mary's Hospital, Seoul, 1974–1978

Year	Grand total of admitted pt. in eye dept.	Admitted pt. of eye injured (M/F)*		Intraocular foreign body pt. of admission (M/F)	
1974	229	18 (12/6)	7.9%	1 (1/0)	5.5%
1975	325	22 (19/3)	6.8%	7 (7/0)	31.8%
1976	415	11 (10/1)	2.7%	8 (7/1)	72.7%
1977	540	13 (12/1)	2.4%	11 (10/1)	84.6%
1978	546	23 (20/3)	4.2%	10 (10/0)	43.4%

* M/F is Male/Female
- % of admitted patients of eye injured is the percentage of for grand total.
- % of IOF patients is the percentage of for admitted patients of eye injured.

In 39 eyes of intraocular foreign body, 20 eyes were conformed as magnet foreign bodies, and their removals were easily done by use of a magnet combined with or without the image intensifier (Table 2; Fig. 5).

Of 39 eyes, 18 eyes (46%) had more than 0.02 (20/1000) of corrected vision after surgery. Visual checks were made at least 6 months

Fig. 5. A case aged 27, male labor, addmitted on 12/19/1975 because of the perforating injury with an intravitreal magnetic (iron) foreign body in left eye. The image intensifier made the foreign body removal by the magnet much easier. This picture was taken from the TV monitoring. Postoperative corrected vision was 20/20 because of clear media.

Table 2. Locations and magnetic properties on 39 eyes of intraocular foreign bodies 1974-1978, St. Mary's Hospital, Seoul.

IOP	Location of IOP Anterior seg.	Location of IOP Posterior seg.	Total eyes	%
Radiopaque metalic & magnetic	5	15	20	51.3%
non-magnetic	3	10	13	33.3%
Radiolucent non-metalic	4	2	6	15.4%
Total eyes	12	27	39	100%

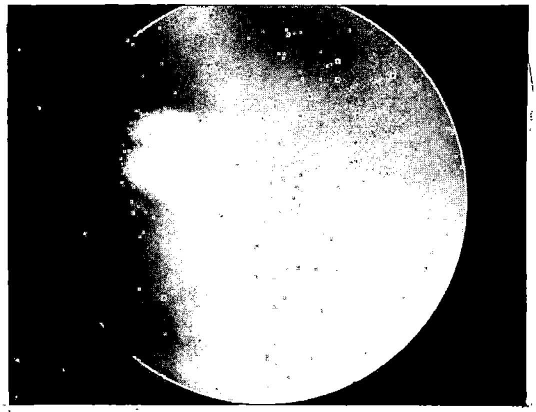

Fig. 6. A case aged 41, male worker admitted with the perforating injury with a foreign body (nonmagnetic) in hemorrhagic vitreous. The injured wound was closed and the vitreous hemorrhage was then removed by the use of VISC and finally the intravitreal foreign body was removed out by a foreign body forceps inserted into the fiber optics which was introduced through the pars plana approach (one port system technique, see Fig. 6). Postoperative vision was 20/40 OD.

later or more postoperately (Table 3).

Since the use of VISC in our Department during the past 2 years, the success rate of foreign body removal had enhanced with the gain of much useful vision postoperately (Fig. 6).

Major postoperative complications were retinal hemorrhage (6 eyes), retinal detachment (5 eyes), vitreous opacity and traction (3 eyes) and phthisis bulbi (3 eyes).

Discussion

In year of 1966, Suckling[5] reported firstly the removal of two non-magnetic intraocular foreign bodies using an image intensifier. The disadventage was that the forceps used to remove the intraocular foreign body were directed by the radiologist supervising the image intensifier. And four years later Anhalt et al.[6] removed a non-magnetic intraocular foreign body by ophthalmo-

In Korea, author[3] reported a successful case (male, 20 aged, stevedore) of intraocular magnetic foreign body which was removed easily out by a special forceps under the direct visualization of image intensifier. In this first case of year 1975, the initial trial of magnet use was failed and 22 days later this retained intraocular foreign body could be removed with a special forceps under the visualization of two plane image intensifier. Total fluoroscopy time in this case was only 8 minutes which is estimated about 5-10 R. of irradition. And author also

Table 3. Final corrected visual acuity of 39 IOF eyes

Final corrected visual acuity	I O F eyes		With Image-Intensifier		With OP, or VISC	
	Anterior segment	Posterior segment	Successfully removal	Failed	Successfully removal	Failed
20/20 or better		2	1	1		
20/30 – 20/100	8	3	5		6	
20/200 – 20/400	4	5	2		7	
FC – HM		6	2	1	3	
LP		4		1	1	2
No LP – phthisis		5	3		2	
Enucleation		2			1	1
Total Eyes (39)	12	27	13	3	20	3

* OP : Operating microscope
* VISC : Vitreous Infusion Suction & Cutter, (used since year of 1977)

studied the experimental removals of the orbital foreign bodies under the use of image intensifier. This method combined the advantages of accurate localization and the ease to grasp the foreign bodies in the lid or in the orbit (Fig. 7).

Presently, non-magnetic intraocular foreign body is more difficult to remove and tend generally to be more toxic than the magnetic foreign body.[7]

Opaque media from extensive hemorrhages or exudates would be caused the difficulty of direct visualization. Such a case has been indicated routinely to use the image intensifier for detection of any intraocular foreign body and for removal of the retained foreign body.

Development of vitrectomy instruments such as VISC, Ocutome, SITE, Stripper and vitreophage, and advanced surgical techniques provided new capabilities to treat certain penetrating ocular injuries with or without the retained intraocular foreign body.[8]

Two instruments technique (two port system) for vitrectomy and for the removal of intraocular foreign body is a popular method. The vitrectomy instrument is used to clear vitreous opacity or hemorrhage, mobilize foreign body, and illuminate operative field and then an intraocular foreign body is grasped with a special foreign body forceps introduced from opposite pars plana.

Author modified this two instruments technique to one instrument technique by introducing the tip of fiber optic illuminator which has contained a fine foreign body forceps in its canal through the pars plana. This one instrument technique could be prevented to another stab wound of the sclera which is an essential procedure in two instruments technique.

With this modified simple technique, another could be removed easily out the nonmagnetic or magnetic intraocular foreign bodies in two cases of each. And that time operating microscope and contact lens of minus 40 diopters (Machemer) are used for direct visualization instead of image intensifier.

Summary

1. A total of 39 perforating eye injuries together with intraocular foreign bodies (37 patients) requiring hospitalization in St. Mary's Hospital, Seoul from 1974 to 1978 year are reviewed.

2. Of the 87 patients, 37 patients (42.5%) had a perforating eye injuries with an intraocular

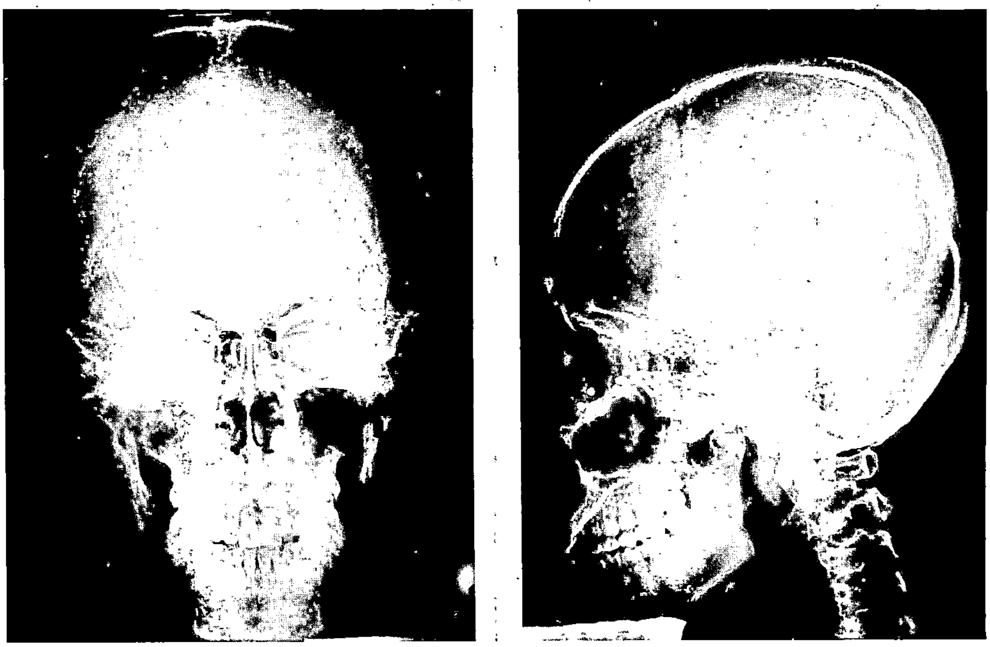

Fig. 7. Six bullets (lead, nonmagnetic) are found on the orbital floor of the right eye (P-A and Lateral views). This case is absolutely indicated to use the two planes image intensifier for the removal of these. Case aged 22, female.

foreign body.

3. Biplanes image intensifier has the advantages of accurate detection and localization of radiopaque foreign body preoperatively, and the ease to grasp the foreign body in opaque media during surgery at safe radiation level. The image intensifier is still useful tool to detection, localization and removal of the foreign body in the eye, the lid and the orbit.

4. Removal of opacity of the vitreous and the lens could be performed dramatically by the use of a VISC. And this advanced technique with a vitrectomy instrument was enhanced to much more improvement to vision with preserving the injured eyes.

5. A modified technique of intraocular foreign body removals with a fine alligator type foreign body forceps which was inserted into the central canal of the fiber optics, a part of VISC, is presented.

References

1. Becker, J.A. Henny, G.C.: Practical evaluation of image intensifier system, Radiology, 79:483-488, 1962.
2. Manges, W.F.: Foreign body removal with the aid of double plane roentgenoscope, Amer. J. Roentgen. 30: 674-676, 1933.
3. Kim, J.H.: Forceps removal of radiopaque intraocular and/or orbital foreign bodies under the aid of television fluoroscopy, J. Korean Ophthal. Soc. 16:59-65, 1975.
4. Machemer, R.: Vitrectomy, A pars plana approach., Grune & Stratton, New York, 1975.
5. Suckling, R.D.: The use of the image intensifier in ophthalmology. Trans. Ophthal. Soc. N. Vol. XVIII, 1966.
6. Anhalt, E.F., Oppenheim, R.S. and Konkal, J.: Removal of nonmagnetic intraocular foreign bodies using the image intensifier, Case report, Canad. J. Ophth. 5:244-247, July, 1970.
7. Havener, W.H.: Intraocular foreign bodies, Clinical Ophthal. Vol. 15, pp. 1-5, Chap. 15, 1977.
8. Tolentino, F.I., Schepens, C.I. and Freeman, H.M.: Vitreoretinal Disorders, PP. 601-610 (Closed vitreous surgery; Removal of foreign bodies from the vitreous), Saunders, 1976.

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Session 13.

Non-occupational Diseases in Industry

THE EFFECTS OF UNSATISFACTORY WORKING CONDITIONS ON THE EPIDEMIOLOGY OF UNAUTHORIZED ABSENTEEISM IN AN OLD TEXTILE FACTORY IN ISFAHAN, IRAN

Nader KAVOUSSI, H.J. MILLER and A. REZVANI, *Iran*

Introduction

Job satisfaction, which can be translated mostly as the psychological and social adaption of man to his work, has been recently considered as one of the most important factors in human productivity.

The conditions of the working environment, including the presence of an effective occupational health and ergonomics system and adequate social services in the work place, will contribute to job satisfaction and in turn improve the laborer's contribution to the work activities and productivity.

In some of the oldest factories built more than 50 years ago in Iran, environmental health applied ergonomic and safety conditions are well below standard. Such circumstances will often produce a higher rate of unauthorized absenteeism from work, as well as a plethora of other problems. In this connection, most previous work absenteeism studies were concerned with absence from work in the form of certified sickness absenteeism, and brief attention was paid to unauthorized absenteeism.

An epidemiological study of such a social/occupational problem as this provides useful information for the factory management so that working and economic conditions may be improved. Further, this waste of human resources has considerable effect on the national productivity, and so with these considerations in mind it seemed profitable to study such subject.

Data was collected from the records of a 50 years old large textile factory in Isfahan, Iran. The factory itself was employing 480 workers (Feb. 1978) though only 335 records were selected by systematic random sampling from amongst the workers.

The following information was recorded: age and sex of the workers, duration of employment, number of workers absent and the number of days of absence per worker because of certified sickness and unauthorized absence, for the years 1975, 1976 and 1977. Also, the total work force, number of women, and number of workers joining and leaving the factory were recorded separately for these three years.

The general working conditions were noted, as well as the comments of the management and a sample of the workers. The workers were interviewed using a questionnaire with an ordinal scale of measurement for recording satisfaction in the following areas; microclimate of factory, transportation to and from work, eating facilities and general social service at work place.

A control factory was also examined in the same area and though similar in terms of type and size, 382 workers, the working environment was very difficult. In the study factory which was more than 50 years old, working conditions were generally well below standard: badly designed, poor maintenance, unhygienic, excessive noise, poor lighting, lack of rest of facilities, lack of occupational health care and with no special transportation facilities for the workers, who live mostly in the surrounding rural areas.

The control factory on the other hand was relatively new, 80 years old, well planned and maintained, with good working conditions. The workers are cared for in terms of adequate rest and eating facilities, company transportation and provision of first aid facilities.

The study was divided into two stages. In the first stage, a comparison was made between the study factory and the control in terms of rates for unauthorized absenteeism. The rates were calculated using the formula recommended for sickness absence analysis (5), and included the measure of severity of absenteeism: the average annual duration per person and the lost time percentage. A measure of frequency of absenteeism was taken using the inception rate persons, and a measure of prevalence of absenteeism was made using the point and period prevalence rates.

In the second stage of the study, examination of data was made from the study factory for the possible effects on unauthorized absenteeism of such factors as age, duration of employment and certified sickness absence patterns.

Results

The comparison of unauthorized absence rates between the two factories is shown in Table 1.

As can be seen from Table 1, there is a signifi-

Table 1. Unauthorized absence rates for study factory and control during 1977

		Study factory	Control factory
Measurement of severity	Average annual duration per person (in days)	7.0	2.5
	Lost time percentage	2.4	0.84
Measurement of frequency	Inception rate persons	0.73	0.48
Measurement of prevalence	Point prevalence rate	0.002	0.001
	Period prevalence rate (week)	0.016	0.011

cantly higher rate of unauthorized absenteeism in the study factory according to the measures of severity, frequency and prevalence.

In the second stage of the study, the following results were obtained from the examination of the effects of age and length of employment in the factory on absenteeism patterns.

As can be seen from Table 2 and Table 3, there were significant differences accounted for by the effects of age and duration of employment on absenteeism patterns. Table 2 shows a marked decrease from 100% of the youngest workers to 59.6% of the older workers, age 50 and over, taking at least 1 day of unauthorized absence during year 1977.

Similarly, the longer the employment, the less likelihood there was of taking unauthorized absenteeism. For those working for 1-4 years in the factory, 91.6% took at least 1 day off during 1977 whilst for those who had been employed for 10 or more years only 67.18% took at least 1 day of unauthorized absenteeism.

Table 4 examines the number of days of unauthorized absenteeism taken by the workers during the same period.

Any worker taking more than 30 days of unauthorized absenteeism was not taken into consideration. The overall pattern was one of a negative correlation between the number of days absent and the number of workers, whilst 83 workers took 1-4 days unauthorized absence, only 19 workers took 25-29 days of unauthorized absence. Since 335 records were examined, it can be seen that 100 workers took

Table 2. Relationship between age and unauthorized absenteeism in a textile factory in Isfahan, Iran (1977)

Age group in years	19	20–24	25–29	30–34	35–39	40–44	45–49	50	Total
Absolute numbers	5	17	35	43	46	31	54	104	335
Percentage	1.5	5	10	12.8	13.7	9.2	16	31	100
Absolute numbers of absent workers	5	16	29	33	33	21	36	62	235
Percentage of absenteeism	100	94.1	82.9	76.7	71.7	67.7	66.7	59.6	70.14

Table 3. Relationship between length of employment and number of people taking at least 1 day of unauthorized absence (1977)

Length of employment (in years)	1–4	5–9	10+	Total
Absolute numbers	24	52	259	335
Percentage	7.2	15.5	77.3	100
Absolute numbers	22	39	174	235
Percentage of workers absenteeism	91.6	75.0	67.18	70.14

Table 4. Number of days of unauthorized absence according to number of workers in factory (1977)

No. of days	No. workers	Mean no days lost	% of total
1–4	83	208	35.3
5–9	61	427	26.0
10–14	26	312	11.0
15–19	24	408	10.2
20–24	22	484	9.4
25–29	19	513	8.0
Total	235	2352	100.0

off no days of unauthorized absence.

The records of the factory were examined also for certified sickness absenteeism and the results are shown in Table 5 and 6.

Table 5. Number of persons taking certified sickness absenteeism according to age (1977)

Age group (years)	Absolute number	Percent of total
19	–	–
20–24	2	0.6
25–29	5	1.5
30–34	5	1.5
35–39	8	2.5
40–44	8	2.5
45–49	10	3.0
50	25	7.5
Total	63	18.8

Table 6. Number of persons taking certified sickness absenteeism according to length of employment (1977)

Length of employment (years)	No.	% of total
1–4	6	1.8
5–9	8	2.4
10	49	14.6
Total	63	18.8

This table shows a positive age correlation pattern, and further more that only 18.8% of the 335 workers took certified sickness absenteeism. Whilst no workers aged under 19 took sickness leave, there was a steady increase in the number of days absent up to the 50 years and over age group where 25 workers (7.5%) took certified sickness absenteeism. It can be deduced that 272 workers (81.2%) took no certified sickness absenteeism.

The large difference is noted between only 6 workers taking certified sickness absenteeism amongst the 1-4 years employment group, against the 49 workers in the 10 or more years employment group.

Table 7 displays the pattern for worker turnover for the year 1975, 1976 and 1977 in the study factory. For the "workers out" group, no distinction is made between those that were dismissed and those that voluntarily left.

Table 7. Worker turnover in study factory for years 1975, 1976 and 1977

Year	No. of workers	Women No.	Women %	Workers in No.	Workers in %	Workers out No.	Workers out %
1975	712	33	4.6	142	20	142	20
1976	650	32	4.9	97	15	130	20
1977	480	28	5.8	48	10	144	30

Discussion

Extensive absenteeism studies have been carried out in the technically developed countries during the last 25 years. Certain findings have been summarized (7), and some consistent associations emphasized (3). It is known for example that with the variable age, an association exists between increasing age and decreasing frequency of absence spells (though their duration increases), a finding that relates to both sexes.

On the other hand, however, no consistent association has been shown with the variables of working conditions and job content, only heaviness of the workload gives a consistent absence related pattern. Wages are a highly complex variable, and the conception of earnings appears more important than actual earnings.

In our study we found that greater unauthorized absenteeism was positively correlated with shorter periods of employment in the younger age groups. Among possible explanations for this are: a wider range of alternative job possibilities and changing work and social attitudes amongst the younger workers and a self-selection process for the older workers whereby they have chosen to work at the factory whilst the more dissatisfied and unhealth workers have left.

The mean of age of the control factory workers is younger (76% of workers age 24 years and under against 6.5% for the study factory) and also the mean duration of employment at the control factory is less (64.2% of workers employed for 1-4 years, against 7.2% for the study factory).

These facts would anticipate a higher rate of absenteeism at the study factory than at the control factory but the opposite findings strongly suggest a powerful influence of the working environment and worker's welfare on the unauthorized absenteeism rates.

Labour turnover if high may be converted into absence, and our findings certainly support this.

Further, there are well documented reports confirming that some men who indulge in frequent episodes of certified sickness, are not necessarily less physically healthy than their collegues (2), (6), (4). The converse also applies, for it is not valid to argue that no sickness absence at all is an indication of good physical health (6). The picture concerning unauthorized absenteeism will of necessity be even more complex (1).

The low rates of certified sickness absenteeism and their positive association with increasing age, certainly support the hyothesis that the workers are expressing some from of dissatisfaction by means of unauthorized absenteeism. Since certified sickness entitles the worker to National Insurance benefits, whilst unauthorized absenteeism means financial loss, it appears to be further support for this above argument.

The consequences of high absenteeism rates are diverse and will affect: the individual worker in terms of lack of promotion and esteem at work place, his family by means of economic hardship and communication of poor work attitudes to the children, the workplace whereby work morale is lowered and productivity disrupt and finally there are the wider implications for society — upon social behaviour and mental health as well the effects on the national economy.

In the last 15 years, great technological advances have taken place in Iran, and as in other industrialized countries there has been an increasing awareness of the importance of worker satisfaction. In our study we have demonstrated the importance of working conditions and their influence upon the unauthorized absenteeism rates which can in turn be translated as economic loss, disturbance of mental health and general social disruption.

References

Hill Trust industrial accident sickness and other absence. Tavistock pamphlet No. 4 London 1962.

Lokander, S. Sick absence in a Swedish company. Acta Med. Scand. 171. Suppl. 337, 1962.

Nowack J.C. Absenteeism a management problem. Report to ILO delegation in Iran.

Raffle. P.A.B. President's address. The occupational physician as a community physician. Proc. rog. soc. Med. 63, 731-739, 1970.

Subcommittee on Absenteeism. Permanent Commission and International Association in Occupational Health Saò Paolo 1972. Brit J. Industr. Med. 30, 402-403, 1973.

Taylor. P.J. (a) Personal factors associated with sickness absence. A study of 194 men with contrasting sickness. Absence experience in a refinery population. Brit. J. Industr. Med. 25, 106-118, 1968. (b) Sickness absence resistance. Trans. Soc. Occup. Med. 18, 96-100, 1968.

Ward Gardner, A. Proceedings of the symposium of absence from work attributed to sickness. London Society of Occupational Medicine 1968.

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THE USE OF A POWERFUL SHORT COURSE REGIMEN (INH + RFP + ETB) IN THE ULTIMATE CONTROL OF TUBERCULOSIS AMONG INDONESIAN NAVY DEPENDENTS

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Historical Background

The indonesian Navy was created very early during our struggle for independence back in 1945. At that time, her members came from all strata of society, and were admitted without having to undergo a complete physical examination. Tuberculosis has been known to be widespread in Indonesia ever since the time of the construction of the Borobuder, this consummate example of Buddhist architecture which was built between 750 and 850 A.D. So it is a matter of course that the original Navy personnel of 1945 harboured many cases of tuberculosis.

During the post-revolution years, continued efforts were mounted to control tuberculosis in the Navy, however, lack of available funds and suitable tuberculostatics interfered with the hoped-for results. Meanwhile, new recruits (military) have to pass pre-service medical checkups, including chest x-rays, before being admitted into the service. In theory, this requirement also apply to civilian personnel. Yet in practice it is not always complied to, and thus form new sources of tuberculosis.

The Medical Service of the Navy is also responsible for the health care of Navy dependents. Not until 1972 did we get proof of the efficacy of the regimen (INH + RFP + ETB) in controlling tuberculosis among service personnel, both military and civilian.

This report deals with our efforts to control tuberculosis in that sector of the Navy community as yet not described, namely the Navy dependents.

Basic Considerations

This ultimate TB control program forms an integral part of the Indonesian Navy's Five Year Medical Development Program (1976-1980), to cure the pool of registered TB cases among Navy dependent at our bases.

The existence of TB cases is a fact. In the past our budget did not allow us to embark on a full scale control program, resulting in the cumulation of active and quiescent cases year after year, and thus providing us with a pool of registered cases in all our dependents' clinics throughout our bases.

Preliminary surveys indicate that at least 80% of this pool comprise TB cases which have received specific treatment for at least one year. Unfortunately, due to short supplies of drugs, only those who did come regularly received adequate treatment. The majority only got tuberculostatics, provided free of charge, on an irregular basis for lack of understanding and transportation problems.

It is feared, therefore, that most of these patients constitute old cases harbouring bacilli which most likely are resistant to INH and to Streptomycin and PAS (Peetosutan, 1976) as well.

This leaves us with only one alternative when starting this program: the use of a powerful and failure proof treatment regimen and schedule.

Because the tuberculostatics employed before usually consists of INH, Streptomycin and PAS, it is obvious that, with our objective in mind, we now have to use Refampicin and Ethambutol in our new treatment regimen. Though INH was much used previously, we assume that not all our cases are as yet resistant to this cheap, safe and efficient drug. For this reason we have included INH in our regimen. Streptomycin and PAS are not used again, judged to be already of no use in any retreatment regimen in view of the possible emergence of secondary resistance. It should be noted that even to date, Pyrazineamide is not yet available in Indonesia.

So our treatment regimen is composed of INH, RFP and ETB. This choice is based on the excellent results obtained so far in the retreatment of TB with this regimen, all yielding up a result of more than 90% cure rate (Proust & Evans, 1972; Figueredo et al., 1974; Hong Kong TB Treatment Service et al., 1974 & 1975; Coop. Chemoth. Study in Poland, 1975). Also, in the original treatment of TB, INH and RFP alone already has proven its effectiveness (Singapore TB Service et al., 1975; EA/BMRC, 1974).

Indication and Case Finding

All patients in the pool must have their sputum examined at least three times, and have it reexamined if necessary without any maximum limit. For the Jakarta patients, sputum examination is centralized at the Naval TB Eradication Main Laboratory, on Jalan Bendungan Jatiluhur and for those in Surabaya, at the Naval TB Laboratory, Ujung. Sputum is examined by direct microscopic method and TTH staining (Jakarta and Surabaya) and for Jakarta in particular, by homogenization and concentration followed by microscopic examination using both the TTH and fluorescence microscopic method and culturing. No matter the method used, those whose sputum appears to be (+) will be treated with this regimen.

Emphasis is placed on those patients with a positive sputum, as they are more dangerous than those with a negative sputum (Rouillon et al., 1976).

Dosage and Administration of Drugs

In view of the latest developments regarding the treatment of TB patients, and to practice economy without giving up quality, a daily dosis of 6 weeks is adopted followed by a dosis of twice a week (Mondays and Thursdays) until the 39th week.

The daily INH dosis is 400 mg plus vitamine B_6 6 mg in one tablet. The daily ETB dosis is 25 mg/kg body weight. The daily RFP dosis is 450 mg 1 x. To facilitate treatment, it should be started on Monday or Thursday. The INH dosis of Monday-Thursday is 2 tablets (800 mg INH + 12 mg vitamine B_6); ETB is given Monday-Thursday, 50 mg/kg body weight, and RFP every Monday-Thursday 600 mg.

All these drugs are given around 10:00 AM every working day. No other food is to be taken in the two hours after taking the drug. Drugs are taken at the respective Medical Units under supervision of nurses appointed to serve these patients. Each patient must bring and leave at the Unit his own drinking glass.

Organization and Management

The Indonesian Navy maintains a medical unit for personnel and dependents respectively. Since the eradication of TB should be an intensive and continual effort, requiring strict administration, special physicians are appointed charged with TB treatment at the medical units. Sputum examination is centralized. This facilitates central monitoring of the progress of TB eradication at the respective medical units, including monitoring the number of patients treated, and follow-up results of the monthly sputum examination during the treatment period (and once every six months during the post-treatment period).

Case Holding

In order to secure that drugs are taken regularly, each clinic will look for those patients who fail to appear at the clinic, both at their offices and homes. This way, there are no irregular appearances for treatment.

When sputum has to be reexamined, the nurse in charge of the drugs has the sputum pot ready, so the sputum can be obtained right away an forwarded for examination.

Result Obtained until the Second Week of May 1978

By early May, 1978, 158 patients out of 190 cases from Surabaya, Jakarta and Tanjung Pinang, in that order (see Table 1), had completed a 9-month therapy. The sputum of all these patients were found negative at the end of the treatment period (sputum conversion rate at the end of treatment = 100%).

Microscopic examination of the sputum of patient K from Jakarta (patient no. 788) at the end of his treatment period showed his sputum to be positive; consecutive reexamination of his sputum turned out to be negative. Cultured, even the positive specimen turned out to be negative. This, probably, was a case of excretion of dead bacilli. Patient S from Jakarta

Table 1. Number of patients according to naval base and treatment obtained

Naval base	Number of TB patients under treatment	Number of patients having completed treatment	Sputum conversion at the end of treatment	Number of patients still under treatment
Jakarta	79	63	100%	16
Surabaya	102	87	100%	15
Tanjung Pinang	9	8	100%	1
Total	190	158	100%	32

Table 2. Treatment results

Number of patients having completed treatment	Sputum conversion at the end of treatment	Relapses within 6 months	Cure rate (with a follow-up period of 6 months)
158	158=100%	0	100%
	(with one false positive)	(with one false positive)	

(patient no. 071) was 3 months pregnant when treatment started. The baby was born normally.

In addition, there are 16 patients at Jakarta, 15 at Surabaya and one patient at Tanjung Pinang who have just received treatment for a few months (see Table 1).

For those who have been re-examined 6 months after the end of chemotherapy, there was only one microscopic "relapse", Mrs. I from Jakarta (patient no. 719). But after re-examining her sputum by repeated cultures, they turned out to be negative. Hence it was only a "false relapse." These results are shown in Table 2.

Discussion

Though 122 or 77% of the 158 patients being treated consists of old cases (see Table 2), still a 100% sputum conversion was reached among those who completed their 9-month therapy.

The potency of this regimen is reflected also by the rapid sputum conversion, usually already accomplished in the first month of treatment and to be completed at the end of the third month.

Actually, in view of experiences abroad using this or a similar regimen, the results we have obtained so far are predictable. So, ours are really a confirmation of results obtained abroad.

It should be added, though, that the key to a successful eradication of TB does not lie with the selection of a potent regimen only, but with the organization and management of the efforts as well which are facilitated by centralizing sputum examination which in turn facilitates central monitoring.

Conclusion

The INH + RFP + ETB regimen proved to be a powerful one to treat a pool of TB patients, the majority of whom have been under treatment for years. Tentative results showed a 100% sputum conversion at the end of the treatment period. After the third month, almost all patients showed a sputum conversion.

To put down the cost of these expensive drugs, it is not necessary to administer a daily dosis for 9 months, but a daily dosis for 6 weeks will suffice, followed by 2 x/week intermittently through the 39th week, or a treatment period of 9 months in all.

Good organization and management, attended by strict case holding, constitute vital support for the successful cure of TB patients.

Summary

We have stated the cause of TB cases in the Navy and the urgency for eradiction.

In view of the fact that the majority of these patients are old cases, it is imperative to find a powerful regimen, i.e. with no or hardly any resistance on the part of the bacilli to the drugs to be used. The choice was INH + Rifampicin + Ethambutol, on account of the satisfactory results obtained by the Armed Forces Health Center PT Ciba Geigy Indonesia with the Rimactane trial and the results obtained abroad using the same or similar regimens.

The results obtained by the Indonesian Navy were very satisfactory, with a 100% conversion figure at the end of the treatment period, and most of this early during the first three months.

Yet another key to the Navy's success lies with good organizational and management abilities, and strict case holding. Centralization of sputum examination facilitates a central monitoring system which in turn greatly facilitates a periodic evaluation of the efforts mounted to eradicate TB.

References

A Cooperative Tuberculosis Chemotherapy Study in

Poland: A comparative study of daily followed by twice or once weekly regimens of Ethambutol and Rifampicin in retreatment of patients with pulmonary tuberculosis, the results at 1 year, Tubercle, 1975, 56, 1.

East African/British Medical Research Council: Controlled trial of short course (6 months) regimens of chemotherapy for treatment of pulmonary tuberculosis, First East African Study, Third Report, Lancet, August 3, 1974, 237-240. Idem, Second Study, Second Report, Lancet November 9, 1974, 1100-1106.

Figueiredo, F.P. de, Brito, A.A., Balle, J.H.L., Tavares, P.H. & Trannin, P.L.: Short duration chemotherapy of pulnomary tuberculosis, A pilot trial, Proc. XXII Int. Tub. Conf. Bull IUAT, 40, 411-417 (1974).

Fox, W.: The modern management and therapy of pulmonary tuberculosis, Proc. Roy. Soc. Medicine, 70, 1977, 4-15.

Hongkong Tuberculosis Treatment Services; Brompton Hospital/British Medical Research Council Investigation of Retreatment Regimens: A controlled trial of daily and intermittent regimens of Rifampicin plus Ethambutol in the treatment of patients with pulmonary tuberculosis in Hongkong; Tubercule, 1974, 35, 1, 1975.

Peetosutan, E & Lambey, W.: Pola resistensi kuman TB terhadap INH, SM dan PAS di Jakarta. Medica, 1976, 2, 33-39.

Proust, A. & Evans, C.: The Australian Rifampicin trial, The Med. Journ. of Austr., 1972, 2, 861.

Rouillon, A, Perdrizet, S. & Parrot, R.: Transmission of Tubercle Bacilli: The effects of chemotheraphy; Tubercle, 1976, 57, 275-299.

Singapore Tuberculosis Service/British Medical Research Council: Controlled trial of intermittent regimens of Rifampicin plus Isoniazid for pulmonary tuberculosis in Singapore; Lancet, December 6, 1975, 1105-1109.

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TUBERCULOSIS AMONG THE INDUSTRIAL WORKERS
— Present Status and Control Measures —

Chong Dal PARK, *Korea*

Abstract

Tuberculosis remains one of the most prevalent health problems among the industrial workers as well as among the general population in Korea.

According to the results of the national sample survey carried out in 1975, the tuberculosis infection rate was 68.7% (80% and above for those more than 20 years of age), prevalence rate of radiologically significant pulmonary tuberculosis was 3.3%, and prevalence rate of bacteriologically confirmed pulmonary tuberculosis was 0.76% for the general population.

The tuberculosis problem of the workers at an industrial complex was investigated and some control measures were proposed.

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CORRELATION BETWEEN THE INCIDENCE OF RESPIRATORY TRACT INFECTIONS AND THE PHYSICAL FITNESS OF THE EMPLOYEES OF PERTAMINA OIL REFINERY IN DUMAI

Soegono SASTROHANDOJO, *Indonesia*

Summary

Respiratory tract infections are the most common diseases affecting the employees of Pertamina Oil Refinery in Dumai.

A study on six-year medical records (1973-1978) of the employees showed that the total

visits in the Out Patient Department caused by respiratory tract infections were always the greatest through the year as compared to the total visits caused by each of the other diseases.

In 1978 Harvard Step Test was performed to determine the level of individual physical fitness (dynamic) of the 994 employees. It was found that 12.6% (125 employees) had a good level physical fitness, 19.3% (192 employees) had a moderate level physical fitness, and most of them, 68.1% (677 employees) had a low level physical fitness.

Correlation between the incidence of repiratory tract infections and the level of physical fitness during 1978 had been studied. The greatest incidence (39.1%) was found in the group of low level physical fitness while the lowest incidence (16.8%) was found in the group of high level physical fitness. The incidence of respiratory tract infections in the group of moderate level physical fitness (28.1%) was intermediate.

The purpose of the study was to test the significancy of the mentioned correlation in connection with the attempt of the writer to raise the level of individual fitness of the employees as an effort to lower the incidence of respiratory tract infections.

Review of some study was made to reveal results that support the findings of the study.

Introduction

Respiratory tract infections referred to C-39 and C-40 in the List-C of the Manual of the International Statistical Classification of Diseases, Injuries and Causes of Deaths were the most common diseases affecting the employees of Pertamina Oil Refinery in Dumai.

A study on six-year medical records (1973-1978) of the employees of Pertamina Oil Refinery in Dumai showed that patient's visits to the Out Patient Department caused by respiratory tract infections were always the greatest through the year as compared to the visits caused by other diseases.

It is widely known that diseases as coded by C-39 and C-40 in the List-C are mostly viral in origin. Therefore they are infectious in character.

Physical fitness that may increase human body resistance to infectious diseases (14) is one amongst a number of factors that influence the occurrence of diseases in man. (3)

From the data after year 1978 a study on correlation between the incidence of respiratory tract infections and the level of physical fitness of the employees of Pertamina Oil Refinery in Dumai had been done. The purpose of the study was to test the significancy of the mentioned correlation in connection with the attempt of the writer to raise the level of individual fitness of the employees as one of the effort to lower the incidence of respiratory tract infections.

Background of the study group

The study group was composed of all male employees of Pertamina Oil Refinery and its servicing departments in Dumai. Almost all of the employees, including their dependants, lived in Pertamina houses located in an area outside the town of Dumai.

Pertamina, which is a State Oil and Gas Mining Enterprise of Indonesia provides a comprehensive health care for its employees and their dependants. Therefore community and personal preventive and curative measures are provided free by Pertamina.

Periodical medical check up for the employees is done annually to evaluate the condition of the individual static fitness of the employees.

In 1978 Harvard Step Test was performed to determine the level of individual dynamic fitness of the employees using a 20 inches height bench. The stepping frequency used in the test was 30 complete steps per minute and, the maximum length of exercise was 5 minutes.

Employees suffering from tuberculosis, diabetes mellitus, cardiovascular disease, etc. were excluded from the test. Therefore they are not used as subjects of the study. The total number of the subjects were 994 employees.

Method of study

The term "respiratory tract infections" is used in this paper to refer collectively to diseases included in the code numbers C-39 and C-40 in the List-C of the Manual of the International Statistical Classification of Diseases, Injuries and Causes of Deaths.

The level of individual physical fitness (dynamic) of the employees determined by the Harvard scoring method as the result of the Harvard Step Test performed in 1978.

According to the level of the individual physical fitness, the subjects were categorized in 3 (three) groups as follows:

Group-A: the group of high level physical fitness which consists of subjects having Harvad score of more than 79.

Group-B: the group of intermediate (moderate) physical fitness which consists of subjects having Harvard score between 55 and 80.

Group-C: the group of low level physical fitness which consists of subjects having Harvard score of less than 56.

The term "incidence" is used in this paper to determine the number of cases (of respiratory tract infections) in each of the above categorial group.

Chi-square test is used as the statistical test.

Findings

Total visits per year caused by each of the ten top listed diagnosis in the Out Patient Department (O.P.D.) is shown in Table-1. It can be seen that within six years, the total visits per year caused by respiratory tract infections (C-39 and C-40) is always highest as to compare with the total visits caused by the other diseases.

It was found from Table-1 that the total visits caused by respiratory tract infections as compared to the total visits of all the ten top listed diseases were: 37.8% in 1973; 27.8% in 1974; 32.3% in 1975; 31.8% in 1976; 30.0% in 1977 and 42.9% in 1978.

The number of subjects in each categorial group of the study resulting from the Harvard step test performed in 1978 is shown in Table-2.

Table 2. Number of subjects in each categorial group

Group	Harvard score	Number of subjects	
		person	%
A	> 80	125	12.6
B	55–80	192	19.3
C	<56	677	68.1
	Total	994	100.0

It can be seen that 125 employees (12.6%) are categorized as having high level physical fitness, 192 employees (19.3%) are categorized as having moderate level of physical fitness and 677 employees (68.1%) are categorized as having low level physical fitness.

It is showed in Table-3 that the incidence of respiratory tract infections is highest (39.1%) in group-C, the group of low level physical fitness, intermediate (28.1%) in group-B, the group of moderate level physical fitness and lowest (16.8%) in group-A, the group of high level physical fitness.

Table 1. Total visits per year (1973-1978) caused by each of the ten top listed diagnosis the O.P.D.

No.	Code-C	Total visits per year					
		1973	1974	1975	1976	1977	1978
1.	3	141	160	199	157	248	191
2.	4	147	259	238	302	276	146
3.	28	143	287	252	149	341	179
4.	39 & 40	1216	1162	1230	1131	1257	1344
5.	51	308	400	377	383	414	239
6.	55	163	341	261	165	255	167
7.	59	288	325	267	278	317	201
8.	60	304	391	341	328	386	215
9.	62	375	387	352	321	402	233
10.	70	132	357	288	344	388	217
	Total	3217	4169	3805	3558	4148	3132

Table 3. The incidence of respiratory tract infections in each categorial group in year 1978

Group	Number of subjects	Incidence	
		Cases	%
A	125	21	16.8
B	192	54	28.1
C	677	265	39.1

Using Chi-square test as the statistical test, it was proved that the difference of the incidence of respiratory tract infections in the three groups of study were statistically significant ($P<0.05$).

It was found that subjects in the group of low physical fitness had more frequent attacks of respiratory tract infections as compared to the group of higher level of physical fitness. (see Table-4).

Table 4. Frequency of the attacks of respiratory tract infections in each categorial group in 1978

Frequency of the attacks in a year	Number of cases in the group		
	A	B	C
1	7	16	34
2	10	10	31
3	2	11	38
4	–	9	41
5	1	4	50
6	–	1	21
7	–	–	22
8	–	1	16
9	–	1	12

Discussion

Diseases included in respiratory tract infections are acute rhino-pharyngitis (common cold), acute sinusitis, acute pharyngitis, acute tonsilitis, acute laryngitis and tracheitis, acute respiratory tract infections of multiple or unspecified sites and acute bronchitis and bronchiolitis that are groups as acute respiratory tract infections and influenza. (16).

Some mycoplasma, bacteria, fungi, rickettsia and more than 100 types of viruses are known as the causative agents of respiratory tract infections (6, 13).

The large number of causes confuse investigation. Overlapping syndromata make clinical differentiation impossible. Specific diagnosis requires isolation of the virus from respiratory tract secretion in appropriate cells or organ cultures. The large number of causes reduces the practicability of control by immunization (13).

The occurrence of respiratory tract infections is world-wide. They are infectious in character and their means of transmission is aerosol. The incubation period of the diseases is relatively short and the susceptability of the host is universal. The communicability unit is family in its extended connotations, includes communal institutions, schools, service barracks, etc. Therefore the most practicable measures to prevent the occurrence of respiratory tract infections are air sanitation and education of the population in personal hygiene and, when possible, avoid crowding in living and sleeping.

An Official Report of the American Public Health Association (2) stated that many known viruses produce inapparent infections. The viruses remain latent in several sites of upper respiratory tract such as tonsils and adenoids. Soeprapti Thaib & Mahdar (1966) found on their serological survey to influenza viruses, that amongst 297 healthy adults and 455 healthy school-children of Bandung, Indonesia, 59.3% and 35.8% were positive to influenza virus type A-2 Hkg-68 (13). Frequently repeated attacks may be due to the level of body resistance and other environment factors.

Human body resistance which is the sum total of mechanisms interpose barriers to the progress of invasion of infectious agents (2, 9) is difficult to be measured. However, Walffe, J.B. (15) said that physical fitness may increase the human body resistance to infectious diseases, although the real mechanism is not known yet.

Timkin (1960, 1964) has reviewed different studies, mainly by Russian researchers, which show that training constitutes a factor of great importance for increasing the nonspecific resistance to infavourable factors. It could be cuased by chemical changes on the cellular level and effects on endocrine glands induced by physical training (1, 14).

Physical training which is physical activity – whether creative or recreational – is usually done to maintain the level of physical fitness. It could be said that the higher the level of physical fitness the higher will be, the nonspecific resistance.

Table-3 of this paper shows that the lowest incidence (16.8%) of respiratory tract infections occurs in group-A, the group of high level physical fitness, while the highest incidence (39.1%) occurs in group-C, the group of low level physical fitness. The incidence of respiratory tract infections in group-B (28.1%) is intermediate.

The incidence of respiratory tract infections in the three groups (A, B and C) proved to be statistically significantly different ($P<0.05$).

Frequency of the attacks of respiratory tract infections in 1978 (Table-4) was found higher in the group of low level physical fitness as compared to the frequency of the attacks in the group of higher level physical fitness.

The findings of the study are in agreement with the statements of Zimkin (1, 14) and Walffe, J.B. (15) that physical fitness may increase human body resistance to infectious diseases. Although the real mechanism has not known, however Kantrovich et al. (1961) (14) have demonstrated that phagocytic activity, which is known as one of the general antibody activity (5) is increases in healthy persons after conditioning program. It is known that phagocytosis of antigen by macrophages is an essential preliminary to antibody production (5).

Banister, R. (14) stated that although exercise, disease and injuries are all stressors, it appears that the stress of regular exercise with its conditioning effects may actually increase the tolerance of the individual and protect him against other form of stress.

In summary, it appears that all the above evidence indicates there are beneficial effects of physical activity/physical fitness in the control of disease.

On the contrary Telfer, J.G. (14) has stated that physical activity does not of itself produce resistance to infection. The different sick calls in the well trained group may be caused by a matter of less pronounced subjective symptoms or a concious suppression of symptoms.

However, whatever the reason may be, the net effect appears to be positive.

Further study is necessary to verify the result of study that support the findings presented in this paper.

A decrease in the incidence of respiratory tract infections in Pertamina Oil Refinery in Dumai is expected in accordance to the raise of the level of individual physical fitness through the application of a physical fitness program.

Conclusion

A study on correlation between the incidence of repiratory tract infections and the level of physical fitness (of the year 1978) of the employees of Pertamina Oil Refinery in Dumai found that the incidence was higher in the group of lower level physical fitness.

Although the real mechanism of the correlation between human body resistance to infectious diseases and the level of physical fitness has not known, however, the findings is in agreement with the result of some studies. Further study is necessary to verify the result of some studies that support the findings presented in this paper.

References

1. Astrand, P.O. & Rodahl. K.: "Physical Training" In: Text book of Work Physiology (pp. 375-424). Mac-Graw Hill Book Comp., *1970.*
2. Benerson, A.R. (Editor): "An Official Report of the American Public Health Association." In: Control of Communicable Diseases in Man. (pp. 159-165; 262-266). Interdisciplinary Books, Pamphlets & Periodicals for the Professional & the Lay Man; Twelfth ed., *1975.*
3. Christie, A.B.: "The Spread and Control of Air-Borne Infections" In: The Theory and Practice of Public Health. (pp. 129-215). Oxford: Medical Publications; Fourth ed., *1975.*
4. Dhanutirto, H.: "Physical Fitness." A Physiological Study with Special Reference to the Use of Step Test. Universitas Indonesia, *1970.*
5. Gold, E.R. & Peacock, D.B.: "Basic Immunology." Bristol: John Wright & Sons Ltd., *1971.*
6. Jan Tanu.: "Farmakologi dan Terapi." Fakultas Kedokteran Universitas Indonesia, *1971.*
7. Jackson, G.G.: "Viral (and Filter Passing Microbial) Infections of the Respiratory Tract." In: Textbook of Medicine. (pp. 184-193). Saunders; Fourth ed., *1975.*
8. Laevell & Clark.: "Preventive Medicine for Doctor

and His Community.'. MacGraw Hill Book Company Inc.; Second ed., *1958.*

9. Larson, L.R. & Yocom, R.: "Measurement and Evaluation in Physical Health and Recreation Education." (p. 162). St. Louis: the C.V. Mosby Co.; Filfth ed., *1951.*

10. Levin, R.H.: "Upper Respiratory Tract Infections." In: Clinical Farmacy and Therapeutics." (pp. 516-558). Baltimore: The William Wilkins Comp., *1975.*

11. Muffson, M.A. et al.: "Etiology of Upper Respiratory Tract Illnesses among Civilian Adults." J.A.M.A., 195: 91, *1965.*

12. Said H.H.: Landasan serta Pedoman dalam Usaha Membina, Memelihara dar Meningkatkan Kesegaran Jasmani." (p. 87). Kursus Dasar Olah Raga, Jakarta, *1974.*

13. Soemiatno: "Penyakit Respitatoir Mendadak Non Bakterriil dar Vaksisasinya." Unpublished paper, *1976.*

14. The American College of Sports.: "Encyclopedia of Sport Sciences and Medicine." New York: The McMillar Company, *1971.*

15. Walffe, J.B.: "Prevention of Disease through Exercise and Health Education." In: Health and Fitness in Modern World. Chicago: The Athletic Institute, *1961.*

16. World Health Organization: Manual of the International Statistical Classification of Disease, Injuries and Causes of Death." Geneva, *1967.*

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BLOOD PRESSURE AND ENVIRONMENT

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About 80 years already have passed since Riva-Rocci devised Sphygmomanometer.

Nowadays blood pressure (afterward abridged as B.P.) is measured routinely in clinic, but there seems to be studied few on B.P. which may concern with social conditions or environments.

On this matter, this is a report on changes of B.P. with difference of social condition. There will be 2 cases shown in the faculties meeting and beer party.

Samples and Methods

Case I: Report about the faculties meeting. Samples are taken from all members of the attendant of 41 in the meeting which continued for 3 hours without exciting condition.

Measuring instrument of B.P. was semiautomatic Sphygmomanometer made by Ueda electric corp. in Tokyo (1975).

The first measure being done 15 minutes before the meeting, the second one was started 3 hours after the beginning of the meeting. By the way measuring time took about 40 minutes. (Date; 1976. 1.9. 2:00 p.m. 5:00 p.m.) [Table 1].

In the case of the beer party, measuring was done on the 14 members of librarians of the university, at the time of 5:00 p.m. and 7:00 p.m., that is, respectively the beginning and the end of the party. [Case II, Table 2-3] (Date; 1977. 7.6. 5:00 p.m. 7:00 p.m.).

The quantity of beer at one member is used about 1200ml.

There goes the friendly atmosphere throughout the party.

Methods of Analysis

As the indices of comparison of B.P. 5 ones were used, that is, respectively maximum B.P. (as max.), minimum B.P. (as min.), pulse pressure (as p.p.), p.p./max., and p.p./min.

By Case I, the difference of indices between before and after the meeting is analysed as distribution going into the 3 categories of decrease or unchange or increase of indices.

As calculation technique, specific x^2-test is used.

In Case II, analysis is done with Ridit Analysis method by Bross as for the distribution of the indices at the before and after the party.

Table 1. Case I. Blood pressure.

Before max.	Before min.	After max.	After min.	Age	Phys. type
140	80	126	80	40	o
130	70	110	76	30	l
150	92	145	88	30	n
142	70	144	70	50	n
104	70	136	80	40	n
130	70	108	70	40	n
120	82	110	78	40	l
140	90	152	84	50	n
130	72	122	78	50	l
142	92	148	102	60	n
130	80	120	80	60	n
100	68	90	62	50	l
120	80	142	90	30	n
108	70	104	66	30	n
130	80	124	68	30	n
140	70	136	72	30	n
132	72	110	72	30	l
122	82	130	100	40	o
134	90	132	88	40	o
122	70	108	70	40	n
132	90	140	98	40	n
110	60	140	80	40	n
120	80	118	80	40	n
172	100	194	120	40	n
122	80	122	80	40	n
172	114	192	112	40	n
130	90	102	70	40	n
120	80	128	92	40	l
140	80	116	72	40	l
120	70	130	78	40	l
142	74	124	80	40	l
108	60	100	62	40	l
140	72	142	82	60	l
140	90	132	72	30	n
130	80	142	70	30	n
120	68	110	74	30	l
130	82	110	74	40	o
150	72	138	70	40	n
162	90	132	90	40	n
142	92	162	98	40	n
162	100	162	108	40	n

l : lean n : normal o : obese

Table 2. Case II. Blood pressure.

No	Before max.	Before min.	After max.	After min	Age	Phys. type	Sex
1	108	60	100	60	30	o	f
2	126	66	120	60	30	n	m
3	128	78	130	60	30	n	f
4	102	60	110	60	30	l	m
5	120	60	120	50	30	n	m
6	126	80	110	70	30	n	m
7	130	80	130	50	30	n	m
8	130	70	110	60	30	l	m
9	134	78	120	60	30	n	m
10	118	74	110	62	30	l	f
11	120	60	100	50	30	n	m
12	112	70	100	50	40	n	m
13	155	92	150	80	40	n	m
14	132	80	150	90	30	n	m

f : female m : male

Table 3. Case II. Indices

No	P.P. bef.	P.P. aft.	max/min bef.	max/min aft.	P.P./min(%) bef.	P.P./min(%) aft.	P.P./max(%) bef.	P.P./max(%) aft.
1	48	40	1.8	1.7	80	67	44	40
2	60	60	1.9	2.0	91	100	48	50
3	50	70	1.6	2.2	64	117	39	54
4	42	50	1.7	1.8	70	83	41	45
5	60	70	2.0	2.4	100	140	50	58
6	46	48	1.6	1.7	58	69	37	41
7	50	80	1.6	2.6	63	160	38	62
8	60	50	1.9	1.8	86	83	46	45
9	56	60	1.7	2.0	72	100	42	50
10	44	48	1.6	1.8	59	77	37	44
11	40	50	2.0	2.0	67	100	33	50
12	42	40	1.6	2.0	60	80	38	40
13	63	70	1.7	1.9	68	88	41	47
14	52	60	1.7	1.7	65	67	39	40

Results and Consideration

Significant levels are shown at Table 4 and Table 5. Judged by the data of Case I, pulse pressure (p.p.) is decreased after the meeting ($p<0.05$) and min. B.P. has a trend to be a little increased.

Another 4 indices (p.p., p.p./max., p.p./min., max./min.) are all decreased significantly. This

Table 4. Case I. Results

	Decrease	Unchanged	Increased	P-value
1. max.	24	2	15	
2. min.	14	9	18	
3. p.p.	25	4	12	(p<0.05)
4. p.p./max.	27	5	9	(p<0.05)
5. p.p./min.	27	1	13	(p<0.05)
6. max./min.	27	1	13	(p<0.05)

Table 5. Case II (Bear party). Results by Ridit analysis

Indices	After-before
max.	not significant
min. (decrease)	$p < 0.01$ (++)
pulse pres. (increase)	$p < 0.05$ (+)
p.p./max. (increase)	$p < 0.01$ (++)
p.p./min. (increase)	$p < 0.01$ (++)
max./min. (increase)	$p < 0.01$ (++)

P.P. : pulse pressure

results are possibly attributed to the fact that p.p. has principal tendency of decrease after the meeting.

By the Case II, there seems to be the tendency that p.p. is increased very significantly, and min. B.P. decreased ($p<0.01$) but p.p./max., p.p./min., max./min. are significantly increased.

In all-round study of Case I and Case II, the following interesting fact will be admitted. That is a clear contrast between Case I and Case II, at the change of p.p..

This tendency has a suggestion that at the faculties' meeting there is possibly a psychological and nervous strain, and adversely at the beer party, the relaxing condition remains in autonomic nervous system, then this gives an subtle effect to the circulating system in human body.

Therefore, these studies should be carried out also at the stand point of occupational health in future.

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VARICOSE VEINS IN MALE WEAVERS

— An Epidemiological Study in Iran —

Daryoush PARVIZPOUR, *Iran*

Abstract

The prevalence of Varicose Veins was studied in 1742 male weavers in Iran, by completing a specially designed questionnaire and medical examinations. To show the effect of occupation on the prevalence of the disease, the findings were compared with a control group of 1661 workers. The overall prevalence of the disease in the weavers was 26.12 compared with 5.90 in the control group. Also there was a direct relationship between the prevalence of the disease and age in both groups, but the increase was more significant among weavers than the controls. Furthermore, there was a positive relation between the length of employment and the prevalence of the disease in the weavers, while this was not the same in controls. Comparing the severity of the disease measured by its extent and complications in both groups, it was indicated that weavers not only had a higher prevalence rate, they also had more severe forms.

In conclusion, it can be said that Varicose Veins is a health problem in the weavers and

can be substantially reduced by taking acçount of the preventive measures.

Introduction

The results obtained from a few epidemiological studies of Varicose Veins in industrial populations (1,2) and statistics obtained from hospitals in different parts of the world indicate that the Varicose Veins are one of the commonest ailment of the people living in some industrially developed countries. The incidence of Varicose Veins varies from country to country. The high incidence of the disease in North America and Europe (3) contrasts with its rarity in Japan and Africa (4). In India, Pakistan and Middle East, the situation is midway between that in Africa and North America. Although it is a minor condition, it is responsible for a significant loss of earning among working class (5).

This study reflects the results obtained from a comparative study of Varicose Veins in weavers and controls in Isfahan, Iran.

Materials and Methods

In a general health survey in three textile mills in Isfahan, 1742 male weavers of similar socio-economic status were studied with particular attention to Varicose Veins.

Along with the medical examination, a questionnaire was administered covering age, sex, occupational history, history of Varicose Veins in the family, obesity, constipation, thrombophlebitis, haemorrhoids and heart diseases. To detect Varicose Veins the workers were asked to stand in a good light in the examining room with the lower limbs completely exposed from groin to toes. The examination included inspection and palpation of the external and internal sapheneous veins. Varicose Veins were graded according to their severity as "generalized" if more than two thirds of the course of the external or internal sapheneous veins was involved, and "localized" if less than two thirds, was involved (4).

To show the effect of occupation on the prevalence of the disease, the findings were compared with a control group of 1661 male workers employed in food processing plants. These workers were similar in age, weight and socio-economic status to the weavers, but the nature of the work didn't require constant standing.

Results

Response rate: Out of a total of 1847 weavers in the three textile mills, there were 985 in mill No. I, 412 in No. II and 450 in No. III, of whom 954 (96.85%), 376 (91.26%) and 412 (91.58%) were examined respectively. In the control group there were 1750 workers of whom 1661 (94.91%) were examined during the study.

Over all prevalence: The over all prevalence of Varicose Veins in the weavers was 26.12 (almost the same in all three mills) compared with 5.90 in the control group. The difference was statistically significant. ($P<0.001$).

Age: Table 1 shows the prevalence of Vari-

Table 1. Prevalence of varicose veins by age in weavers.

Age groups (years)	No. of workers examined	Without varicose veins		With varicose veins					
				Licalize		Generalize		Total	
		No.	%	No.	%	No.	%	No.	%
<19	52	52	100	0	0	0	0	0	0
20–29	430	371	86.28	59	13.72	0	0	59	13.72
30–39	554	432	77.98	117	21.12	5	0.90	122	22.02
40–49	528	341	64.58	146	27.65	41	7.76	187	35.42
50–59	164	85	51.83	46	28.05	33	20.12	79	48.17
60 +	14	6	42.86	3	21.43	5	35.71	8	57.17
Total	1742	1287	73.88	371	21.30	84	4.82	455	26.12

Table 2. Prevalence of varicose veins by age in weavers and controls.

Age groups (years)	Weavers			Controls		
	No. of workers examined	With varicose veins		No. of workers examined	With varicose veins	
		No.	%		No.	%
<19	52	0	0	42	0	0
20–29	430	59	13.72	409	8	1.96
30–39	554	122	22.02	522	32	6.13
40–49	528	187	35.42	512	41	8.01
50–59	164	79	48.17	164	15	9.15
60 +	14	8	57.14	12	2	16.67
Total	1742	455	26.12	1661	98	5.90

cose Veins and its type by age in the weavers. As indicated in this Table, there is a direct relationship between the prevalence of the disease and age i.e. The higher the age, the higher the prevalence and this is statistically significant ($P<0.001$). Furthermore, the number of workers suffering from generalized type of Varicose Veins increases with their age.

Family history: The prevalence of Varicose Veins among weavers and controls with a positive family history of the disease was higher than among workers with no family history, the ratio being 43.33% and 25.82% among weavers and 13.04% and 5.80% among controls. The difference between these ratios were statistically significant ($P<0.01$).

Constipation: Due to the cellulose-containing dietary habits in these groups none of the workers suffered from chronic constipation, so it was impossible to study the effect of constipation on the prevalence of the disease.

Occupation: Table 2 shows the prevalence of the Varicose Veins in weavers and controls by age. Although there is an increase in the prevalence of the disease with age in both groups, but the increase is more significant among weavers compared with the controls. The difference in the prevalence of the disease in weavers and controls in each age groups is statistically significant ($P<0.001$).

Length of employment: The study of the effect of length of employment on the prevalence of the disease indicates that there is a positive relationship in weavers, where as there is no such a relation in the controls. As reflected in Table 3 in each age groups of the weavers by the increase of the length of employment there is a significant increase in the prevalence of the disease ($P<0.001$).

Severity of the disease: Table 4 shows the severity of Varicose Veins measured by its grade and complication in both weavers and controls. It was found that the weavers had a more severe form of the disease with a rate of 15.16% suffering from generalized type without complication and 3.30% with complication such as Varicose ulcer (5 cases), oedema (4 cases) and pigmentation (6 cases). The controls on the other hand, had only 3.06% suffering from the generalized type and non with complication. The differences were statistically significant $P<0.001$).

Discussion and Conclusion

The present finding clearly support all previous observations that works requiring constant standing tend to cause Varicose Veins (4, 6, 7, 8) and the disease so developed is due to inadequate functioning of peripheral venous heart resulting from inadequate contraction of leg muscles and continued strain induced by prolonged standing. Furthermore, this study indicates that the length of employment has significant effect on the incidence and severity of the disease.

In conclusion the incidence of Varicose Veins among workers may be substantially reduced if prolonged standing during working hours is prevented by using ergonomically designed seats and paying more attention to detect minor abnormalities during medical

Table 3. Prevalence of varicose veins by length of employment and age in weavers.

Age groups (years)		Length of employment (years) <9	10–19	20–29	30+	Total
<29	N	320	162	–	–	482
	X	35	24	–	–	59
	%	10.94	14.81	–	–	12.24
30–39	N	44	432	78	–	554
	X	8	88	26	–	122
	%	18.18	20.33	33.33	–	22.02
40–49	N	20	292	172	44	528
	X	4	83	72	28	187
	%	20.00	28.42	41.86	63.64	35.42
50 +	N	–	50	48	80	178
	X	–	15	21	51	87
	%	–	30.00	43.75	63.75	48.88
Total	N	384	936	298	124	1742
	X	23	216	134	82	455
	%	5.99	23.08	44.97	66.13	26.12

N = Number of workers examined.
X = Number of workers with varicose veins.

Table 4. Severity of varicose veins measured by their extent and complication in the weavers and controls.

Groups	No. of workers with varicose veins	Unilateral		Bilateral		Generalized Without complication		Generalized With complication	
		No.	%	No.	%	No.	%	No.	%
Weavers	455	97	21.32	274	60.22	69	15.16	15	3.30
Controls	98	57	58.16	38	38.78	3	3.06	0	0

examinations.

References

Lake, M., Pratt, G.H., and Wright, I.S. (1942). Journal of the American Medical Association, 119,696.

Howard, J.B. (1966). The Epidemiology of Varicose Veins in an industrial population, M.D. Thesis, Yale University, U.S.A.

Dodd, H., and Cockett, F.B. (1956). The pathology and surgery of the Veins of the lower limb, P. 3 Edinbugh, Livingstone.

Mekky, S., Schilling, R.S.F., and Walford, J. (1964). Varicose Veins in women cotton workers, British Medical Journal, P. 591.

Ministry of Pensions and National Insurance (1962). Report, London, H.M.S.O.

Askar, O., and Emara, A. (1970). Varicose Veins and Occupation, J. Egypt Med. Asso. P. 341-350.

Burkitt, D.P. (1972). Varicose Veins, Deeps Vein Thrombosis, and Haemorrhoids: Epidemiology and Suggested Aetiology, British Medical Journal, 2.556.

Mencik, M., and Naus, A. (1970). A study in the influence of occupation upon the health conditions of a groups of shop assistants and restaurant personnel. Occupational Safety and Health series No. 25. ILO, Geneva.

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EVALUATION ON MASS SURVEY OF GASTRIC DISEASES IN INDUSTRY

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In view of the increased deaths from adult diseases in this country in recent years, mass screening of industry workers for adult diseases has become very important, though substantial part of the workers are composed of young people. So in the present investigation, how such screenings to detect adult diseases were being conducted in industry was surveyed through a questionnaire. Further, based on the results of mass screening for gastrointestinal diseases, which is most commonly conducted to detect gastric cancer, the most frequent neoplastic disease, a model population was comparatively studied against an equivalent hospital patient group.

The subjects of the present investigation were selected 1412 industrial establishments all over the country, of which 480 returned their answers and the retrieval rate was 33.99%.

Fig. 1 shows whether mass screening for adult diseases was conducted or not in these 480 establishments according to the number of the employees. Of the 480, 320 or 66.7% conducted the screening. As analyzed by the number of the employees, establishments that had conducted the screening constituted 40.8% of those with less than 50 employees, 69.8% of those with 50-99 employees, 79.6% of those with 100-499 employees, and nearly 100% of those with 500 or more employees, thus, the larger the establishment, the better the mass screening assured.

Fig. 2 shows what kind of diseases were the target of the screening. Of the 320 establishments, gastrointestinal diseases were looked for in 309 or 96.6%, cardio-vascular diseases and hypertension in 313 or 97.8%, diabetes mellitus in 201 or 62.8%, and other adult diseases in 68 or 21.3%. The target diseases were sometimes screened for in such combina-

No. employees	No. establishments	Screening conducted	rate in%
~ 49	211	86	40.8
50~ 99	43	30	69.8
100~ 499	49	39	79.6
500~ 999	35	35	100
1000~1999	50	50	100
2000~2999	28	27	96.4
3000~3999	14	14	100
4000~4999	4	4	100
5000~	28	28	100
Unknown	18	7	38.9
Total	480	320	66.7

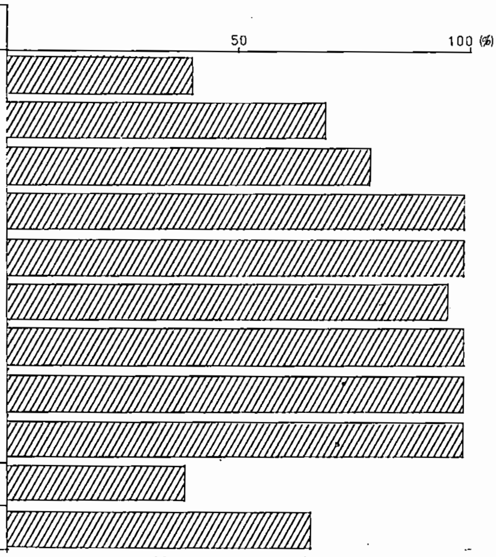


Fig. 1. Mass screening for adult diseases conducted

Items of Screening	No. establishments	%
Gastrointestinal (G.I.)	309	96.9
Cardiovascular & hypertension (Cir)	13	97.8
Diabetes Mellites (Diab)	201	62.8
Others	68	21.3
(G. I.) + (Cir)	302	94.4
(Cir) + (Diab)	201	62.8
(G. I.) + (Diab)	198	61.9
(G. I.) + (Cir) + (Diab)	198	61.9

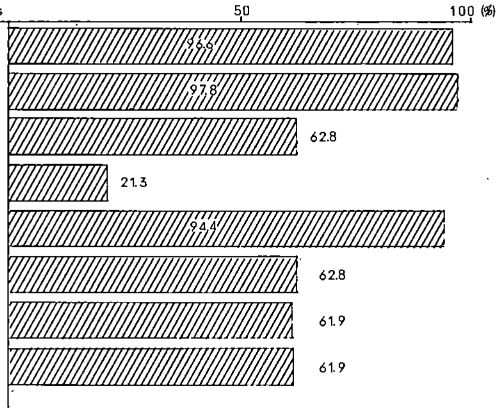


Fig. 2. Diseases examined for in mass screening

Diseases	Cases: Males	Cases: Females	Cases: Total	%
Gastric Ulcer	170	25	195	3.12
Duodenal Ulcer	263	30	293	4.68
Gastroduodenal Ulcer	35	3	38	0.61
Gastric cancer	21	1	22	0.35
Gastric polyp	18	5	23	0.37
Erosive gastritis	6	4	10	0.16
Gastric diverticulum	3	–	3	0.05
Hiatal hernia	18	3	21	0.34
Esophageal diverticulum	12	4	16	0.26
Duodenal diverticulum	31	5	36	0.58
Calcification in abdomen	15	11	26	0.41
Extragastric compression	8	3	11	0.18
Normal			5.566	
			6.260	

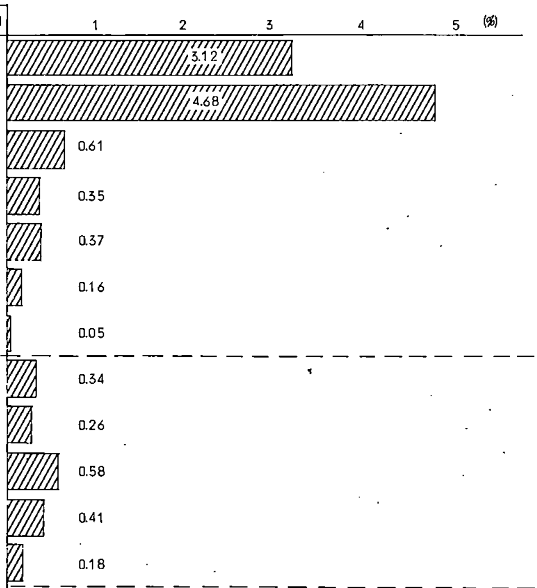


Fig. 3. Results of mass screening and diseases found

tions as follows: gastrointestinal and cardio-vascular diseases and hypertension in 302 establishments or 94.4%, cardio-vascular diseases, hypertension and diabetes mellitus in 201 or 62.8%, gastrointestinal diseases and diabetes mellites in 198 or 61.9%, and gastrointestinal and cardio-vascular diseases, hypertension and diabetes mellitus in 198 or 61.9%.

Thus, gastrointestinal mass screening is most frequently conducted to detect gastric cancer in its early stage, but in industry which includes relatively young people, mass screening should be so organized as to control benign diseases, not to speak of the early detection of gastric cancer.

The speaker and my colleages have carried out gastric mass screening on truck drivers since 1970 in order to detect gastric cancer in its early stage. Fig. 3 shows the diseases found through the screening over 5 years starting 1972. Gastric cancer was found in 22 cases or 0.35%, gastric ulcer in 195 or 3.12%, and duodenal ulcer in 293 or 4.68%. These morbidity rates are fairly high and the diseases must have had

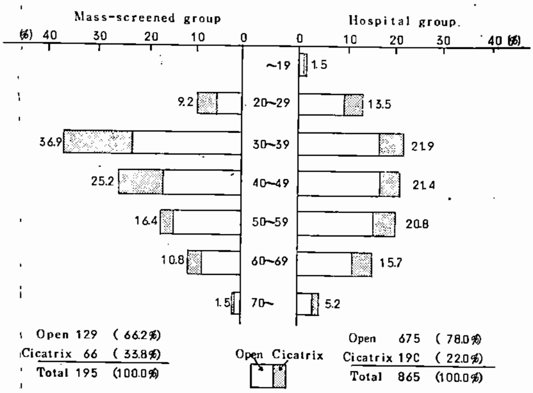


Fig. 4. Age distribution of gastric ulcer patients

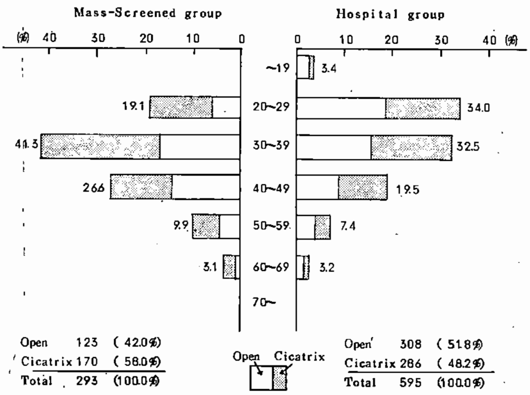


Fig. 5. Age distribution of duodenal ulcer patients

an unnegligible influence over the work done by the affected people.

On the other hand, mass screening for peptic ulcer was carried out on the patients to the Department of Gastrointestinal Diseases, Nihon University Hospital (to be abbreviated as the hospital group) during the same period.

Fig. 4 shows the age distribution of gastric ulcer patients. A similar pattern of distribution was found with the mass-screened and the hospital group, with a peak at the ages between 30 and 39 years old.

Fig. 5 shows the age distribution of duodenal ulcer patients. Here, again, both groups had a similar pattern of age distribution. Cicatrical ulcer was significantly more frequent than gastric ulcer (P<0.01).

Fig. 6 shows the endoscopic findings of the ulcer at the initial examination. Both groups gave similar findings. Cicatrization was significantly more frequent in duodenal ulcer (P<0.01).

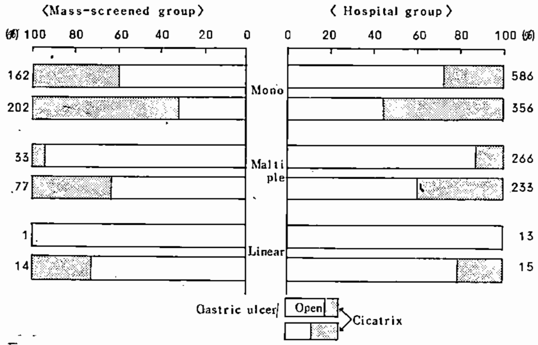
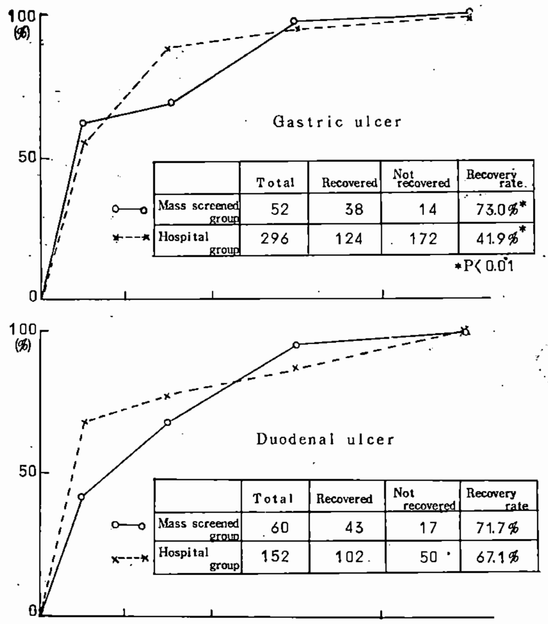


Fig. 6. Incidence of open and cicatrated cases detected by initial endoscope



	Total	Recovered	Not recovered	Recovery rate.
Mass screened group	52	38	14	73.0%*
Hospital group	296	124	172	41.9%*

	Total	Recovered	Not recovered	Recovery rate
Mass screened group	60	43	17	71.7%
Hospital group	152	102	50	67.1%

Fig. 7. Recovery Rate and Duration of Recovered Health.

Fig. 7 shows the recovery rate for the cases followed up for three years and the duration of recovered health for those recovered. the recovery rate of gastric ulcer was 73.0% for the mass-screened group, which was significantly higher than 41.9% for the hospital group (P<0.01). But the duration of recovered health was similar in both groups. The recovery rate of duodenal ulcer was 71.7% for the mass-screened and 67.1% for the hospital group, the difference was insignificant. The duration of recovered health was not much different between the two groups.

Fig. 8 shows the relapse rate for the two groups. The relapse rate of open gastric ulcer

Table 1. Operation rate and fatal cases by follow up study

	No. ulcers	No. operations	No. (Operations no. ulcers)	Deaths
Mass-screened	67	16	23.9%	0
Unscreened	575	151	26.3%	2

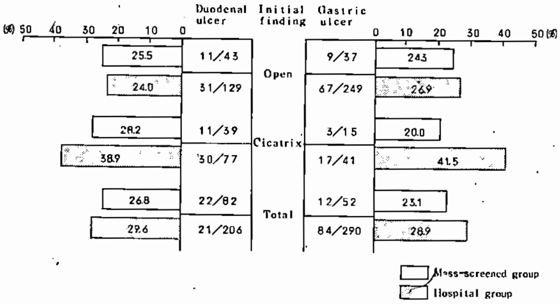


Fig. 8. Relapse rate by Nature of Ulcer

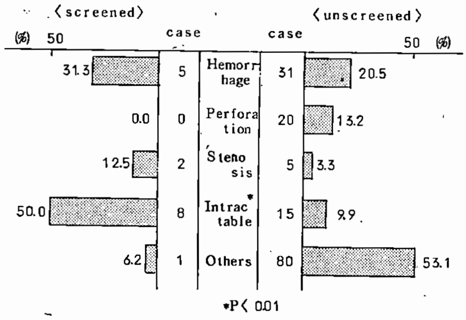


Fig. 9. Direct cause of operation.

was 24.3% for the mass-screened group and 26.9% for the hospital group. Relapse starting from the cicatrix was seen in 20.0% of the mass-screened group and 41.5% of the hospital group. When summed up, the total relapse rate was 23.1% for the former and 28.9% for the latter. The cicatrix relapse rate was significantly higher in the latter ($P<0.01$).

As for duodenal ulcer, the relapse rate of open cases was 25.5% for the mass-screened group and 24.0% for the hospital groups; the cicatrix relapse rate was 28.2% and 38.9% respectively, so the total relapse rate of duodenal ulcer was 26.8% for the mass-secreened and 29.6% for the hospital group, and the difference was insignificant.

Next, the ratio of operated cases was compared between the mass-screened group and patients with gastric or duodenal ulcer found by other means than mass screening (unscreened group). It is ulcer that causes the sufferer to stay out of his job that gives a direct loss to the industry. As seen in Table 1, the operation rate was 23.9% in the mass-screened group and 26.3% in the unscreened group. The difference between the two groups was insignificant, but two of the unscreened cases ended in death. The direct cause of operation was as shown on Fig. 9. Perforation was present in none of the mass-screened group but in 20 (13.2%) of the unscreened group. The ulcer was intractable in 8 cases of the mass-screened group (50.0%) but in 15 of the unscreened group (9.9%), the incidence being higher in the former ($P<0.01$).

Conclusions

1) The questionnaire survey revealed that mass screening for adult diseases was carried out in 66.7% of industrial establishments. It was found that, the larger the establishment, the more the opportunity of receiving mass screening by the employees. The diseases that tended to be the target of the mass screening were gastrointestinal and cardio-vascular diseases and hypertension.

2) The ulcer detected by industry mass screening has a higher recovery rate and a lower relapse rate from the cicatrix. The operation rate did not differ significantly between the mass-screened and unscreened group, but in ulcers detected by other means than mass screening, operation on account of perforation was more frequent and two fatal cases were experienced. These facts suggest that ulcer in this group was sometimes too far advanced to be treated effectively. Thus it is clear that early detection of ulcer through mass screening and its subsequent control is essential.

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SOME FINDINGS FROM WORKERS EXPOSED TO HARMFUL ENVIRONMENT

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For this work, our Gyeongbug Branch and this Gyeongbug Industrial Health Institute of Korean Industrial Health Association (KIHA) are occupied two rooms of Medical School of Kyungpook National University, KNU, Daegu city, under the care of industrial health professors, and these two organizations co-operated directly or indirectly for promoting activity of industrial health study, through the mass survey and the other available ways.

It was begun from February 26, 1976, when President of KIHA and Dean of the Medical School of KNU joined hands and made a letter of agreement with for the work in Gyeongbug area.

This is the results of the proceeding of the industrial health project in Daegu and vicinity area, during three years, 1976 to 1978.

Subject and Method

The coverage area for this study is Daegu city and vicinity nine Guns (counties).

They are generally characterized by textiles and wearing apparel.

The rate of subject exposed to somewhat harmful environment was about 47.2% of them in 1976 but it was reduced to about 40.4% in 1978; about 7% were reduced. However, we could designate that our actual numbers of subjects were increased about 102,000 more.

According to Labour's Law, our travelling clinic had been visited the industries consulted to check the occupational health conditions of the employees exposed to harmful environment since 1976.

Authorized doctors who participated in this task were three boardmen for preventive medicine.

And also two technicians — one for clinical pathology and another for radiology, and one nurse attended to this task.

Within the first quarter of period every year, the location and the role of our mobile survey team were informed to pertinent industries through the mail.

When this team was called from the employers by telephone or a message, the mobile clinic moved to the industry. Only, physical examination of employees working in harmful environment and the investigation of the operating circumstance were carried out. And various clinical materials such as blood and urine were immediately transferred to the Laboratory of the Department of Preventive Medicine, KNU except simple testing materials which could be treated on the spot. If there were a small number of the relevant labourers, we guided in order that they have to come to see our Institute. The checking forms defined in the rule (No. 186 confirmed by the Labour Department in 1976) were used.

Results

The number of the visited and examined industries out of 1,707 registered in the Daegu Labour Office is 76 (4.5%) in the first year. The examination rate of labourers who exposed to harmful environment is increasing in a trend yearly; 35.7% in the first year, 43.1% in the second year and 55.6% in the third year. And the general prevalence including occupational and non-occupational diseases is 30.4%, 33.9% and 33.7% during three years, respectively. It is about one third in average of the total examinees.

And those who had to keep some attentions for their industrial health are 21.3%, 24.3% and 26.5%, respectively in the same period. It is just like gradually increasing (Table 1).

The findings related to their occupation are just only 4.6%, 8.5% and 6.5%, respectively. And the non-occupational findings are 3.6%, 1.3% and 0.7%, respectively. The former is slightly increasing but the latter is gradually decreasing.

The rate of complaints related to occupation is not significant in both sexes. The rates of those who have to keep awareness are higher in female to male; 2:1, 3:2 and 3:2 in ratio by years. But the rates of non-occupational complaints are conversely lower in female to male; 1:3, 1:3 and 1:20, respectively (Table 2).

Considering the environmental factors, the cases of C_5-dip (60dB) diagnosed from noise-workers exposed to 90dB and more accounts for six percent in the first year, 9.9% in the

Table 1. Examined rate of industries and the employees, and rate of findings from them, by yearly health examination for occupational diseases in the establishment during three years, 1976–1978

Calendar year		1976	1977	1978
Total industries		1,707	(2,440)*	3,173
Examined	(E)	76	296	134
Rate, %	(ER)	4.5	12.1	4.2
Total employees	(EI)	19,041	38,138	32,403
The exposed to harmful	(A)	8,994	20,161	13,083
Rate, % of A	(AR)	47.2	52.9	40.4
Examined employees	(B)	3,209	8,679	7,275
Rate, % (B/A X 100)		35.7	43.1	55.6
Complaints No.	(C)	974	2,946	2,450
Rate, % (C/B X 100)		30.4	33.9	33.7
Needed careful attention	(AT)	713	2,112	1,930
Rate, % (At/B X 100)		22.2	24.3	26.5
Occupational	(OC)	149	733	470
Rate, % (Oc/B X 100)		4.6	8.5	6.5
General	(G)	114	101	50
Rate, % (G/B X 100)		3.6	1.2	0.7

* Mid-number of 1,707 and 3,173.

Table 2. Sexual frequency distribution of complaints and the cases needed somewhat careful attentions in relation to their occupations

Items	1976			1977			1978		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
The examined	1,486	1,723	3,209	2,908	5,771	8,679	2,497	4,778	7,275
Complaints related to occupation	72 4.8%	77 4.5	149 4.6	161 5.5	572 9.9	733 8.5	158 6.3	312 6.6	470 6.5
Needed careful attention	194 13.1%	490 28.4	684 21.3	495 17.0	1,617 28.0	2,112 24.3	512 20.5	1,418 29.7	1,930 26.5
Non-occupational complaints	83 5.6%	31 1.8	114 3.6	63 2.2	33 0.7	101 1.3	44 1.8	6 0.1	50 0.7

Table 3. Prevalence of findings by calendar years

Items	1976			1977			1978		
	Examined	Findings	%	Examined	Findings	%	Examined	Findings	%
C_5-dip (more 60dB)	2,010	121	6.0	7,292	724	9.9	5,708	429	7.5
Complaints by solvents	203	28	13.8	573	9	1.6	567	21	3.8
1) Pulmonary tbc.	378	21	5.6	960	15	1.6	889	22	2.5
2) Respiratory	751	3	0.4	1,856	4	0.2	1,756	NC	
3) Eyes	170	4	2.4	323	NC		300	NC	
4) E.N.T.	2,010	23	1.1	7,292	30	0.4	5,708	NC	
5) Hypertension	1,199	19	1.59	1,387	27	1.95	1,567	10	0.64
6) Anemia	203	36	17.8	573	2	0.4	567	NC	
7) Sugar in urine	372	1	0.27	896	3	0.34	867	15	1.73
8) Proteinuria or pyuria	373	7	1.88	896	3	0.34	867	3	0.35

NC: means no check. 1), was checked from dust-workers. 2), from solvent-and or acid-alkali- or dust-workers. 3), from acid-and or alkali-workers. 4), from those who were exposed to noise. 5), from all workers except those who exposed to noise. (Over 100mmHg in diastolic and 150mmHg in systolic). 6), from those who handled various solvent (Defined as Hb, below 14g% in male and 12g% in female.) 7) and 8), from those who handled solvents and acid-and or alkali-workers (It was tested by labstix made in the Mistomo, Japan).

second and 7.5% in the third. The rates of somewhat findings from those who exposed to various organic solvents are 13.8%, 1.6% and 3.8%, respectively (Table 3).

The rate of pulmonary tuberculosis from dust-workers are 5.6%, 1.6% and 2.5%, respectively. The rates of upper respiratory findings from dust-and inorganic solvent-workers are 0.4%, and 0.2%, respectively, but not detected in 1978. The rates of ENT-findings except C_5-dip are 1.1% of 1976 and 0.4% of 1977, and hypertensive cases are 1.59% of all workers except noise-workers in 1976, 1.95% in 1977 and 0.6% in 1978. The anemia cases detected from the solvent-workers is 17.8% in 1976 and 0.4% in 1977. The cases of glucosuria from organic solvent-workers are 0.27%, 0.34% and 1.73% by years, respectively.

Anemia cases are gradually reducing from year to year, but the cases of glucosuria are conversely increasing. The cases of genito-urinary diseases are 1.88% in 1976, 0.34% in 1977 and 0.35% in 1978.

The highest prevalence on the kinds of working type is generally revealed in the manufacturing company of 19-hole-coal. And the textiles, the transport equipment, the fabricated metal products-machinery and equipment- and the basic metal are following in order. The others are more or less similarly arounding in about 5%. But it is rapidly reducing in the Corporation of Refining of Tungsten, one of the nationalized industries, year by year. The prevalence of occupational hearing loss in the screening test is highest in the textiles in spite of the grade of C_5-dip was checked up in the rule with 60dB as hearing range on audiogram, which leveled up from 40dB of the sound pressure for 4,000 Hz.

The other prevalence regarding to occupation are not reducing in the basic metal, the fabricated metal product—machinery and equipment, and the rubber. And it is rather increasing in the transport equipment (Table 4).

Discussion

The first task of Gyeongbug Branch of KIHA started from 1965 was successful in the general physical mass examination only in the large-scaled industries having 1,000 or more of employees, in spite of intense competition with local physicians of non-specialist for preventive medicine and industrial health. After then, the authorities of Gyeongbug Branch had to give

Table 4. Percent distribution of physical findings according to sorts of works

Sorts of works	Findings by calendar year								
	Occupational			Non-occupational			Total		
	1976	1977	1978	1976	1977	1978	1976	1977	1978
Refining of tungsten	5.6%	0.4%	–%	5.0%	0.4%	0.3%	10.6%	0.7%	0.3%
Textiles	5.0	10.4	8.0	0.7	0.5	0.04	5.7	10.9	8.0
Wood product	14.2	–	1.3	–	–	1.4	–	–	2.7
Paper product	–	–	–	–	3.4	–	–	3.4	–
Printing	6.0	–	5.3	6.9	1.3	0.8	12.9	1.3	6.1
19-hole-coal manufacturing	1.1	11.1	–	22.8	55.6	–	23.9	66.7	–
Basic metal	3.6	3.8	2.3	7.7	1.0	2.8	11.3	4.8	5.1
Fabricated metal product									
Machinery and equipment	2.3	2.2	3.3	12.6	3.8	2.0	15.0	6.0	5.3
Transport equipment	–	1.8	4.0	–	5.2	3.9	–	7.0	7.9
Chemical	–	2.0	1.0	–	1.9	4.7	–	3.9	5.7
Rubber	–	5.1	5.1	–	2.6	–	–	7.7	5.1
Ceramic product	–	–	2.7	–	8.5	1.4	–	8.5	4.1
Others	–	6.5	2.3	–	1.6	1.0	–	8.1	2.3
Total	4.6	8.4	6.2	3.6	1.0	0.6	8.2	9.4	6.8

up the task whether for detection of occupational or non-occupational diseases in the early years of 1970s. There were not only shortage of enough budget and the specialized staffs but also many unreasonable matters. And it was begun again from 1976 by our team under the encouragement of the president of KIHA and the moral support of authorities of the Daegu Labour Office.

However, this task is different in character from the past task; the objectives of the present task are early diagnosis of occupational diseases, and evaluation of industries in a view of industrial health and medicine etc., through mass survey for occupational diseases and investigation of the operating environment. Here, many problems lay in the base line, such as the resistance of employers with the lack of understanding on the industrial health and spiritual concentration on saving time and money, less positive attitude of doctors temporally contracted with employers for industrial health, and employees' negligence for their health, etc.. Accordingly, we consider the advance or failure of this task depends on the supervisers' activity of the areal Labour Office.

The industries regularly conducted health examination of employees under the self-regulation are only a few large-scaled. During three years for study, the rate of industrial mass examination under the supervisions of the Labour Office is only about five per cent of all the registered industries. This unprogressive result suggests or designates the dark sense for the preventing task of occupational disease in future, and points out the less positive ways of thinking of employers and leaders of the labour union.

Out of the yearly prevalence in relation to occupations, that of 1977 is highest as 12.1%, because it was introduced from the strict supervision of the Labour Office. We know that the enforced official message was sent to them, at least four or five items in 1977 in comparison of once or twice in common years when the supervisers' activities were concentrated on solving the employees' minimum weges; so called standardizing campaign for the wages of living base.

The workers in somewhat harmful environment were about 40-50% of total subject industries. It is similar result of Bai(1967) as 49.6% even if the number of subject employees were reported to Daegu Labour Office by the all registered employerselves. While the consulted workers for occupational health examination are smaller numbers than actual relevant employees, paticularly in the larger industries, but it is conversely rather higher in the smaller one.

In this study, the rates of examination for occupational diseases out of the registered number were 35.7% in 1976, 43.1% in 1977 and 55.6% in 1978. It is gradually increasing with about two times in comparison of 28.3% Bai (1967), and it means that the concept on industrial health control are changing toward health and well-being of employees, year by year, and there are of course gradually following of constituting of the marchinery automation in the large-scaled industries.

On the other hand, we have to say that it is a important program which the prevalence was not decreased and rather maintained as about one third of the total examined employees 30.4% in 1976, 33.9% in 1977 and 33.7% in 1978. Particularly in regarding to harmful environment, the hard of hearing in 4,000Hz, C_5-dip to the level of 40dB in sound pressure and abnormal signs from solvent-workers are slightly higher in rate as 27-35% and 1.6-13.8, respectively, than the results of Yoon (1967)-24.7% and 6.2%. But non-occupational diseases are gradually decreasing in tendency than that of Yoon(1967). Pulmonary tuberculosis is 5.6% in 1976 to 2.5% in 1978, the other respiratory diseases are 0.47% to 0.2%, the signs of ENT except C_5-dip are 1.1% to 0.4%, eye-signs are 2.4%, and hypertension is 1.59% to 0.64%. And Yoon's results of 1967 were 4.6%, 0.6%, 8.5%, 7.8%, and 7.7%, respectively. In investigation on the sorts of working, the highest prevalence is appeared in the manufacturing companies of 19-hole-coal. We suppose the reason was induced from that employers and employees belonging to the small-scaled industries were neglectful of their health. And the working style was also simple, so all workers directly exposed to black coal dust. And the fact of that the prevalence was not reduced in the textiles, in the basic metal, in the fabticated metal product-machinery and equipment, and the rubber, is remarkable in the future.

It is of particular importance that anemia cases were reduced 7.8% in 1976 to 0.4% in 1977, and the glucosuria cases were increased 0.27% in 1976 to 1.73% in 1978. It seems that it is a significant datum in comparison of Yoon's(1967) report as much as 5.9% of malnutrition. We wonder that such a phenomenon depends upon nutritional improvement of workers by campaign of minimum wages enforced by the Government from 1976.

In general, we obtained that the prevalence of occupational diseases is maintaining or rather increasing in tendency than before, but that of non-occupational diseases is decreasing in this survey. And the nutrition of the workers may be appeard in a good status.

Summary

This paper presents the role of a travelling clinic for occupational diseases at Daegu area in Korea during last three years. For this work in this area, the Gyeongbug Center of Industrial Health of the Korean Industrial Health Association was founded by making a letter of agreement with the School of Medicine, Kyungpook National University, Daegu, at February 26, 1976. Accordingly, a Travelling Clinic was staffed with a specialized physician for industrial health, a nurse, a clerk and two technicians-one for clinical pathology and another for radiology.

Total number of industries which had five or more employees, and which registered in Daegu Labour Office were 1,707 in the early of 1976, but increased to 3,173 in the end of 1978. And about 80% of them were located in Daegu city. About 50% of them were textiles.

In this situation, only about five per cent in average for three years from 1976 to 1978 were covered. Among workers who exposed to 90dB in noisy environment, the cases of the hard of hearing in 4,000Hz. C_5-dip are 27-35% on the level of 40dB in sound pressure, and 6 to 10% on 60dB. Abnormal signs from solvent-workers appeared in about 1.6%-13.8%. Pulmonary tuberculosis is 5.6% among the dust-workers in 1976 and 2.4% in 1978, and the other respiratory disease is 0.4% of them in 1976 and

0.2% in 1977. Hypertension is 1.59% in 1976 and 0.64% in 1978. And the signs of eye and ENT are 2.4% in 1976, and 1.1% in 1976 and 0.4% in 1977, respectively.

In investigation on the sort of working, the highest prevalence in regard to general diseases is appeared in the manufacturing company of 19-hole-coal, and in occupational diseases, in the textiles.

Generally, we can find out that the prevalence of occupational diseases is not fluctuant or rather gradually decreasing.

Particularly, one of facts that we have to pay an attention in the explanation of the health status among employees is decreasing anemia and increasing glucosuria. It may regard as a benifit of campaign to solve of minimum wages enforced by the government program from 1976. It means that the nutritional status of the workers appears to be better.

References

Bae, K.T. (1967): Industrial Health Management, Bul. Korea Indust. Med., 6(4): 107-122.

Economic Planning Board (1977): Statistical Year Book of Economic Planning Board, 1977.

Korean Industrial Health Association (1977): Status of Korean Industrial Health Association, The Health and Industry, 1:53-57.

Yoon, H.Y. (1967): Diseases of Workers, Bul. Korean Indust. Med., 6(4): 27-36.

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Session 14.

Diseases due to Noise and Vibration

HEARING CONSERVATION PROBLEMS IN AUSTRALIA

W. Hugh DENEHY, *Australia*

1. Introduction to Australia

Australia has a large land mass of 7.7 million square kilometers, there being six states, the Northern Territory, and the Australian Capital Territory.

The population as at December 1977 was 14.16 million. As is to be expected, the population is very widely distributed throughout the land mass, with marked concentrations in some States and in the Capital City of each State. From Appendix I it is readily seen how the population is concentrated in the Eastern States, New South Wales and Victoria, and the greatest concentration in the Capital Cities, namely Sydney and Melbourne. It is in these two Capital Cities that the majority of manufacturing is performed in Australia. There is manufacturing to a far lesser degree in Brisbane, Adelaide and surroundings, and one must not forget the mining operations in the State of Western Australia in the broad sense of industry. Another aspect to consider is that much of Australian manufacturing is performed in companies employing 50 or fewer personnel, and these have no medical coverage such as from a group occupational health service. Only the large corporations have an occupational health service and it is in such services that hearing conservation has been undertaken for a number of years. Several State Divisions of Occupational Health have for some years performed audiometry with mobile units to large and small industries, in particular South Australia and Western Australia.

2. Federal and State Dichotomy

Australia, with a Federal Government and a Government in each State as well, has the same

Appendix I. Australian population distribution – December 1977.

State	Population	Capital City	Population
New South Wales	4,900,000	Sydney	3,021,000
Victoria	3,800,000	Melbourne	2,604,000
Queensland	2,150,000	Brisbane	957,700
South Australia	1,283,000	Adlaide	900,400
Western Australia	1,210,000	Perth	805,700
Tasmania	412,000	Hobart	162,000
Northern Territory	109,500	Darwin	46,600
Australian Capital Territory	212,700	Canberra	196,500

Appendix II. Variations in maximum allowable exposure times.

Agency		85 dBA	90 dBA	95 dBA	100 dBA	105 dBA	110 dBA	115 dBA	120 dBA
Inter. Org. Standards 1963		2 hrs.	2 hrs.	50 min.	25 min.	16 min.	12 min.	8 min.	5 min.
O.S.H.A. 1974			8 hrs.	4 hrs.	2 hrs.	1 hr.	30 min.	15 min.	–
O.S.H.A. 1976 (Proposed)		8 hrs.	4 hrs.	2 hrs.	1 hrs.	30 min.	15 min.	3 min.	–
N.H.& M.R.C. Draft 1976 S.A.A.			8 hrs.	2.5 hrs.	50 min.	15 min.	5 min.	1.5 min.	–
Victoria	Regulations								
South Australia	"								
Queensland	"								
New South Wales	Draft		8 hrs.	2.5 hrs.	50 min.	15 min.	5 min.	1.5 min.	–
West Australia	"								
Tasmania	"								
N.H.& M.R.C. Draft 1976 Future S.A.A.		8 hrs.	2.5 hrs.	45 min.	15 min.	5.5 min.	1.5 min.	0.5 min.	–

problem as the United States of America prior to the advent of the Occupational Safety and Health Act (O.S.H.A.) of 1970. The United States has the Federal Act, where no such Act exists in Australia, the Regulations on occupational health being at State level, and under State control. The State Departments are guided by the various Codes of Practice and by the T.L.V.'s recommended by the National Health and Medical Research Council.

3. History of Sensorineural Deafness Criteria

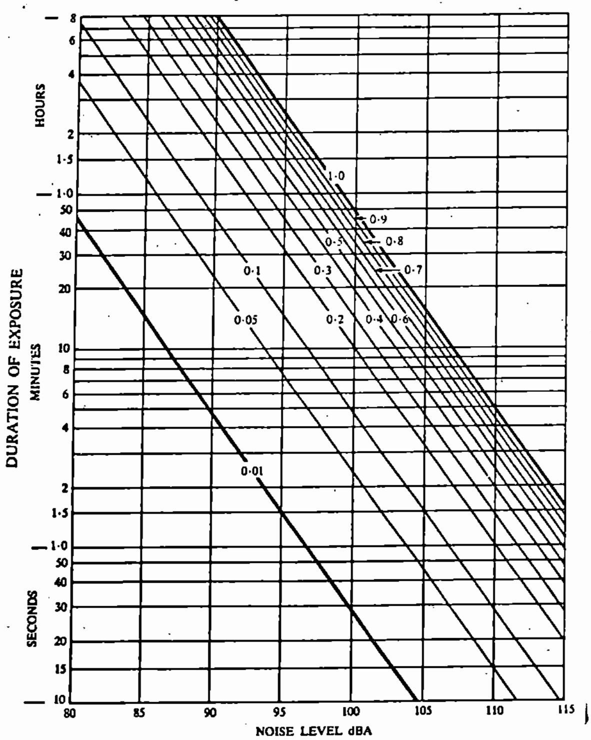
There is little value in surveying the general history of sensorineural deafness and boilermaker's deafness, as this is so well known. However, the criteria levels for noise exposure have varied over a period of years and it is interesting to examine the maximum exposure times allowed at various noise levels from different agencies, starting with the International Organisation of Standardization in 1963. Appendix 2 shows these variations. The National Health and Medical Research Council Model Regulations approved in October 1976 and the Australian Standard 1269-1976 from the Standards Association of Australia formed the basis for the current State Regulations for hearing conservation. Obviously, both agencies have examined the recommendations and regulations elsewhere and have endeavoured to produce a recommendation which not only is reasonable medically, but practical for industry. This, however, may be argued.

4. Description of National Health & Medical Research Council Draft Model Regulations and Standards Association Code

Appendix 3 shows the Daily Noise Dose Calculation Chart and this shows the levels to which people can be and cannot be exposed. The figure of unity is quoted and this is the

Appendix III.

Daily Noise Dose Calculation Chart



basis for current recommended exposures, in that at unity there can be exposure to a continuous noise level of 90 decibels A scale for eight hours per day, 95 dBA for 2½ hours per day, 100 dBA for 50 minutes per day, 15 minutes exposure for 105 dBA, 5 minutes for 110 dBA, and 1.5 minutes for 115 dBA without hearing protection.

The above recommendations are in the opinion of many occupational physicians reasonable and realistic. The National Health and Medical Research Council state that had the level been reduced to 85 dBA initially, Australian industry would have been unable to attain this level rapidly except with enormous expenditure. The National Health and Medical Research Council have furthermore recommended that within five years existing premises reduce their noise levels to the 85 dBA level for eight hours as the maximum. The cost of engineering noise reduction in Australia has not been given, but it obviously will be extremely great, as in Australia in 1978 the Medical Director of a large American corporation stated that the estimated cost of conforming to the 90 dBA limit in the United States was $13 billion and $41 billion if the level were reduced to 85 dBA.

There is a distinct variation in the approach to temporary threshold shift from the National Health and Medical Research Council and the Standards Association. In the former it is recommended that a minimum period of seven hours with an exposure of less than 80 dBA is sufficient for the performance of audiometry, but the Standards Association regard the minimum as 16 hours. Many exports in the field consider both periods too short and that a minimum of 24 hours, or preferably even 48 hours, is essential for initial audiometry. 48 hours is impractical in that audiograms would have to be performed in Australia on a Monday morning, after the weekend away from work. However, this raises further questions of external exposure which will be discussed later. For practical purposes, audiograms are performed at the commencement of the shift and this means that approximately 16 hours have elapsed from the end of the previous shift. We usually request no external exposure, e.g. shooting, motor mowers, etc., after the end of the previous shift. On the subject of temporary threshold shifts, it is obviously on many occasions much greater than what we really consider in the performance of audiometry, as it has been noted that several employees have been in a high noise level of drop forging, 110 to 114 dBA and wearing hearing protection, have shown an improvement in audiograms following a three to six months holiday out of the noisy environment.

The Regulations in Victoria, South Australia, Queensland, and draft regulations in New South Wales and Tasmania are almost replicas of the N.H. & M.R.C. draft model regulations. In the draft regulations from the State of New South Wales, is a requirement of communication devices where there could be problems in high noise areas. This is obviously an excellent theoretical approach and practical in some industries, but totally impractical in a drop forging area such as in my own company. The nature of the work in my company is such that repair and maintenance of communication devices would be totally out of all proportion.

5. Audiometry Training

In my home State, Victoria, there are four audiometry training programmes, only two of which are in the Capital City, Melbourne; the others are in provincial areas. In several other States training courses are available. Audiometry training is required under the Victorian State Regulations and the University of Melbourne Course was apparently designed by academics without consultation with occupational physicians practising in the field. There is a requirement of 24 hours training with nearly three hours on the use of sound level meters, dosemeters, and a further four hours on the practical use of these. In my opinion, this has nothing to do with audiometry and is an engineering function. Certainly within many corporations, and within my own, there are engineers who perform this work and provide the medical service with the required information.

6. External Exposure to Noise

While many workers in Australia have been exposed to high noise levels over a period of years in various industrial undertakings, a tremendous number have hearing loss which is unrelated to their present daily work. In the older age groups, many have had military service, as well as exposure to recreational shooting, and other noisy activities. One of the greatest concerns is the 16 to 18 age group who are applicants for apprenticeships. Many have been shooting wild rabbits and wild birds for recreation at weekends, riding trail motor cycles with open exhausts, driving tractors on farms on holidays and regularly attending pop concerts and discotheques. In these last modern music areas they are regularly exposed to levels of 110 to 120 dBA, and this applies in many other countries of the world. It has been found that stereophonic headphones for music provide high noise level exposure also. Reverting to the question of shooting, it is quite common for the participants to travel in excess of 300 km each way on weekends for this sport. Over the past four years in my own company, the apprentice intake at the age of 16 to 18 years has shown an incidence of early sensorineural deafness in approximately 30% of applicants. Of interest here, the majority have shown a loss at 6000 Hz and not 4000 Hz.

7. Workers Compensation

Comments in this area will be very brief, but sensorineural deafness is a compensible condition. In the State of Victoria, an employee with a total loss of hearing can receive the payment of $15,090, and a percentage of this total amount is paid for the varying degrees according to a formula from the National Acoustic Laboratories. Payment can be made for exposure to a noise level of less than the daily dose of 1.0 if the suggestion of undue susceptibility is made.

8. Audiometry within a Large Scattered Corporation

Within my own company we have geographical problems of performing audiometry, as shown on the slide. The manufacturing companies are spread from one side of the Melbourne Metropolitan area to the other, East to West and North to South. There is also manufacturing within the other States, but that can be dealt with by physicians and occupational health nurses. In the Melbourne Metropolitan area, we have established our own audiometric booths in major manufacturing plants and have recently commissioned a mobile unit, in charge of an occupational health nurse. The van body is soundproofed, has air conditioning, and an audiometric booth bolted to the floor. Other facilities are provided for first aid. The attenuation of the van body, and the booth in conjunction with the van body is shown in Appendix 4 and conforms to the Standards Association of Australia Code. For practical purposes, audiometry is performed on a continuous daily basis commencing early morning, and employees are required to wear heavy duty muffs with an attenuation of approximately 25 dB from the commencement of the shift and until the audiogram has actually been performed. The system seems to be working quite well. The form of recording in Appendix 5 consists of a two sided card with the information shown. For full assessment, information

Appendix IV. Audiometry requirements.

	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Maximum level under S.A.A. A.S.1269	52	35	15	14	29	36	28
Attenuation of van and booth	37	40	52	62	71	74	72
Maximum level allowable outside van	89	75	67	76	100	110	100

As a result of the above attenuation figures, the mobile unit is placed in a quiet area of each company, usually the warehouse; i.e. away from machinery noise.

Appendix V.

NAME .... ADDRESS ....

BIRTH DATE .... COMPANY .... COMMENCED ....

PREVIOUS EMPLOYERS TYPE OF WORK TIME

1. ____________________

2. ____________________

3. ____________________

4. ____________________

HISTORY OF EAR DISEASE YES ☐ NO ☐ FAMILY HISTORY OF EAR DISEASE YES ☐ NO ☐

		HOW OFTEN	DURATION	HEARING PROTECTION	
MOTOR MOWERS	YES/NO			HEARING PROTECTION	
SHOOTING – RIFLES/SHOTGUNS	YES/NO				YES/NO
ENGINES – CARS	YES/NO			MUFFS	YES/NO
– MOTOR CYCLES	YES/NO			PLUGS	YES/NO
TRACTORS	YES/NO			AT WORK	YES/NO
POWER BOATS	YES/NO			OUTSIDE WORK	YES/NO
POWERED MODEL AEROPLANES	YES/NO				
DANCES	YES/NO			TIME	
POP MUSIC	YES/NO			PROTECTION USED	
STEREO HEADPHONES	YES/NO				
OTHERS	YES/NO				

REPCO COMPANY NOISE EXPOSURE

YEAR										
DEPARTMENT										
MACHINE										
NOISE LEVEL										
CALC. NOISE DOSE										

AUDIO-GRAM	RIGHT							LEFT						
	25k	5k	1 k	2 k	3 k	4 k	6 k	25k	5k	1 k	2 k	3 k	4 k	6 k

COMMENTS/ACTIONS:

Appendix VI. Audiogram results.

Classifications:

C	=	catarrhal (conductive) loss
N	=	noise loss –
		(conductive and noise loss can be present together)
L	=	small loss – less than 30 decibels
M	=	moderate loss – 30 – 50 decibels
S	=	severe loss – 50 – 70 decibels
V.S.	=	very severe loss – greater than 70 decibels

Name	Previous Audiograms	Classification	Comments	Further Invest. Required	Prorection Required

is comprehensive covering previous employment, external exposure, use of hearing protection while working or indulging in recreational pursuits, the noise level of the machine worked, and provision for the daily noise dose obtained by the use of dosemeters. The latter will not be available until late 1979. Furthermore, eight serial audiograms can be recorded on the one card.

Consideration has been given to computerizing the audiogram results, as a basic classification for management purposes has already been devised. The classification is simple, concise, and easily understood, as in Appendix 6.

9. Hearing Protection

When assessing audiogram results and whether hearing protection is required, particularly in areas with a noise dose of less than 1.0 consideration is given to

(a) the age of the employee
(b) previous exposure at work
(c) present exposure at work
(d) external exposure.

Protection is provided where the noise dose in 1.0 or more under the following circumstances

(a) during the period prior to adequate engineering noise reduction
(b) if engineering noise reduction is not feasible.

Employees are given the choice of fitted ear plugs, or ear muffs. The decision on the particular brand was made after examination of attenuation figures and clamping force (of muffs) provided by National Acoustic Laboratory. For management guidance, a recommendation has been provided for ear muffs based on the simple classification into:

(a) heavy duty: 25-29 dB
(b) medium duty: 22-23 dB
(c) light duty: 15-21 dB.

To date, even in the drop forging plant, no instances have been brought to my notice of otitis external due to either ear muffs or ear plugs.

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VIBRATION DISEASE IN AN IRON FOUNDRY

Noriaki HARADA and Tadao MATSUMOTO, *Japan*

Introduction

About eighty years have passed since Loriga (1911) first reported Raynaud's phenomenon due to vibrating tool operation. Since then, various types of portable vibrating tools have been developed and introduced with the progress of industry. Subsequently, more than a few investigators have reported those tools to cause the vibration disease. In 1975, the working and health conditions of vibrating tool operators and control workers in an iron foundry were investigated. It became clear that vibration disease occurred frequently, especially in the workers operating chipping-hammers powered by compressed air, and that little had been done to remedy the situation. As a result, we instituted medical treatment for the afflicted workers, an improvement of working conditions in the foundry, and have performed annual medical examinations. In this paper, our experience gained in hygienic control for vibrating tool workers in this foundry is reported.

Subjects and Methods

This iron foundry, situated in Nagano city (altitude 420 meters), mainly produces molded boilers. Since about twenty-five years ago, a number of chipping-hammers and air-grinders have been used as finishing tools.

The first medical examination included fifty-four workers. Of these, thirty-three were using chipping-hammers or had used them before, thirteen were using the other vibrating tools such as air-grinders, sand-rammers or vibrators, and eight were control workers not using vibrating tools. Average age for each of these three groups was 45.0 (27-57), 48.2 (32-56), and 42.0 (33-56), respectively. Average years experience of using vibrating tools for the first two groups was 12.8 (1-24) and 12.1 (2-26), respectively.

Medical examinations consisted of an interview on subjective symptoms, several tests on upper extremities covering motor function, sensory function and peripheral circulatory function, and a physical examination. Motor function was observed by grasping power, pinching power and tapping test; sensory function was observed by vibratory sense threshold and pain threshold; and peripheral circulatory function was observed by skin temperature and hyperaemia time after nail press practice. In particular, sensory function and peripheral circulatory function were studied before and after immersion of left had in a cold water bath at 10°C for ten minutes.

Results of first investigation

The first medical examination and investigation of working conditions was conducted in March 1975.

As shown in Table 1, the chipping-hammer workers had many more subjective symptoms, both local and general complaints, than the control workers. Eighteen of the thirty-three chipping-hammer workers (54%) complained of Raynaud's phenomenon, and seventeen (51%) complained of finger numbness. In addition, arm heaviness, easy fatigability, hearing loss, forgetfulness, and hypersensitivity to cold revealed a high percentage of symptoms, which was statistically significant compared with the control workers. The incidence of subjective symptoms in the other vibrating tool workers was higher than those in the control workers, but lower than those in the chipping-hammer workers. In this group of thirteen workers, one complained of Raynaud's phenomenon.

Table 2 shows the rates of abnormal findings of three function tests in the upper extremities. Criteria for evaluating these tests have been partly reported already (Matsumoto et al., 1977). The rates of abnormal findings on vibratory sense threshold and pain threshold as a sensory

Table 1. Number of works with subjective symptoms.

Symptom		Chipping-hammer workers (%)	Other vibrating tool workers (%)	Control workers (%)
Local symptoms				
Finger	Raynaud's phenomenon	18 (54)**	1 (8)	0
	Numbness	17 (51)**	4 (31)	0
	Pain	5 (15)	1 (8)	1 (13)
Arm	Numbness	7 (21)	0	1 (13)
	Pain	6 (18)	1 (8)	0
	Heaviness	13 (39)*	2 (15)	0
Elbow	Pain	8 (24)	1 (8)	0
Shoulder	Pain	8 (24)	2 (15)	0
	Stiffness	19 (58)	5 (38)	2 (25)
Waist	Pain	16 (49)	8 (62)	4 (50)
General symptoms				
Easy fatigability		15 (45)*	2 (15)	0
Heavy-headedness		10 (30)	0	1 (13)
Hearing loss		15 (45)*	1 (8)	0
Forgetfulness		17 (51)**	2 (15)	0
Irritability		9 (27)	0	0
Hypersweating		12 (36)	1 (8)	1 (13)
Stomach trouble		8 (24)	2 (15)	0
Sexual disinclination		11 (33)	3 (23)	2 (25)
Hypersensitivity to cold		12 (36)*	2 (15)	0
Total		33 (100)	13 (100)	8 (100)

* $P < 0.05$, ** $P<0.01$: Statistical significance compared with control workers.

Table 2. Abnormal findings by the objective examination.

Examination	Chipping-hammer workers (%)	Other vibrating tool workers (%)	Control workers (%)
Motor function			
Grasping power	16 (49)	9 (69)*	1 (13)
Pinching power	3 (9)	2 (15)	0
Tapping test	16 (49)	2 (15)	2 (25)
Sensory function			
Vibratory sense threshold	10 (30)	1 (8)	0
Pain threshold	20 (61)**	2 (15)	0
Peripheral circulatory function			
Skin temperature	17 (51)	4 (31)	2 (25)
Nail press test	12 (36)*	3 (23)	0
Total	33 (100)	13 (100)	8 (100)

* $P < 0.05$, ** $P < 0.01$: Statistical significance compared with control workers.

function test, and on skin temperature and nail press test as a peripheral circulatory function test, were highest in the chipping-hammer workers, followed by the other vibrating tool workers. The rates of abnormal findings for grasping power and tapping test in the motor function test were higher in the chipping-hammer workers than those in the control workers.

Table 3 shows the distribution in the three groups of overall evaluation of medical examination. For the use of hygienic control as reference data, the total evaluation has five stages: (–) means no abnormal findings, (+) is presence of clearly abnormal findings of some functional tests or of Raynaud's phenomenon, (++) is presence of Raynaud's phenomenon and increased abnormal findings of functional tests, (±) is intermediate stage between (–) and (+), and (+++) means more aggrevated stage than (++). As shown in Table 3, all advanced cases judged (++) or (+++) belonged to the chipping-hammer groups; there were thirteen workers, an incidence of 39%, in this group.

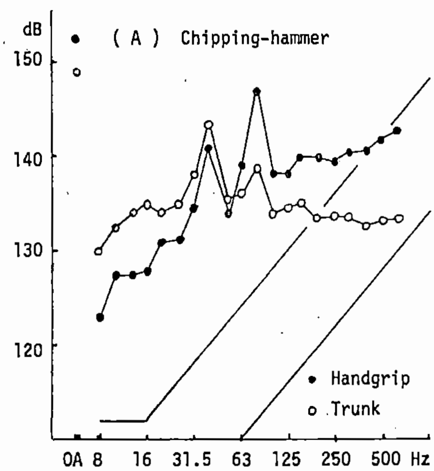
Table 3. Distribution of medical evaluation.

Stage	Chipping-hammer workers (%)	Other vibrating tool workers (%)	Control workers (%)
–	2 (6)	4 (31)	7 (87)
±	8 (24)	5 (38)	1 (13)
+	10 (30)	4 (31)	
++	6 (18)		
+++	7 (21)		
Total	33 (100)	13 (100)	8 (100)

The results of medical examination demonstrated that the chipping-hammer was the most injurious tool to the health of the operator in this iron foundry.

Fig. 1 shows the results of vibration analysis of the popularly used chipping-hammer in this foundry. This chipping-hammer weighed nearly four kilograms. It had a vibration acceleration level of approximately 150 dB (ref. 100 dB = 1 m/s^2, rms value), with peak frequencies at 40 Hz and 80 Hz, and surpassed the exposure limits proposed by ISO (1979). The noise level generated by this chipping-hammer was about 115 dB(C) at the ear position of operator, with peak frequencies between 500 and 2000 Hz, and also surpassed the exposure limit.

Average atmospheric temperature during the day in this foundry was –2 to 2°C in winter and 19 to 25°C in summer; the temperature inside this drafty structure was the same as in the open air. The actual working time was 420 minutes per day, including 180 to 210 minutes of chipping-hammer operation.



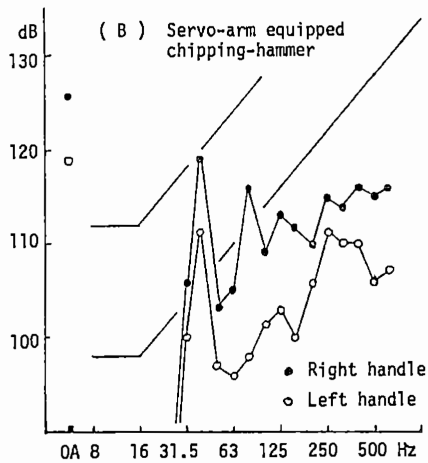


Fig. 1. Vibration acceleration level of chipping-hammer and servo-arm with third octave frequency analysis. Two curves show the exposure limits for 30 minutes (upper) and 8 hours (lower) per day without periodic rest proposed by ISO (1979).
100 dB = 1 m/s^2, rms value.

Countermeasures of vibration disease and change in medical findings

On the basis of the results of investigation in 1975, the following measures were taken to improve the working conditions of chipping-hammer operators and therapy for patients.

First, the operating time of vibrating tools, including chipping-hammer, was limited to two hours per day. The casting process was improved to diminish the flash that is object of chipping-hammer operation. For the purpose of reducing the vibration transmitted to operator, a servo-arm that has a servomechanism for the chipping-hammer was developed and introduced. As shown in Fig. 1, vibration acceleration level on the handles of the servo-arm was reduced by 20 to 30 dB compared with the chipping-hammer operated directly. The noise level of this mechanism was reduced to 95 dB(C), too.

Secondly, infrared lamps in the foundry and air curtains at the doorway were installed for keeping the chipping-hammer operating area warm. As a result of these measures, the corrected effective temperature in winter was raised by 4 to 5°C. Furthermore, a warm room was set up in the foundry for taking warmth during a rest period and protective clothing against the cold was provided.

Lastly, the workers who displayed health disturbances in medical examinations were treated by periodic visits to the clinic or extended hospitalization or alternated to a job without vibration exposure, according to this stage of disease. Clinic treatment with medicinal therapy and physical therapy, and hospital treatment with theraputic exercise in addition to these, were undergone during the cold season from November to April.

In order to estimate the effect of these countermeasures and to take data for hygienic control, annual medical examinations were conducted. The change in medical findings between 1975 and 1978 in nineteen workers, classified into three groups according to medical treatments received, is shown in Table 4. They had been using chipping-hammers at that time of the first medical examination in 1975 and were examined annually after that.

Improvement of Raynaud's phenomenon was observed in nine out of twelve workers (75%). Of this nine, Raynaud's phenomenon disappeared in three, but the others merely showed a decrease of attack incidence. Subjective symptoms other than Raynaud's phenomenon showed slight tendency for improvement. Of the functional tests, a tendency for improvement was recognized in sensory function and peripheral circulatory function, but not in motor function. In the total evaluation of nineteen workers, the number who showed an improve-

Table 4. Change in medical findings between 1975 and 1978.

Measure	Raynaud's phenomenon			Subjective symptoms except Raynaud's phenomenon			Motor function			Sensory function			Peripheral circulatory function			Total evaluation		
	↑	↔	↓	↑	↔	↓	↑	↔	↓	↑	↔	↓	↑	↔	↓	↑	↔	↓
Periodic visits to clinic		2	1	1	3	2	1	5			3	3		2	4		3	3
Job alternation and periodic visits to clinic	1		5	1	5	3		7	2		5	4		5	4		4	5
Job alternation and hospitalization			3	1	2	1	1	3		1	3			3	1	1	3	
Total	1	2	9	3	10	6	2	15	2	1	11	7		10	9	1	10	8

↑ = Aggrevation ↔ = No change ↓ = Improvement

ment, no change, and aggrevation were eight, ten, and one, respectively. Comparing three groups with different medical treatments showed that the workers with hospitalization, who were advanced cases, had less tendency to improve than the other two groups.

Discussion and Conclusion

The study of health conditions of workers using vibrating tools in an iron foundry clarified that health disturbance occurred frequently in the chipping-hammer operators. Vibration acceleration level of the chipping-hammer they operated sharply surpassed the permissible limit. This health disturbance, characterized by peripheral circulatory and sensory function disorders and various subjective symptoms, is considered to result from the transmitted vibration to upper extremities by chipping-hammer operation. The noise generated by the chipping-hammer also surpassed the exposure limit. In addition to affecting the hearing of operators, this noise is considered to induce vasoconstriction throughout the autonomic nerve and intensify the vibration disease. Furthermore, the cold environment in winter augmented by the drafty structure of this foundry, the situation at an altitude of 420 meters, and the cooling effect of adiabatic expansion of exhausted air from the chipping-hammer is also considered to intensify the vibration disease.

Health disturbances caused by the operation of vibrating tools in the cast metal industry have been pointed out previously by several other investigators, including Agate and Druett (1947) and Marshall et al. (1954). In spite of these reports, the fact is that no effective countermeasures for vibrating tool operators have been initiated and vibration disease patients are left as they are. In the foundry where we instituted hygienic controls, comprehensive measures were performed, including not only medical treatment but also improvement of working conditions. As a result, improvement of Raynaud's phenomenon, sensory function and peripheral circulatory function was observed in three years. However, it became clear that the course of recovery was not fast and some advanced cases showed less improvement after hospital treatment. This indicates the importance of hygienic control which enables vibration disease patients to have early diagnosis and treatment.

Furthermore, in order to eradicate the vibration disease in the cast metal industry, a drastic reform of the finishing process is necessary. Blasting machines such as hydroblast and shotblast have been introduced, but have not successfully substituted for chipping-hammers or air-grinders. The servo-arm reported in this paper makes an attempt to operate vibrating tools indirectly. For the reduction of vibration exposure to operator, further technical investigation and improvement is necessary.

References

Agate, J.N. and Druett, H.A. (1947) A study of portable vibrating tools in relation to the clinical effects which they produce. Brit. J. Industr. Med., 4: 141-163.

ISO/TC 108 (1979) Principles for the measurement and the evaluation of human exposure to vibration transmitted to the hand.

Loriga, G. (1911) Il lavora coi martelli pneumatici. Boll. Ispett, Lavoro 2: 35. Cited by Taylor, W. (1974).

Marshall, J., Poole, E.W. and Reynard, W.A. (1954) Raynaud's phenomenon due to vibrating tools. Neurological observations. Lancet 6823: 1151-1156.

Matsumoto, T., Yamada, S., Hisanaga, N., Harada, N. and Kaneda, K. (1977) On vibration hazards in rock-drill operators of a metal mine. Jap. J. Ind. Health 19: 256-265 (in Japanese with English abstract).

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VIBRATION HAZARD OF THE SWAGING MACHINE

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Introduction

Up to the present time, there exist numerous reports on vibration diseases due to vibrating tools. However, reports on vibration disease caused by machines which are not classified as vibrating tools are very scarce. In this paper my colleagues and I report on the vibration mechanism of the swaging machine, the exposure condition of workers exposed to the vibration, and the results of our investigation of vibration disease.

1. The nature of the work

The factory investigated manufacturers products such as piano strings and steel wires for construction processing hard steel. The first step involves the removal of scratches on the surface of the hard steel by a shaving machine. In the process, in order to be able to insert the hard steel into the shaving machine, the coils of hard steel must first be reduced to about 70% of their original size by beating a section from the end of coil to a point 1.5 meters. It is the swaging machine that performs this procedure.

This machine was developed at the factory in question. Figure 1 shows a cross section of the part of the swaging machine which produces the beat motion. Because of the centrifugal force of the backer, which is caused by the rotating motion of the parts in the figure shaded by oblique lines, the 8 outside rollers fixed on the outside of the machine are hit by the backer causing beat motion to the center and gives rise to the action of the dice by which a beat force of 18 tons is applied to the hard steel inserted in the center. The frequency of beats is 2100/min. Vibration of 35 beats per second results, and this vibration moves up from the inserted coil of hard steel to the worker's fingers, hands, forearms, elbow joints, and upper arms. A worker is exposed to this vibration 2 minutes for each coil of hard steel. This is the time required to insert and pull out the hard steel into and from the swaging machine and occurs once for every coil.

Figure 2 shows the position of the worker at the machine. If 30 coils are done in one day, exposure time is a total of 60 minutes. The work is done in rotating shifts (3 groups of workers, 2 shifts), one shift being 12 hours, and the exposure time to vibration per worker

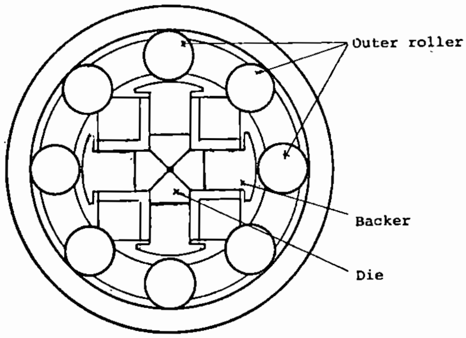

Fig. 1. Swaging machine

Revolutions per minute	350
Beats per minute	2100
Center height (cm)	90
Size (cm)	80x150x140
Weight (Kg)	2800

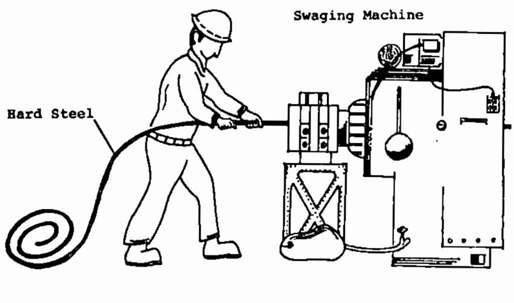

Fig. 2. Position for vibration exposure.

is 60 minutes. The factory is located in the city of Tokyo and the work is conducted indoors so that except for the work conducted during winter night shifts, problems involving cold temperatures are few. However, there is no heating system in the room where swaging machine work is done, and the workroom during winter night shifts is 10°C, causing workers to feel pain from the cold when they take hold of the hard steel coil. Compared to outdoor work done in cold temperatures, the effects of the cold may be small, but it is possible that the exposure to the cold during winter night shifts may be one of the causes of vibration disease in these workers. Previously the workers wore cotton or leather gloves on the job, but after becoming aware of the hazards of vibration, these were changed to thick gloves padded with cotton, which offer more protection against vibration.

2. Materials and methods

As indicated in Table 1, the subjects of the medical examination conducted were 5 male swaging machine workers with recognized Raynaud phenomenon, ages 35 to 39. Three of these workers had been working at the swaging machine for 5 years and the other two for 3 years. The average number of working days per month being 18 days, the vibration exposure time of the worker exposed the longest time is about 1000 hours and the work exposed the shortest was about 20 hours.

Peripheral circulatory function was observed by skin temperature, hyperaemia time after nail press practice, and plethysmography before and after immersion in cold water (5°C) for 10 minutes. Peripheral nerve function was observed by measuring pain in threshold and vibrating sense threshold before and after immersion in cold water. Motor function was studied by grasping power and finger tapping counts, and diagnosed by medical examination of fingers, hands, elbows and shoulder joints.

3. Results of medical examinations

Questioning the workers on subjective symptoms we found only local symptoms such as slight numbness of elbows, cold sensation in hands, and white fingers. As indicated in Figure 3, the extent of Raynaud phenomenon was greater among those workers with longer total exposure time to vibration. What all 5 workers had in common was that Raynaud phenomenon did not appear during the time spent at the swaging machine and that it was associated with cold stress. However, Raynaud pheonomenon could not be induced in any of the 5 workers by immersion in cold water.

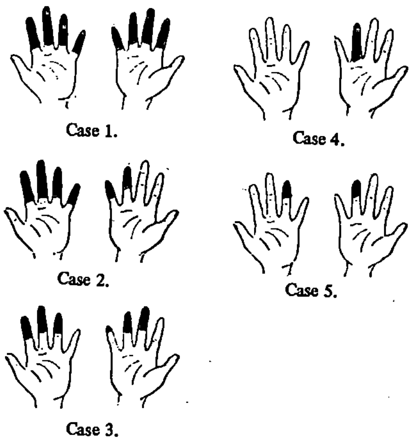

Fig. 3. Extent of Raynaud phenomenon.

Table 1. Subjects and histories of vibration exposure.

Subjects No.	Sex	Age	Duration of exposure (years)	Exposure time per day (minutes)	Total exposure time (hours)
1	Male	29	5	60	1080
2	Male	33	5	60	1080
3	Male	33	5	20	360
4	Male	34	3	20	216
5	Male	35	3	20	216

In the examination of the 5 cases, skin temperature, hyperaemia time, plethysmography, pain threshold and vibratory sense threshold were used to evaluate the degree of severity of vibration disease. These criteria are indicated in Tables 2 and 3. At present there are no officially recognized criteria so those used in this study are based on reports of researchers and data from our Occupational Health Service Center. In particular, the criteria of severity as seen by plethysmography after immersion in cold water was established using findings on chain saw workers made by our center together with the findings of the present study. The grade of severity was determined depending on the number of minutes. Flatt, Plateau and Arch waves were observed after immersion in cold water. Pulse waves indicating over 3 mV/v at room temperature were considered negative and those indicating below 3 mV/v were assigned a score of 1. Table 4 shows the scores of the workers obtained by these criteria.

Table 2. Criteria and scores for evaluating the degree of severity from examination results.

Examination	Score	At room temperature R-finger	At room temperature L-finger	Immediately after water exposure*	After 5 min.	After 10 min.
		less than				
Skin temperature (Celsius)	1	30	20	8**	25	28
	2	28	28	7	20	25
	3	26	26	6	15	22
		more than				
Hyperaemia time (Second)	1	2	2	3	2	2
	2	2.5	2.5	3.5	2.5	2.5
	3	3	3	4.5	3.5	3.2
		more than				
Pain threshold (gr; by weighted needle)	1	3	3	8	3	3
	2	4	4	11	5	4
	3	5	5	13	8	6
		more than				
Vibratory sense threshold (dB at 125 Hz)	1	10	10	20	15	10
	2	15	15	25	20	15
	3	20	20	30	25	20

* Water exposure: hands were immersed in 5°C water for 10 minutes.

** Skin temperature values are the average of the last 5 minutes during immersion.

Table 3. Criteria and scores for evaluating the degree of severity from flatt, plateau or arch wave of phethysmogram after immersion in cold water.

Indication of flatt, plateau or arch wave: Immediately after water exposure	5 min. after water expos.	10 min. after water expos.	15 min. after water expos.	Degree of severity
–	–	–	–	Normal
+	–	–	–	Normal
+	+	–	–	1
+	+	+	–	2
+	+	+	+	3

Table 4. The degree of severity from examination results of peripheral circulatory and nerve functions.

Subjects (case number)			1	2	3	4	5
Skin temperature	at room temperature	R.	2				1
		L.	3				1
	during water exposure		3	2	3	2	2
	5 min. after water exposure		3	3	2	3	3
	10 min. after water exposure		3	3	1	2	2
Plethysmogram	height of pulse wave		1				1
	shape of pulse wave		3	2	1		
Pain threshold	at room temperature	R.	2	1			
		L.	2	2			
	immediately after water exposure			3			
	5 min. after water exposure		1	3			
	10 min. after water exposure		2	3			
Vibratory sense threshold	at room temperature	R.		1	1		
		L.		2			
	immediately after water exposure		3	2	3		
	5 min. after water exposure		2	2			
	10 min. after water exposure		3	3			
Total of scores			33	32	11	7	10

Discussion

These cases clearly indicated vibration disease; however, the swaging machine is not included in the category of vibrating tools. I believe that these swaging machine cases are similar to work done at the grinding machine where the fingers, hands, and arms are exposed to vibration via materials which are held in the hands. The vibration of the hard steel caused by the beat motion of the swaging machine moves up through the fingers and hands to the arms giving rise to vibration disease, resembling the case of vibration exposure incurred in work done at the grinder. However, since the vibration of the swaging machine is caused by the beat motion of the dice it can be considered to resemble more closely the vibration of vibrating tools which have a hammering motion rather than the vibration of the grinder. Because the swaging machine was being remodeled at the time of the investigation, we were not able to measure the actual vibration of the hard steel. However, in *The Disease of Occupations* (1978), Donald Hunter notes:

> In 1918 Leahe, who worked with Alice Hamilton, recorded the vibration of stonecutters' hammers by a mechanical device which was the only method then available. He thought that 3500 beats per minute was dangerous frequency. . Since then, various workers have claimed that tool spreads of from 2,000 to 36,000 per minute were the dangerous ones.

Hunter and others (1945) found that vibration rates of from 2,000 to 3,000 per minute were the worst. As the swaging machine has 2,100 beats per minute I believe that vibration caused by this machine is hazardous to workers.

Next I will discuss severity of vibration disease and exposure time.

The scores as determined by the examinations are shown in Table 4. As seen in the table, those workers with longer exposure times indicate higher scores. The plethysmogram findings in particular drew our attention. Normal subjects indicate slight if any are Flatt, Plateau and Arch waves immediately after immersion in cold water. I believe that the fact that these workers indicated such waves after 5, 10 and even 15 minutes is directly related to vibration exposure. Furthermore, functional disturbance of the peripheral circulatory system was observed in all cases, but disturbance of the peripheral nervous system was noted in only two cases with long vibration exposure times. The vibration from the swaging machine has notable effect on the circulatory system and as has been reported a number of times, the degree of harmful effects are marked in those workers with long vibration exposure time. In the case of chain saw workers, Raynaud phenomenon appears after a handling time exceeding 1000 hours, but in our cases Raynaud phenomenon was noted after a total vibration exposure time of 200 hours. The reason Raynaud phenomenon occurred after a much shorter exposure time in our cases cannot be clearly ascertained but it is probably because work at the swaging machine is conducted continuously throughout the year regardless of season or weather conditions, plus the fact that the vibrating hard steel is grasped firmly thus increasing the effect of the vibration. In any case, it seems from these facts that, depending on the nature of the vibration and work procedures, Raynaud phenomenon can be incurred in an unexpectedly short period of vibration exposure.

When the procedure of insertion of hard steel into the swaging machine was mechanized, the workers were no longer exposed to vibration and the cause of vibration disease was completely eliminated. The taking of such a radical countermeasure eliminated the cause of vibration disease, but one reason countermeasures were not taken soon, before the victims actually incurred vibration disease, was because the swaging machine was not included in the category of vibrating tools. A second reason is that because exposure time to vibration being 2 minutes for each coil (30 coils/day) thus not exceeding 60 minutes per day, no one thought that vibration disease would result. A third reason is that Raynaud phenomenon did not appear during working hours but either while commuting to and from work, or at a cold place away from work. Thus it took time for the workers to realize that their exposure to vibration at the swaging machine was the cause.

Conclusion

1. Vibration disease caused by work at the swaging machine in 5 workers were reported in this paper.

2. The subjective symptoms were cold sensation of the fingers and hands, numbness of elbows, etc., and disturbance of peripheral circulatory function with Raynaud phenomenon as the main symptom and were observed in all 5 workers. The severity of the symptoms was marked in those workers with long exposure time to vibration, and disturbance of peripheral sensory function was noted in only two workers with long exposure times.

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REGIONAL DIFFERENCE, PHYSICAL CHECK-UP AND BALNEOTHERAPY OF VIBRATION SYNDROME

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Introduction

The vibration hazards such as damage to the circulatory system, nervous system, bone, joints and so on, have been recognized as a social problem in Japan, representing now an important problem as an occupational disease. This study was performed to clarify the factors concerning its appearance, by comparing five regions. It was investigated by medical examination methods and the diagnostic criterias, now used in Japan. Moreover, a follow-up study was carried out on the effects of therapy. And the obtained results were as follows.

Methods

This study was carried out on forestry workers in Hokkaido prefecture. Hokkaido is situated in the northern part and belongs to the cold region of Japan. The study on the medical examination methods and diagnostic criterias was performed to know the effectiveness of measured items related to the diagnosis by applying the discriminant function analysis. Subjects were placed in three groups, the first group was the control (25 persons), the second group had the cases of disorders due to vibration (33 persons), and the third group was of normal persons who use vibrating devices. Then, the follow-up study was made on the effect of medical treatment with 15 persons who have disorders due to vibration. The above mentioned items were measured before and after the balneotherapy for a period of four weeks.

Results and Discussion

The incident rates of vibration disorders were as follows. Obihiro region was found to show the highest level 42.6%, followed by 23.1% and 22.7% in Sapporo and Kitami regions respectively with 11.5% of Asahikawa region having the lowest. This signifies that Hakodate, situated in a wamer region does not show the lowest rate, nor the highest rate is found at Kitami, which is a colder region. It seems therefore, that among these regions, cold environment has no especially important meaning.

Comparing Group II with the other groups, the results revealed no significant differences as to skin temperature and nail press test, while significant differences were recognized regarding pain sensation, vibratory sensation, and pinching power test.

The higher F-value in the formula of discriminant function indicates the more effective item for discrimination. The higher F-value were obtained in; nail press test at 10 minutes after immersion in cold water ($F=32.8739$); pain sensation ($F=16.7602$, 29.9928, and 29.8962 respectively at just before, immediately after, and 5 minutes after cold immersion); vibratory sensation ($F=13.5329$, not-dominant hand); and pinching power ($F=27.7928$, dominant hand).

Table 1. shows the coincident ratio which is the percentage of disordered (or normal) judged persons by the actual medical examinations. The coincident ratio in Group I was 92.0%. In Group II, with the coincident ratio of 84.8%, actual disordered persons were judged to be disorder with such percentage by the discriminant function analysis. It is emphasized that the application of discriminant function analysis was very useful.

Regarding the follow-up study, the balneotherapy consisted of: hot spring bath treatment, functional training gymnastics, hot pack, paraffin bath, and drug therapy. In the case of skin temperature, just before cold immersion, with 29.28°C and 31.29°C at the time of entering and leaving the hospital respectively, an improvement of 47% was shown, a statistically significant improvement. The significant difference be-

Table 1. The coincident ratio between the discriminant function analysis and the diagnosis by the actual medical examination (Diagnosis coincident ratio).

Actual diagnosis \ Prediction	Number of persons	Group I	Group II	Group III
Group I	25	23	2	0
		92.0%	8.0%	0.0%
Group II	33	2	28	3
		6.1%	84.8%	9.1%
Group III	25	0	0	25
		0.0%	0.0%	100.0%

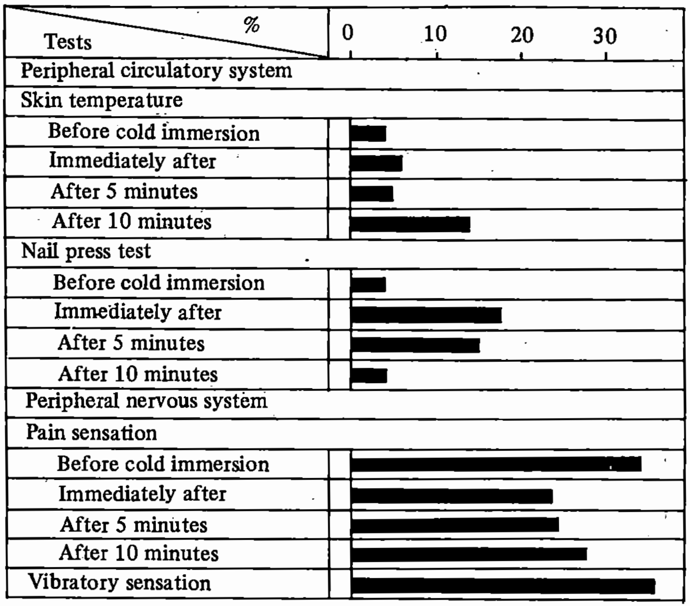

Fig. 1. Improvement ratio(%) of mean value of each test.

tween entering and leaving the hospital were also observed in case of nail press test and vibratory sensation. However, no significant differences were observed in the case of pain sensation, pinching power and tapping test.

The improvement ratio is shown in Figure 1. It seemed that the balneotherapy was effective for the improvement of the peripheral circulatory system and the peripheral nervous system.

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Session 15.
Pneumoconiosis

SILICOSIS FROM THE MINING AND PROCESSING OF WHETSTONE

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Introduction

For many years whetstone has been mined in the Kyoto area. The whetstone was originally utilized in sharpening Samurai swords and then later used to sharpen agricultural tools like sickles and hoes, carpentry tools like chisels and planes, kitchen knives, and barbershop razors. Recently, however, technological improvements have lowered the demand for whetstone. Although composed of variety of compounds, whetstone contains of high percentage (62-66%) of silicon dioxide, the main cause of silicosis. And, because whetstone is mined in the Kyoto area with very narrow, poorly ventilated mine shafts, the occurrence of silicosis is quite understandable. It has been recorded historically that many patients with silicosis die in their forties. With recent medical advances and environmental improvements, the number of silicosis patients and the severity of their illness have decreased.

In this presentation, we will talk on clinical findings of sixty-five cases with whetstone silicosis in our clinic.

Patients

In the 74 patients with whetstone silicosis we examined, 65 only had silicosis and 9 had both silicosis and tuberculosis. We summarized data in the 65 patients with silicosis only. All patients were male with an average age of 59.2 and 34 of the patients (52%) were over 60 years old. Their average duration of employment was 28.8 years and 49 of the patients (75%) had worked over 20 years.

Clinical Findings

Symptoms: The patients exhibited a variety of symptoms. All cases showed exertional dyspnea with following breakdown according to the Hugh Jones classification: 3 patient (5%) in group I, 28 patients (43%) in group II, 31 patients (48%) in group III, and 3 patients (5%) in group IV. Also, 45 patients (69%) complained of coughing and 45 patients (69%) showed a high amount of sputum. Many patients with a relatively long span of employment showed more severe dyspnea than those patients employed for a shorter time, but their greater age perhaps exerts an influence to some extent.

Chest X-ray findings: 36 patients (55%) showed nodular opacity only and 29 patients (45%) showed nodular opacity with conglomerate masses. Emphysematous findings appeared in 24 patients (37%) and enlarged hilar lymph nodes appeared in 3 patients (5%). In patients with nodular opacity only, 17 of 36 were in Hugh Jones classification III and IV, but 17 of 29 patients exhibiting nodular opacity with conglomerate masses were in group III and IV. This was a significant difference ($P<0.005$).

Pulmonary function tests: 20 patients (31%) showed normal ventilatory function, 30 patients (46%) showed a decrease in % VC (<80), and 28 patients (43%) showed a decrease in % $FEV_{1.0}$ (<70). Normal diffusing capacity was present in 15 patients (33%) and decreased to 60-74% in 6 patients (13%) and to less than 60% in 24 patients (53%). Also, PaO_2 levels were normal in 41 patients (95%) and decreased in 2 patients (5%). Comparing the degree of dyspnea and ventilatory disturbances, we found a significant difference ($P<0.05$) between patients in Hugh Jones group I-II and patients in groups III-IV with 16 of 31 group I-II patients showing ventilatory disturbances and 29 of 34 group III-IV patients showing such disturbances. In comparing the degree of dyspnea and diffusing capacity, there was no significant difference between the Hugh Jones I-II patients and the III-IV patients. Also, no significant difference was found between patients with nodular opacity only and patients with both nodular opacity and conglomerate masses when their ventilatory disturbances or diffusing capacity were compared. There was also no significant difference between emphysematous and non-emphysematous patients on chest x-ray findings when their ventilatory disturbances or diffusing capacity were compared.

Laboratory findings: Raised BSR (>15 mm), 38% of the patients, CRP (+), 28%, RA (+), 11%, raised leukocytes (>8000/mm^3), 15%, raised serum gamma globulin (>20%), 40%, raised IgM (>130 mg/ml), 67%, raised IgA (>350 mg/ml), 31%, raised IgG (>1580 mg/ml), 57%, raised IgE (>400 IU/ml), 40%, tuberculin test positive, 81%.

Although there was no significant difference between the nodular opacity only group and nodular opacity with conglomerate masses group in regard to raised BSR, such difference ($P<0.05$) was found between patients in Hugh Jones groups I-II (7 of 30) and patients in group III-IV (17 of 33). Also, significant differences were found between the nodular opacity only patients and nodular opacity with conglomerate masses patients in regard to raised gamma globulin (11/36 vs. 16/29, $P<0.05$), raised IgA (4/23 vs. 11/19, $P<0.01$), and raised IgE (12/14 vs. 7/23, $P<0.05$). There was also a difference between patients in Hugh Jones groups I-II and patients in Hugh Jones groups III-IV in regard to raised gamma blobulin (9/31 vs. 17/34, $P<0.005$).

Summary

Clinical data of 65 patients with whetstone silicosis were investigated and mutual relationships between symptoms, chest x-ray findings, pulmonary function tests and laboratory findings were compared. The following significant differences were discovered.

1. Patients with both nodular opacity and conglomerate masses showed more severe dyspnea than patients with nodular opacity only in chest x-ray findings.

2. Patients in Hugh Jones classification groups III-IV showed more ventilatory disturbances and greater increases of BSR and serum gamma globulin than patients in groups I-II.

3. Patients with nodular opacity and conglomerate masses showed greater increases of serum gamma globulin and IgA than patients with nodular opacity only, but patients with nodular opacity only showed a greater increase of IgE than patients with nodular opacity and conglomerate masses.

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OCCURRENCE OF RESPIRATORY IMPAIRMENTS AMONG KOREAN ANTHRACITE MINERS

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Introduction

Rapid development of modern industry brought us a great comfortness and convenience. During this process various occupational disease were inevitably increased.

To protect workers from the occupational diseases and to enhance productivity, preventive measures for occupational health impairments have been applied and emphasized.

Penumoconiosis is one of the major problems in the field of industrial health in Korea since its prevalence and hazards are highly increased.

Pneumoconiosis is characterized by fibrotic lesion in the lungs caused by inhaled dusts and it has been studied extensively up to present.

Because of significance of the disease among other occupational diseases particular effort have been made to improve the methods of diagnosis and effective therapy as well as insurance benefit in accordance with the Industrial Accident Compensation Law.

Author carried out a health survey for anthracite mine workers at mine located in the Western Coast in Korea during May 1978-July 1978.

Materials and Methods

Two privately owned anthracite mines in the Western Coast in Korea were chosen for the study.

Among 663 workers, 211 were selected randomly. Dust was measured by midget impinger (M.S.A.) sampling method.

The lung volumes and ventilatory functions were determined by spirometry.

Chest X-ray examinations were carried out on 211 workers who had been exposed to anthracite dust and qualitative and quantitative features in the analysis of X-ray finding were based on the ILO classification.

Results

The amount of dust at the cross sinking was 0.86–1.89 mg/m³ while it was 9.20–16.90 mg/m³ in the caving place. The latter concentration is much higher than the permissible dose set by office of labour (5 mg/m³). The mean year of age was 35.35±7.23 with the maximum value being 35-39 years. The duration of employment was averaging 3.69±3.35 years and 68.2% was in the range of less than 5 years of employment. The year of working in average was 6.58±4.46 years. The vital capacity decreased significantly according to increasing ages and there was a significant correlation ($p<0.05$) with year of employment. The vital capacity according to duration of employment was significantly increased among the over five year-group ($p<0.05$). The residual volume (mean was 1915.6±484.2) tended to increase as age increases ($p<0.001$). The average % $FEV_{1.0}$ was decreased in general with value of 69.34±13.09. This shows obstructive tendency, however, the predicted % $FEV_{1.0}$ by Birath's Method is in the normal range. Thirty cases on pneumoconiosis including the category 0 were found (14% of the workers) by chest X-ray examination. However, most their grade was the early stage of pneumoconiosis (13 cases of category 0, 13 cases of category 1, 2 cases of category 2 and 2 cases of category 3).

The residual volume was significantly increased among the group of category 2 and 3 when compared to category 0 and 1. ($p<0.018$). The % vital capacity measured according to Baldwin's formula and Im's formula was 107.6±12.2 and 112.0±13.0 respectively. Only 0.4 and 0.9% of the subjects was with less than 80% of the predicted vital capacity.

Conclusion

1. The amount of dust in the caving place was 8.20-16.9 mg/m³. This value is beyond the permissible dose recommended by the Administration of Labor Affairs in Korea.

2. There was no correlation between vital capacity and the X-ray findings of the lesions. However vital capacity decreased in accordance with increasing age as well as with increment in years of employment ($p<0.05$).

3. The average value of residual volume was 1915.6±484.2. This is higher than the value reported by Kim, et al.

4. In correlation between X-ray findings and residual volume, the subjects in the Category 2 & 3 tended to have higher correlation than those in the Category 0 & 1.

5. Measured %$FEV_{1.0}$ was 69.34±13.09 in average, while predicted average was 78.72±2.67.

6. The incidence of pneumoconiosis of this study was 14% (30 subjects) including Category 0. When the Category 0 was excluded, it was 8% (17 subjects). These values are higher than the previously reported results. These findings call for more definite environmental control measures as well as occupational health management.

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EVALUATION OF FORCED END-EXPIRATORY FLOW

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Intorduction

The development of simple tests which can indicate small airway obstruction in the early stages of chronic obstructive pulmonary disease are of great practical importance because the obstructive process occurs mainly in small airways less than 2 mm in internal diameter(1) and this process is a potentially reversible stage (2). Until recently, the lung function tests to detect small airway obstruction have been utilized, such as frequency dependence of compliance, body plethysmography, flow-volume curve, closing volume and volume of isoflow. However, in comparison, spirometry is more widely used for routine and screening test in pulmonary function laboratory because it can be performed with simpler and less expensive method. Recently, the maximal mid-expiratory flow (MMF) have been proposed as a more sensitive index than the other ventilatory indices calculated from the forced vital capacity(FVC) curve in detecting small airway obstructive disease (3).

In patients with small airway disease, reduction in expiratory flow is presented to be most at low lung volumes. Therefore, diminished flow near the end of the FVC maneuver may be more sensitive indicator of disorders with small airway obstruction.

The purpose of this study was to analyze a new spirometric measurement of forced end-expiratory flow at 75 to 85 per cent of FVC ($FEF_{75\text{-}85\%}$) to present the normal value in the form of prediction equation of this measurement in a healthy population, and to compare this value with the measurement of forced mid-expiratory flow ($FEF_{25\text{-}75\%}$, MMF) as a reliable test for detecting the early obstructive pulmonary disease.

Materials and Methods

We studied 291 healthy male adults who were totally free of symptoms or history of cardiorespiratory disease aged 20-55 years and 81 pneumoconiosis patients with presumed small airway disease aged 30-49 years from coal mines. All patients had normal range for maximal expiratory flow rate, MMF and forced expiratory volume in one second/FVC but abnormal value for maximal expiratory flow at 25 per cent of FVC. The physical characteristics of the subjects studied are presented in table 1.

The FVC curve was measured by the Flow-Volume Curve Recorder in the standing position. The measurements were performed at least twice to obtain a maximal effort. The best effort was always selected. The measurements were corrected to BTPS. From the FVC curve, we calculated $FEF_{75\text{-}85\%}$ and $FEF_{25\text{-}75\%}$. In addition to expressing these indices in liter per sec, both flows were divided by the subject's FVC to reduce the variability of these flows with the different lung size.

Table 1. Physical characteristics of the subjects

(Mean± SD)

	No. of subject	Age (year)	Height (cm)	Weight (kg)	B.S.A. (m^2)
Healthy	291	34.2±7.1	169.4±4.7	62.6±6.7	1.72±0.10
Pneumoconiosis	81	42.4±4.0	166.7±5.7	62.1±5.6	1.70±0.10

Results

The mean values for $FEF_{75\text{-}85\%}$ and $FEF_{25\text{-}75\%}$ in liter per sec and liter per sec divided by FVC in a healthy population are presented in table 2. There was a gradual decrease for both flows as the age increased. The mean values for $FEF_{75\text{-}85\%}$ in liter per sec and liter per sec divided by FVC were significantly decreased from 30-39 years group when compared with 20-29 years group but the mean values for $FEF_{25\text{-}75\%}$ in liter per sec and liter per sec divided by FVC were significantly decreased in old age group.

We examined several independent factors to determine their relationships to flows. The correlation coefficients between expiratory flows and age, body size and FVC in healthy subjects are presented in table 3. In this table, simple correlation coefficient was significant ($P<0.05$) if it was greater than 0.114. $FEF_{75\text{-}85\%}$ and $FEF_{25\text{-}75\%}$ in liter per sec had negative correlations with age and positive correlations with height and FVC. To find whether the use of multiple independent variables would improve our ability to predict expiratory flows, we determined multiple correlation coefficients for age, combined with heights, body surface area and FVC (table 3). The multiple correlations were larger than simple correlations of independent variables but there was no significant difference between multiple and simple correlations and between multiple correlations.

Prediction equations for $FEF_{75\text{-}85\%}$ and $FEF_{25\text{-}75\%}$ in liter per sec using age combined with height and FVC are shown in table 4.

There were wide interindividual variabilities of $FEF_{75\text{-}85\%}$ and $FEF_{25\text{-}75\%}$ when expressed as liter per sec. Though we attempted to reduce these variabilities by size compensation, dividing flows by FVC, the coefficients of variation were not significantly decreased for either measurement of flow (table 5). There was a tendency that the coefficients of variation were larger in $FEF_{75\text{-}85\%}$ when comprared with $FEF_{25\text{-}75\%}$.

Comparison of the observed flow values

Table 2. Mean values of forced end-expiratory and mid-expiratory flows and as ratios to forced vital capacity in healthy subjects

(Mean±SD)

Flow / Age (yr)	$FEF_{75\text{-}85\%}$ (ml/sec)	$\frac{FEF_{75\text{-}85\%}}{FVC}$	$FEF_{25\text{-}75\%}$ (ml/sec)	$\frac{FEF_{25\text{-}75\%}}{FVC}$
20~29	1,779.9±362.6	0.411±0.088	4,620.2±841.8	1.067±0.206
30~39	1,473.5±382.5	0.351±0.083	4,439.9±982.5	1.061±0.224
40~49	1,181.0±311.9	0.300±0.070	4,092.0±1,016.3	1.043±0.250
50~55	880.4±253.9	0.253±0.072	3,093.2±715.3	0.896±0.240
Total	1,485.0±428.9	0.355±0.092	4,379.3±992.0	1.053±0.227

Table 3. Simple and multiple correlation coefficients of forced expiratory flows and as ratios to forced vital capacity with independent variables in healthy subjects

Dependent variables	Independent variables							
	Age	Height	Weight	B.S.A.	FVC	Age+ Height	Age+ B.S.A.	Age+ FVC
$FEF_{75\text{-}85\%}$	−0.543*	0.330*	−0.100	0.040	0.448*	0.579*	0.545*	0.603*
$FEF_{25\text{-}75\%}$	−0.294*	0.271*	0.098	0.179**	0.365*	0.359*	0.346*	0.402*
$\frac{FEF_{75\text{-}85\%}}{FVC}$	−0.453*	0.100	−0.211*	−0.135	0.053	0.453*	0.471*	0.471*
$\frac{FEF_{25\text{-}75\%}}{FVC}$	−0.107	−0.044	−0.012	−0.026	−0.171**	0.129	0.110	0.252*

* $P<0.001$, **$P<0.01$, † $P<0.05$

Table 4. Prediction equations for forced end-expiratory and mid-expiratory flows

	Prediction equation	R	SEE
$FEF_{75\text{-}85\%}$	$= -29.56A + 19.081H - 735.65$	0.579	351.5
	$= -26.24A + 0.2452FVC + 1{,}358.10$	0.603	343.9
$FEF_{25\text{-}75\%}$	$= -33.64A + 44.809H - 2{,}058.95$	0.359	930.8
	$= -25.44A + 0.5915FVC + 2{,}778.95$	0.402	912.9

Forced expiratory flows in ml/sec, A; Age in years,
H; Height in cm, FVC; Forced vital capacity in ml,
R; Multiple correlation coefficient, SEE; Standard error of estimate

Table 5. Coefficients of variation for forced expiratory flows and as ratios to forced vital capacity in healthy subjects

Flow / Age(yr)	$FEF_{75\text{-}85\%}$	$\frac{FEF_{75\text{-}85\%}}{FVC}$	$FEF_{25\text{-}75\%}$	$\frac{FEF_{25\text{-}75\%}}{FVC}$
20~29	20.4	21.4	18.2	19.3
30~39	25.9	23.6	22.1	21.1
40~49	26.4	23.3	24.8	24.0
40~55	28.8	28.5	23.1	26.8
Total	28.9	25.9	22.7	21.6

Coefficient of variation represents the SD divided by the mean value, expressed as per cent.

Table 6. Comparison of $FEF_{25\text{-}85\%}$ and $FEF_{25\text{-}75\%}$ in healthy subjects and pneumoconiosis patients with presumed small airway diseases 30 to 49 years of age (Mean ± SD)

	Healthy	Patient
$FEF_{75\text{-}85\%}$, ml/sec	1,402.2±404.2	723.8±149.5
% predicted		61.2±10.7
$FEF_{25\text{-}75\%}$, ml/sec	4,355.1±1,002.1	3,098.7±406.5
% predicted		77.9±10.8
Age, years	36.5±4.8	42.4±4.0
Height, cm	169.4±4.5	166.7±5.7
No. of subjects	201	

of 201 healthy subjects with 81 pneumoconiosis patients with presumed small airway disease aged 30-49 years showed higher mean values for both flows in healthy subjects (table 6). However, the mean value of predicted $FEF_{25\text{-}75\%}$ was within normal range (77.9%) but this value of predicted $FEF_{75\text{-}85\%}$ abnormal (61.2%). The relationship between predicted and observed values of both flows in patients are presented in figure 1 and 2. Ninety-six per cent of the observed values for $FEF_{75\text{-}85\%}$ were less than 75 per cent of predicted mean and 24 per cent less than minus 1.645 standard error of estimate (SEE). Fifty-nine per cent of the observed values for $FEF_{25\text{-}75\%}$ decreased to below 75 per cent of predicted mean and 4 per cent to below minus 1.645 SEE.

Discussion

During the FVC maneuver, expiratory flow of the initial 25 per cent of expired volume is effort-dependent whereas flow below about two thirds is more dependent on mechanical properties of the lungs (effort-independent)(4). The final 10 to 15 per cent of FVC may also be effort-dependent in normal subjects, especially

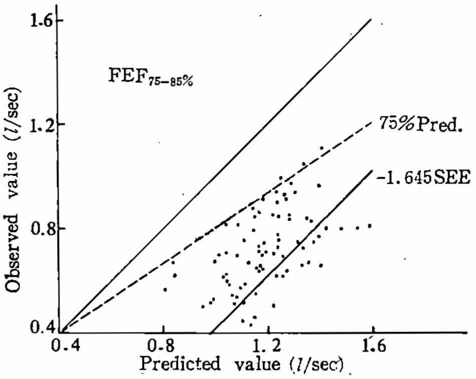

Fig. 1. Relationship of observed and predicted $FEF_{75\text{-}85\%}$ in 81 pneumoconiosis patients with presumed small airway disease 30 to 49 years of age.

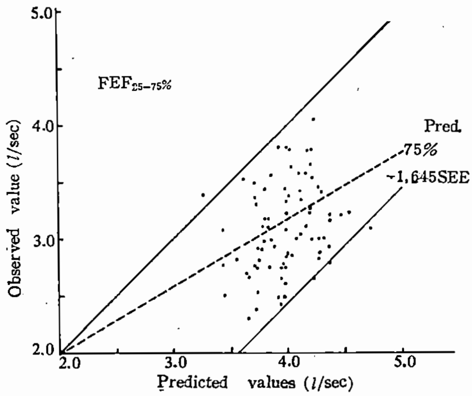

Fig. 2. Relationship of observed and predicted $FEF_{25\text{-}75\%}$ in 81 pneumoconiosis patients with presumed small airway disease 30 to 49 years of age.

under the age of 40 years(5). In patients with early stage of chronic obstructive pulmonary disease, flow abnormalities should be present only at low lung volumes. Therefore, analysis of flow at low lung volumes may be more sensitive indicator in detecting the early stage of airway obstruction. Morris and co-workers(6) reported that comparison of flow values of male smokers with nonsmokers was higher mean values in $FEF_{75\text{-}85\%}$ and $FEF_{25\text{-}75\%}$, however, the difference was significant only in $FEF_{75\text{-}85\%}$. In the present study, spirometric analysis of expiratory flow at low lung volume ($FEF_{75\text{-}85\%}$) was more sensitive than $FEF_{25\text{-}75\%}$ in detecting the patients with presumed disease of small airways.

Effort to decrease the variability of expiratory flow has been directed at correction for differences in lung size by expressing flow divided by FVC, TLC and height. Zapletal and co-workers(7) in their study of young people less than 18 years of age demonstrated that the variability of maximal expiratory flow was significantly decreased when flow in liter per sec was divided by TLC. However, in this study, there was no improvement of variability, expressed by coefficient of variation, of both $FEF_{75\text{-}85\%}$ and $FEF_{25\text{-}75\%}$ even though flow in liter per sec was divided by FVC.

Age and height are commonly used to predict ventilatory measurements. Our data supported that age and height or FVC were useful factors for prediction of expiratory flows.

In determining the normal range of pulmonary functions, one of the method is to take some fixed percentage of the predicted normal value, usually 80%, as the lower limit of normal and another method is the mean±2 SD or the predicted±2 SEE, which will encompass 95 per cent of normal group. The latter is statistically more legitimate. However, in pulmonary function measurements, only one end of the distribution is considered abnormal (the lower end of 2.5 per cent). Therefore, normal lower limit become 1.645 SD or SEE instead of 2 SD or SEE. Using a one-tailed significance test, the value of 1.645 SEE would identify 5 per cent of the normal population as being abnormally low. In the present study of 81 patients with presumed small airway disease, the SEE of $FEF_{75\text{-}85\%}$ expressed as liter per sec was too wide to be clinically useful for the detection of small airway disease when the lower limit of normal was 1.645 SEE of predicted mean(figure 1). We suggested that the use of 75 per cent of predicted mean for $FEF_{75\text{-}85\%}$ be a greater value than using 1.645 SEE in attempting to detect the patients with obstructive changes of small airways.

Conclusions

A new spirometric analysis of forced end-expiratory flow at 75 to 85 per cent of FVC ($FEF_{75\text{-}85\%}$) was performed with 291 healthy male adults. $FEF_{75\text{-}85\%}$ had a negative correlation with age and positive correlation with height and forced vital capacity. The prediction equation for $FEF_{75-85\%}$ using age combined with height and FVC were reported. There was no improvement of variabilities for $FEF_{75-85\%}$ and $FEF_{25-75\%}$ when both flows in liter per sec were divided by FVC. In comparing the measurement of $FEF_{75-85\%}$ with that of $FEF_{25-75\%}$ in 81 pneumoconiosis patients with presumed small airway disease, the mean value of predicted normal for $FEF_{75-85\%}$ was below normal range whereas this value for $FEF_{25-75\%}$ within normal range. In relationships between predicted and observed valued of both flows in 81 patients, ninety-six per cent of the observed values for $FEF_{75-85\%}$ were less than 75 per cent of predicted mean and 24 per cent less than minus 1.645 SEE but fifty-nine per cent of the observed values for $FEF_{25-75\%}$ were less than 75 per cent of predicted mean and only 4 per cent less than minus 1.645 SEE. With the above considerations in mind, we suggested that $FEF_{75-85\%}$ might be a more sensitive ventilatory index than $FEF_{25-75\%}$ for early detection of respiratory impairement and the use of 75 per cent of predicted mean for $FEF_{75-85\%}$ might be of greater value than using 1.645 SEE in attempting to detect patients with small airway disease.

References

1. Hong, J.C. et al.: Site and nature of airway obstruction in chronic obstructive lung disease, N. Engl. J. Med. 1968, 278, 1355.
2. Ingrum, R.H., Jr. & O'Cain, O.F.: Frequency dependence of compliance in apparently healthy smokers versus non-smokers. Bull. Physiopathol. Respir. (Nancy). 1971, 7, 195.
3. McFadden, E.R. & Linden, D.A.: A reduction in maximal midexpiratory flow rate, A spirographic manifestation of small airway disease. Am. J. Med. 1972, 52, 725.
4. Fry, D.L. & Hyatt, R.E.: Pulmonary mechanics: A unified analysis of the relationship between pressure, volume and gas flow in the lungs of normal and diseased human subjects. Am. J. Med. 1960, 29, 672.
5. Leith, D.E. & Mead, J.: Mechanisms determining residual volume of the lungs in normal subjects. J. Appl. Physiol. 1967, 23, 221.
6. Morris, J.F. et al.: Normal values and evaluation of forced end-expiratory flow. Am. Rev. Resp. Dis. 1975, 111, 755.
7 Zapletal, A. et al.: Maximum expiratory flow-volume curves and airway conductance in children and adolescents. J. App. Physiol. 1969, 26, 308.

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OCCUPATIONAL HEALTH PROBLEMS IN OFFSHORE OIL OPERATIONS IN IRAN

Jehangir ARYANPUR, *Iran*

Abstract

Offshore oil operation is a relatively new industry. Since the site of different operations of this industry is in the sea various occupational health problems are encountered due to factors such as space limitation, obligatory living and working in the same premises, hostile nature of the sea, remoteness from adequate rescue, fire-fighting, first aid, medical and health facilities, and necessity for regular transportation between these premises and home towns, all of which create specific health problems, with different nature and solutions than those of in-land petroleum industry.

The purpose of this report is to review the results of a preliminary survey conducted by our occupational health team regarding the main occupational health problems of N.I.O.C. offshore oil companies in Persian Gulf.

The report is based upon the results obtained from questionnaires, direct communication with authorities concerned, local visits and evaluation of some environmental factors.

Environmental heat forms one of the major occupational health problems in this area. The average temperature in the shade in summer is about 40°C, with humidity spells as high as 100%. In spite of such adverse climatic conditions no instances of clinical heat exhaustion are recorded, due to optimal air-conditioning of the living and recreational quarters, where they spend most of their times in hot seasons.

Occupational noise is another major problem which can affect the hearing of exposed employees.

Diving operations take place in depths of 30 to 80 meters. A mixture of oxygen and helium is used instead of compressed air in depths greater than 50 meters. Diving accidents have occurred less than similar operations in rough seas with cold waters.

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RADIOGRAPHIC PROGRESSION OF PNEUMOCONIOSIS

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Pneumoconiosis is one of the most important disabling occupational diseases in Korea and it is particularly true of coal miners. The prevalence of pneumoconiosis reach 4.9% for all coalmine workers nowadays, which we reported already on the occasion of the previous conference. In addition, we have found a number of pneumoconiosis suspects which numbered 5.7% of examinees.

Generally speaking, the biological mechanisms involved in the development of pneumoconiosis are not clearly understood even today. Therefore, it may arouse some interests to note the features of progression of pneumoconiosis which take place under continued dust exposure and also under discontinued dust exposure.

We have tried in this report to disclose the differences in the radiographic progression of pneumoconiosis of coalworkers through the study of serial chest X-ray films.

Materials and Methods

The patients for this study consisted of 375 pneumoconiosis and suspects who were brought up to our hospital from anthracite mines by Workmen's Compensation authorities during the seven year period from 1970 to 1977. The patients were divided into two groups; namely, one group of 211 patients who stopped working underground after the confirmation of pneumoconiosis (this group will be called non-exposure group hereafter) and the other group of 164 patients who were further engaged in underground work even after the diagnosis of pneumoconiosis (this group will be called exposure group hereafter). For the former group, we were able to take standard-size chest X-ray's at 3-4 month intervals regularly, while, for the latter group, only the check-up with chest X-ray's at irregular intervals was possible. When a patient continued his underground work for sometime after initial diagnosis and then stopped working underground or vice versa, he was handled as two cases, one belonging to dust exposure group and the other belonging to non-exposure group.

We followed, for radiographic observation, the extended classification of the ILO U/C International Classification of Radiographs of Pneumoconiosis published in 1971.

Of course, there were patients in whom radiographic progression into large opacities was observed. However, such occasions were excluded from this study and this report is limited to the growth of small opacities. Furthermore, when the growth over two steps was noted on the 12 point scale, it was regard the progression took place at a steady speed. The observation period extended over 6 to 152 months in this study.

Results

1. Growth in size of small opacities (Table 1).

Table 1. Progression of the size of small round opacities of pneumoconiosis

Dust	Status initial type	Stabilized No. of cases	Stabilized Average of obs. period (month)	Progressive No. of cases	Progressive Average of obs. period (month)	Rate of prog. (%)
Non exposure	p	24	23.5±11.98	2	4.5±0.05	7.7
	q	127	27.3±20.45	7	5.1±2.40	5.2
	r	51	24.1±12.61			
	Sub-total	202		9		4.3
Exposure	p	12	21.7±10.12	7	34.9±20.15	36.8
	q	60	25.7±16.33	33	30.3±20.27	35.5
	r	18	24.9± 9.47			
	(0/1)	11	19.2± 9.04	23	49.0±28.71	67.6
	Sub-total	101		63		38.4

As a whole, the increase in nodule size was noted in 4.3% of non-exposure group patients and in 38.4% of exposure group patients.

There were 26 patients with punctiform or p-type small opacities in non-exposure group and 53 patients with punctiform opacities in exposure group including suspects. The growth of nodule into micronodular or nodular forms was noted in 7.7% of patients in the non-exposure group, while in 56.6% of patients in exposure group.

There were 134 patients with micronodular or q-type opacities in non-exposure group and 99 patients with micronodular opacities in exposure group. The growth of small opacities from nodular forms was observed in 5.2% of patients in the former group and in 35.5% of patients in the latter group.

There were also 51 patients in non-exposure group and 18 patients in exposure groups with nodular or r-type opacities. However, no growth in the nodule size was recorded in both groups, because any patient who showed radiographic progression into large opacities was excluded artificially in this study.

In spite of the little difference in the average observation period between two groups, the growth in nodule size was very marked in exposure group. The growth was also rather pronounced in punctiforms than in other forms on an average.

2. Growth in profusion of small opacities (Table 2).

The growth in profusion of small opacities

Table 2. The progression of radiographic categories of pneumoconosis.

Initial category / Status	Non exposure Progressive Obs. period (M ± SD)	Non exposure Progressive Prog. rate (%)	Exposure Progressive Obs. period (M ± SD)	Exposure Progressive Prog. rate (%)
0/1			49.0±28.71	67.6
1/0	38.0±31.91	46.7	49.8±27.03	68.6
1/1	34.0±21.78	16.4	37.6±20.06	55.1
1/2			28.8±13.58	72.2
2/1	38.6±43.02	60.0	23.8± 7.36	60.0
2/2	30.3±14.75	20.0	41.5±22.05	51.7
2/3	45.0±0	10.0	44.0± 0	16.7
3/2			27.0±12.29	21.4
Total		19.4		57.2

was observed in 19.4% of non-exposure group patients, while the progression was noted in 57.2% of exposure group patients.

There were 34 pneumoconiosis suspects in exposure group only and the progression rate was 67.6% in this group of patients.

There were also 180 patients with Category 1 or 1/0 to 1/2, 133 patients with Category 2 or 2/1 to 2/3 and 28 patients with Category 3 or 3/2 or 3/4 in this study.

Among Category 1 patients, radiographic progression in profusion of small opacities took place in 21.9% of patients in non-exposure group, while in 59.1% of patients in exposure.

Among Category 2 patients, 21.1% of patients in non-exposure group showed progression in profusion of small opacities, while the progression rate was 50.0% in exposure group patients.

Among Category 3 patients who consisted of 3/2 patients only, no patients showed progression in non-exposure group, while we noted the growth in profusion in 21.4% of patients in exposure group.

Thus, generally speaking, the growth in profusion was again very marked in exposure group patients than in non-exposure group patients. There is a tendency to show higher progression rate in lower category patients and the progression rate falls as the profusion proceeds in the exposure group.

3. The growth of small opacities in different age groups (Table 3).

Table 3. Radiographic progression in categories classified according to age

Age / Status Category	30–39 Prog. rate (%)	40–49 Prog. rate (%)	Over 50 Prog. rate (%)
0/1	72.2	75.0	0
1/0	87.5	50.0	100.0
1/1	50.0	41.5	12.5
1/2	70.0	55.6	0
2/1	85.7	40.0	0
2/2	41.6	41.0	12.5
2/3	14.3	33.3	0
3/2	25.0	20.0	0
Total	57.6	44.7	14.3

There were 144 patients of 30-39 years of age, 181 patients of 40-49 years of age and 42 patients of 50 and more years of age in this study.

The progression in profusion was noted in 57.6% of patients at their thirties, in 44.7% of patients at their fourties and in 14.3% of patients at their fifties.

In the group at 30-39 years of age, the suspects showed the progression rate of 72.2% and the rate for Category 1, Category 2 and Category 3 patients were 64.5%, 44.7% and 25.0% respectively.

In the group at 40-49 years of age, the progression in profusion took place in 75.0% of suspects, in 45.9% of patients of Category 1, in 40.0% of patients of Category 2 and in 20.0% of patients of Category 3.

In the group of 50 and more years of age, 21.1% of patients in Category 1 and 10.0% of patients in Category 2 showed some growth in profusion, while no suspect patients and no Category 3 patients showed any radiographic progression on their films.

We may therefore say that radiographic progression in profusion takes place more often in the younger patients than in older patients. Also, it may be noted that profusion proceed more often in suspects and low category patients than in high category patients in general.

4. The growth of small opacities in different types of underground work and different length of work experiences (Table 4).

Out patients consisted of 231 coal miners, 72 tunnel drivers and 72 miscellaneous workers. According to the length of work experiences, 14 patients worked less than 5 years underground, 131 patients 6-10 years, 214 patients 11-20 years and 16 patients more than 20 years.

We have noted that the growth of small opacities took place most often among coal miners which was followed by tunnel drivers and miscellaneous workers in a decreasing order. The figures in both non-exposure and exposure groups are shown on the Table 4.

The lower figures for tunnel drivers, as compared with coal miners, may be attributed to the facts that, though tunnel drivers are usually exposed to dusts with higher silica content, their dust retention in the lung is less severe

Table 4. Radiographic classification according to years of job and the kind of job

Kind of job	Underground																	
	Coal miner						Tunnel driver						Other					
Yr. of job	5	6–10	11–15	16–20	21	Total	5	6–10	11–15	16–20	21	Total	5	6–10	11–15	16–20	21	Total
Status																		
Non exposed																		
Prog. rate (%)		17.2	14.9	10.3	1.2	43.7	2.5	15.0	12.5	5.0		35.0	5.3		5.3		5.3	15.8
Exposed																		
Prog. rate (%)		24.5	26.6	8.6	1.4	61.2	3.3	20.0	13.3	13.3	3.3	53.3		10.9	10.9	4.4		43.5

owing to the extensive use of wet drills and also extensive use of respiratory protective devices during the last two decades in this country. This was not the case with coal miners who were usually obliged to be engaged in strenuous work under heavily dusted conditions.

With regard to the work experiences, higher progression rates were observed among the workers who engaged in underground workers six to fifteen years.

5. The speed of growth of small opacities

Figure 1 illustrates the course of radiographic progression of pneumoconiosis which was observed practically in all patients.

It will be readily seen that progression of pneumoconiosis almost never take place at a steady speed. But it occurs rather only suddenly after a long quiescent stage. It seems therefore that there exist a certain activating mechanism for the progression of pneumoconiosis.

Summary

It is a matter of some interest to know how the progression of pneumoconiosis takes place even in the absence of dust-exposure and under continued dust-exposure as well.

In order to disclose the way in which pneumoconiosis progresses, the author has radiographically observed 375 pneumoconiosis patients over the period of 6 to 152 months. The patients were divided into two groups, namely one group of 211 patients who were not exposed to dust after initial diagnosis and the other group of 164 patients who were further exposed to dust even after confirmation of pneumoconiosis. For the former group, radiological examination was carried out periodically every 3-4 months and for the latter group at irregular intervals.

The results were as follows:

1. In the non-exposure group, 7.7% of p type patients and 5.2% of q type patients progressed into other type of small round opacities, while, in the exposed group, 36-8% of p type patients and 35.5% of q type showed progression.

2. With regard to the profusion of small round opacities, 19.4% of non-exposure group and 57.2% of exposure group progressed into higher categories during the observation period.

3. The rate of progression was as a whole higher in younger group than in older group. The progression rate was more marked among coal miners than tunnel drivers and other underground workers.

4. It seems that there exists a certain activating mechanism for the progression of pneumoconiosis, as the process took place only at irregular and intermittent intervals rather than at steady speeds.

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HEALTH HAZARDS AMONG TEXTILE WORKERS OF THAILAND

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Introduction

With the increase in number of textile mill workers as a consequence of recent industrialization, a need is strongly felt to organize effective occupational health and ergonomic activities to eliminate the potential hazards. Since the industrialization has started in many of the Southeast Asian countries in the 1960s, the concern over the workers' health is rising, but occupational health care at both large and small textile mills has not expanded noteworthily, its activities being mainly limited to treatment at factory clinics. With respect to workpalce environmental conditions and daily working life of textile workers, who are known to be exposed to potential harms (El Batawi et al., 1973; Ministry of Labour, India, 1967; Textile Committee, ILO, 1978; Kogi, 1977), basic information is still lacking there.

In order to explore the possible courses of action at the provincial level to cope with those health impairing agents, field investigations were undertaken at three textile mills in the Samutprakarn Province of Thailand, an industrial zone south of Bangkok, by a joint working team which comprised Samutprakarn Provincial Hospital, Occupational Health Department of Mahidol University, Occupational Health Center I, and Institute for Science of Labour with cooperation of relevant agencies and Department of Hygiene of Okayama University and Ergonomics Laboratory of Kanagawa University.

In this series of work, special attention was paid to assessment of environmental causative agents to which the textile workers were vulnerable. They included among others effects of three-shift systems (Maurice, 1975; Textile Committee, ILO, 1978), noise (Taylor et al., 1965; Kell, 1975) and cotton dust (Schilling, 1962; El Batawi et al., 1973; Shima, 1970; Imbus, 1974). The results and experiences gained are expected to help promote occupational health programs for workers of the textile and other manufacturing industries of the region.

Methods

A total of 605 workers from three textile mills in the Samutprakarn Province of Thailand were subjected to interviewing and health examination, at each mill the working team spending one week inside the factory premises and examining about 200 workers. During the investigation period, environmental conditions of workshops were evaluated by measuring temperature, humidity, heat radiation, illumination and levels of noise and airborne dust.

Of the 605 examinees, 107 were male (33 in spinning/sizing, 48 as mechanics, and 26 in weaving and others) and 498 were female. The female consisted of 21 workers in blowing and carding, 134 in spinning, 90 in winding/sizing, 23 in reaching-in work, 175 in weaving, and 55 in inspecting and others. Most of them were being weekly rotated in the 8-hour three shift system.

The interviewing was conducted using a specially arranged questionnaire form that included personal history, family status, troubles at work, health conditions, respiratory symptoms according to the cotton mill survey form of the British Medical Research Council, safety conditions and welfare facilities. The health examination comprised physical examination by physicians of the Provincial Hospital, audiometry, and measurement of vital capacity and forced expiratory volume using a vitalograph.

Environmental evaluation of noise was done by means of a sound level meter with a digital display unit, and that of dust by an impaction-filtration type total-and-respirable dust sampler

Table 1. Features of the examinees.

Item	Female −29	Female 30–39	Female 40–	Female Total	Male −29	Male 30–39	Male 40–	Male Total
No. of examinees	344	114	40	498	62	32	13	107
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Single	72.1	48.2	35.0	63.7	51.6	21.9	7.7	37.4
Married	27.9	51.8	65.0	36.3	48.4	78.1	92.3	62.6
Shift work	89.5	86.8	77.5	88.0	75.8	62.5	30.8	66.4
Living in a dormitory	72.4	57.0	55.0	67.6	62.9	28.1	7.7	45.8
Blowing/carding	2.9	7.0	7.5	4.2	(Included in group 2)			
Spinning	27.0	27.2	25.0	26.9		Group 1		
Winding/sizing	16.6	20.2	25.0	18.1	29.0	37.5	23.1	30.8
Reaching-in	5.8	2.6	0.0	4.6		Group 2		
Weaving	36.3	36.0	22.5	35.1	25.8	21.9	23.1	24.3
Inspecting/others	11.3	7.0	20.0	11.0				
Mechanics	–	–	–	–	45.2	40.6	53.8	44.9

and filtration type personal dust samplers. Details of dust concentration measurement are described in another paper presented at this Conference (Dust concentrations in Thai textile mills).

Results

Table 1 gives features of the examined workers by sex, age and job. The majority were age under 30 for both sexes (69% of the female and 58% of the male), while unmarried workers accounted for 64% of the female and 37% of the male. The rate of those rotated in the three-shift system was higher for the female (88%) than for the male (66%), the rate being higher among younger workers. About two-thirds of the female were living in the dormitories, the corresponding rate being less than half for the male. The age composition was similar for different jobs, the majority being always less than 30 years old except for the group of blowing and carding sections.

Troubles at work: In interview, both female and male workers complained very frequently of uncomfortable environmental conditions. Especially high rates of complaints were noted as to being too dusty (66.7% of the female and 63.6% of the male), too noisy (60.6% and 58.9%) and too hot (60.4% and 58.9%). Also frequent was the feeling too stuffy. Heavy work-load was mentioned by 20.5%, too short pauses being noted more frequently by females (26.1%) than by males (9.3%).

Subjective symptoms: Among subjective symptoms claimed by the workers, the most frequent were 'tiredness after work' in the case of the female (56.6%) and 'low back pain' in the case of the male (56.1%). Next to them were 'joint pain,' 'low back pain' and 'sleepiness at work' for the female (51.6, 51.0 and 51.0%, respectively) and 'joint pain,' 'sleepiness at work' and 'tiredness after work' for the male (45.8, 43.9 and 33.6%, respectively). Palpitation (47.0%) and depression (35.7%) were also claimed by more than one-third of the female. The rate of stomachache and diarrhea was similar to both sexes (Fig. 1).

Findings by physical examination: Many were suffering from irritation and inflammatory changes of the skin, eyes, nose and pharynx. Dermatitis was found in 9.3% of the examinees, conjunctivities in 25.3%, rhinitis in 19.5% and pharyngitis in 19.1%. Perforation of the tympanic membrane was found in 5.1%. Hypertension with systolic blood pressure of 160 mmHg or more or diastolic pressure of 95mmHg or more accounted for 4.0% of the female but

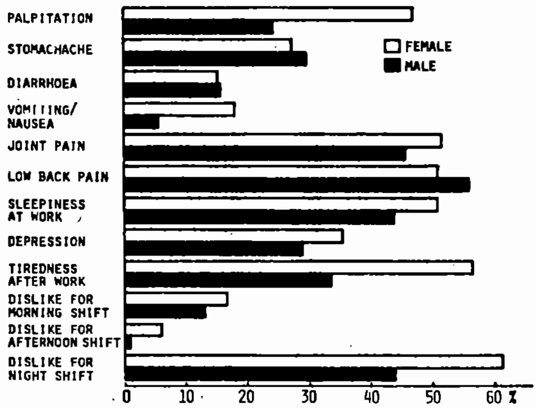

Fig. 1. Rates of subjective symptoms and of those with dislike for each shift among female and male textile workers studied.

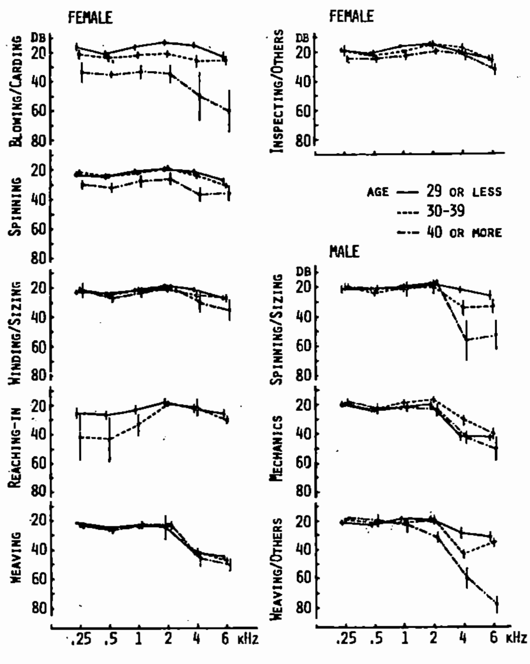

Fig. 2. The mean plus or minus standard error hearing levels of the examinees by sex, age and job based on results of audiometry.

9.3% of the male. Part of those findings were obviously related to unhygienic conditions and contact with dust. According to interviews, 73.6% found toilets or washrooms in the work-sites unclean and 39.5% water unclean, whereas of 385 dormitory residents, 80.3% found toilets and washrooms there unclean and 53.0% water unclean. Skin irritation by dust was felt by 54.9% of the whole workers, and eye irritation by 48.9%.

Hearing loss levels: Hearing loss levels based on audiometry are illustrated in Fig. 2. A very clear tendency of enhanced hearing loss at 4 kHz and 6 kHz is seen for female weavers and mechanics. Further, in the case of female spinning workers and male spinning/sizing workers of age 40 or more the 4 kHz dip was dominant. Noteworthy is little difference between the three age groups in hearing level decline at 4 kHz for female weavers and male mechanics, evidence that the decline was noise-induced.

Another evidence for the noise effect on those two groups is given by Table 2, which indicates percentages of workers with different categories of hearing loss of both ears. Category I refers to the hearing loss at 4 kHz 10 dB or more larger than the average of losses at 250, 500, 1 k and 2 kHz and equal to or larger than loss at 6 kHz. Category II refers to the hearing loss at 4 kHz similarly 10 dB or more larger than the average of losses at 250-2 kHz but less than loss at 6 kHz. The hearing loss at 4 kHz was 50dB or more for IA and IIA and less than 50 dB for IB and IIB. Those classified as I or II for both ears are suspected of noise-induced losses, those of IA or IB being highly suspected. As shown in the table, the rate of those in categories I and II was significantly high for female weavers (25.1%) and mechanics (33.3%). Notable were the particularly high rates of IA or IIA for these two groups. It should be also noted that few of the workers had been instructed about protection from noise and none were provided with personal noise-protective devices in any of the three mills, although the noise level in weaving sections was always as high as around 100 dB(A).

Table 2. Percentage of workers with different hearing levels

Job	Number of workers	Hearing loss of both ears					
		Normal	I_A	I_B	II_A	II_B	Others
Total	605	287	37	24	12	8	237
	100.0	47.4	6.1	4.0	2.0	1.3	39.2
Female, total	498	51.1	4.0	3.0	1.8	1.4	38.6
Blowing/carding	21	61.9	4.8	0.0	4.8	0.0	28.6
Spinning	114	85.1	0.0	3.5	0.0	0.0	11.4
Winding/sizing	90	66.6	0.0	0.0	1.1	0.0	32.2
Reaching-in	23	82.6	0.0	0.0	0.0	0.0	17.4
Weaving	175	12.0	10.9	6.3	4.0	4.0	62.9
Age −29 years	125	12.8	9.6	7.2	4.8	3.2	75.2
30–39	41	9.8	12.2	2.4	2.4	4.9	68.3
40–	9	11.1	22.2	11.1	0.0	11.1	44.4
Inspecting/others	55	80.0	0.0	0.0	0.0	0.0	20.0
Male, total	107	30.8	15.9	8.4	2.8	0.9	50.5
Spinning/sizing	33	51.5	15.2	3.0	0.0	0.0	30.3
Mechanics	48	20.8	20.8	6.3	4.2	2.1	45.8
Weaving/others	26	23.1	7.7	17.2	3.8	0.0	50.0

Normal : $L_{250\text{-}2K}$ and/or $L_{4K} < 35$dB, and/or $L_{6K} < 45$ dB
I : $L_{4K} \geqq L_{250\text{-}2K} + 10$dB, and $L_{4K} \geqq L_{6K}$
II : $L_{4K} \geqq L_{250\text{-}2K} + 10$dB, and $L_{6K} - 10\text{dB} < L_{4K} < L_{6K}$
A : $L_{4K} \geqq 50$dB
B : $L_{4K} < 50$dB

Respiratory symptoms and pulmonary functions: As Fig. 3 shows, the rate of those with history of tuberculosis was small, 1.2% for the female and 3.7% for the male, but that with history of asthma was rather high for females (4.8%), while it was 2.8% for the male. Those with cough during the day or at night for 3 months or more a year accounted for 6.6% of the female and 6.5% of the male, but the rate was higher for the female of blowing and carding sections. This group had similarly higher rate of those bringing up phlegm for 3 months or more a year. The female workers of blowing and carding had rates higher than the average for cough on the first day after holiday (23.8%) or chesttightness on the first day after holiday (14.3%). Because only 2.4% of the female workers were tobacco smokers, as opposed to 54.2% among the male, the observed respiratory symptoms were not related to smoking.

Based on results by the lung function test, the examinees were divided into four groups, the criteria being 70% of vital capacity in percentage of the normal level estimated by Baldwin's formula and 70% for percent-FEV_1. These criteria were chosen after examining the distribution patterns of those values, assuming that the normal values of vital capacity would be somewhat lower than the estimated ones. As indicated by Table 3, the results clearly show that those having either low %VC (vital capacity) or low %FEV_1 values were relatively frequent in blowing/carding and in spinning, as many as 33.3% in females of the blowing/carding sections, where 28.6% had %FEV_1 lower than 70%.

As discussed in the other paper to this Conference, dust concentrations in the air of these workshops far exceeded the standard value of 1 mg/m^3 of Thailand, more than excessive to cause respiratory disorders (British Occupational Hygiene Society, 1972).

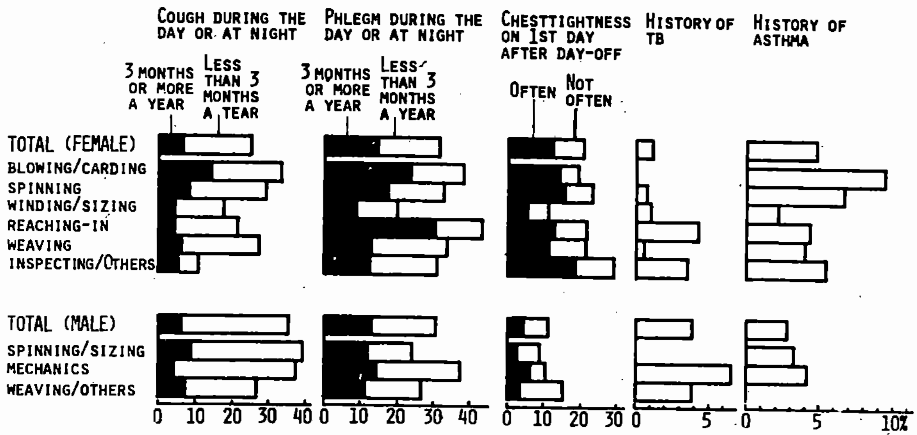

Fig. 3. Rates of examinees with various respiratory symptoms and past illnesses.

Table 3. Classification of examinees by two criteria of pulmonary functions, 70% in %-vital capacity and $\%FEV_1$

Job	Number of workers	A $\%VC \geqq 70$ $\%FEV_1 \geqq 70$	B $\%VC < 70$ $\%FEV_1 \geqq 70$	C $\%VC < 70$ $\%FEV_1 < 70$	D $\%VC \geqq 70$ $\%FEV_1 < 70$
Total	604	552	24	6	22
	100.0	91.4	4.0	1.0	3.6
Female, total	497	90.5	4.0	1.0	4.4
Blowing/carding	21.	66.7	4.8	4.8	23.8
Spinning	133	88.0	6.0	0.0	6.0
Winding/sizing	90	95.6	3.3	0.0	1.1
Reaching-in	23	95.7	4.3	0.0	0.0
Weaving	175	92.0	2.3	1.7	4.0
Inspecting/others	55	90.9	5.5	1.8	1.8
Male, total	107	95.3	3.7	0.9	0.0
Spinning	33	90.9	6.1	3.0	0.0
Mechanics	48	97.9	2.1	0.0	0.0
Weaving/others	26	96.2	3.8	0.0	0.0
Pulmonary function type		Normal type	Restrictive type	Mixed type	Obstructive type

Conclusions

1) The textile mill workers studied were revealed to have complaints about their environmental conditions such as climate, noise and dust as well as about fatigue from shift work, joint and low back pains, sleepiness at work and others. Effects of unhygienic conditions of workplaces and dormitories must be taken into account.

2) Clear evidence was gained concerning the noise-induced hearing loss among female weavers and male mechanics, both groups showing declines in mean hearing levels at 4 kHz and more and having higher incidence of hearing loss centering around 4 kHz. Longer exposure to noise would produce severer hearing loss (Taylor et al., 1965; Kell, 1975).

3) Respiratory symptoms in terms of chronic coughs, bringing up phlegm and chesttightness seemed to be associated with high dust concentrations, especially in the blowing and carding sections. Irritation by dust of the skin and the eyes was also frequently claimed.

4) The lung function test results showed that the rate of those having %FEV_1 lower than 70% was high in blowing and carding sections, implying increase of those with obstructive type impairment. Those results are suggestive of the existence of byssinosis or related respiratory illnesses to a significant degree among textile workers of Thailand (El Batawi, 1973; Imbus, 1974; Palmer et al., 1978; Shima, 1970). High dust levels are relevant here.

5) The obtained results point to the need of developing proper occupational health programs for the textile mill workers aimed at improving their environmental conditons and shift work systems. Joint work involving local agencies and research units would be of prime importance in organizing such occupational health programs.

References

British Occupational Hygiene Society, Committee on Hygiene Standards, Subcommittee on Vegetative Textile Dusts (1972) Hygienic standards for cotton dust. Ann. Occup. Hyg., 15:165.

El Batawi, M.A. and El-Din Shash, S. (1973) Int. Arch. Gewerbepathol. Gewerbehyg., 19:393.

Imbus, H.R. (1974) J. Occup. Med., 16:547.

Kell, R.L. (1975) Ann. Occup. Hyg., 18:97.

Kogi, K. (1977) Philippine Labour Rev., 2(4): 29.

Maurice, M. (1975) Shift Work. International Labour Office, Geneva.

Ministry of Labour, Labour Committee (1967) Report on Survey of Labour Conditions in Cotton Textile Factories in India.

Palmer, A., Finnegan, W., Herwitt, P., Waxweiler, R. and Jones J. (1978) J. Occup. Med., 4:627.

Schilling, R.S.F. (1962) J. Occup. Med., 4:627.

Shima, S. (1970) Nihon Kyobu Rinsho, 29:602.

Taylor, W., Pearson, J.C.G., Mair, A. and Burns, W. (1965) J. Acoust. Soc. Am., 38:113.

Textiles Committee, International Labour Organisation, Tenth Session (1978) Conditions of Work in the Textile Industry, Including Problems Related to Organisation of Work. International Labour Office, Geneva.

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Symposium 1.
Maximum Permissible Level of Pollutants and the Practical Evaluation of Them

WHO PROGRAMME ON INTERNATIONALLY RECOMMENDED HEALTH BASED EXPOSURE LIMITS FOR OCCUPATIONAL HAZARDS
– Progress Report –

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World Health Organization

Introduction

One of the important means for the prevention of health impairment from occupational exposure to harmful agents is to control such exposure to a "limit" judged to have no adverse health effect during the lifetime of the worker. Limits recommended by institutions and governments in different parts of the world vary considerably; and for the same agents often diverge much more than one would expect from the available scientific information. This situation has resulted in confusion with respect to means of control of occupational health hazards.

Recognizing this problem, the Executive Board of WHO resolved to implement a programme aiming at the development of Internationally Recommended Health-based Exposure Limits in Occupational Exposure to Toxic Substances (Resolution EB60.R2, 1977). The first Study Group by the subject was held to make such recommendations in 1979 in respect to certain heavy metals that were selected as priority. It also aimed at the harmonization of methodology in application of existing information for making decisions on safe "exposure limits" to toxic substances in the working environment, and establishing a policy that could be further elaborated in countries for undertaking this exercise.

The four heavy metals selected as priority; cadmium, lead, manganese and mercury represent a common occupational hazard in various countries, which results in serious damage to health. For each of the metals, the Study Group made a review of data on epidemiological studies and identified concentration levels where the very early manifestation of "adverse health effects" to workers are observed. In the light of analysis and evaluation of known information, the Group made recommendations of health-based exposure limits for the atmosphere of the work environment, and, in some instances, a biological limit was also recommended, indicating the level that should not be exceeded in the human body. Current research of health effects of various substances was reviewed and gaps in knowledge were identified. We distinguish these recommendation as the first of two-steps procedure; the second being the translation of these "health-based" limits into operational or compliance standards which are to be defined by countries in accordance of their local policies and other social and economic factors.

Implications of the Programme

a) As these "health-based" recommendations are the first step of a two-steps procedure, WHO would be expected to assist Member States in arriving at operational or compliance decisions through technical cooperation programmes in occupational health.

b) This is the first exercise of its kind initiated by WHO in the field of occupational health.

It is a new activity with international reflection on harmonization among countries of their occupational hazard control guidelines.

Conditions in developing countries sometimes impose constraints on the application of "occupational exposure limits" and may influence the authorities with regard to the adoption and/or development of these limits. On one side, health planners must convince legislators about the need for health-based exposure limits, particularly in terms of the potentially greater vulnerability of the working populations in these countries due to prevailing endemic diseases and malnutrition. Other planners, however, may argue that such limits may be stringent requiring additional costs to comply with them in the work environment. In view of the possible higher vulnerability of the working populations, we should alert countries of the danger to health of their working populations from simultaneous exposure to general diseases and occupational hazards. One of the means to deal with the problem is to use pre-employment health screening as a step for treating and curing general ill-health to make sure that workers start their employment as healthy people. Further control of hazards in the working environment would ensure the maintenance of health during employment.

c) Follow-up action in research concerning existing gaps in knowledge should be taken and possibly thereafter a revision made of recommended health-based exposure limits.

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AN OVERVIEW OF THE MAXIMUM PERMISSIBLE LEVEL OF AIRBORNE TOXIC MATERIALS IN WORKING PLACES IN JAPAN

Toshio TOYAMA, *Japan*

Setting a control level for toxic materials in the air we breathe either in working places or community environment is becoming a growing concern regardless of one's like and dislikes. The limit level, aimed primarily at human health protection, should be based on rational scientific evidence which should be approved by both professionals and users.

In Japan at present, the regulatory threshold limit for toxic substances in the air in working places is not legislated by the Ministry of Labor, although community air quality standards for some pollutants have been promulgated by the Environment Agency. During the postwar period, the so-called maximum allowable concentration, thus the term MAC, was not taken into account as a vital tool in regard to industrial health, despite the Labor Standard Act first enacted in 1945.

In 1959 a committee for maximum permissible concentration was inaugurated as one of the standing committees in the Japan Society of Industrial Health, which was headed by the late Dr. Shunji Minami. The first job of the committee was to set the limit values for 17 kinds of toxic materials, which at the time were thought to be an urgent concern. At present, in 1979, the MAC list includes 110 items, and about 40 other substances are now being considered for addition.(1) The first chairman of the committee was the late Dr. Susumu Harashima, the former ICOH organizer in Tokyo in 1969. The second was Dr. Juko Kubota, the present president of the Society, whom I have succeeded as chairman of the TLV committee.

The committee members prepare documents concerning toxicological criteria for the agents and make additions to and revisions of the list, which is later approved by the annual general assembly of the Society, usually held in April or May. Our philosophy in setting limits is quite similar to that of TLV of ACGIH; the average values for eight working hours are given for all the materials, and, for some materials, a short-term peak limit is given, i.e. benzene and asbestos.

Although our TLV for the majority of the materials has been adopted from ACGIH's values, there are different values for 20 items out of the 110. Some of them have been derived from original Japanese data taken from both animal experiments and human experiences. A copy of the 1974 list is available to the committee of the Society upon request.

It seems to be a remarkable tendency in the U.S. that TLV is becoming more and more stringent; NIOSH in particular has recommended strict limits for some materials. This might be partly due to the appearance of sophisticated medical and analytical research equipment and, in part, to alteration of the concept of health and disease or dose(exposure)-response relationship. The TLV committee has several subdivisions which work throughout the year and deal with carcinogenic agents, sensitizing agents, dust and particulates, and physical factors. Unlike ACGIH, we do not yet have lists for short-term limits and biological threshold limits based on blood, urine and expired air.

The most difficult and intractable problem for setting standards now involves carcinogenic and mutagenic agents. We have tentatively adopted the concept of the British Health and Safety Commission that signifies "as low as reasonably practicable" and NIOSH's recommendation for carcinogenic agents, that is "as low as technologically feasible" in regard to engineering and analytical aspects. However, we have adopted this concept for only a few materials such as vinyl chloride and asbestos. Our subcommittee for carcinogenic agents is still discussing two contraposed concepts of the threshold: "no-threshold or single-hit theory" which involves the mechanism of DNA and the "threshold or multiple-hit theory," which were cited by Dr. John Zapp in his Stokinger lecture in 1977.(2) This matter is urgent and needs to be solved, but may require much further discussion. I believe many industrial carcinogens have thresholds, and, in respect to the protection of workers' health in practice, this notion would be rational, based on past experience.

The question of whether permissible limits should be controlled by government legislation or by the recommendations of a nonlegal scientific society is not easy to answer because of the possibility of implications arising from various circumstances. In the U.S., nonlegal ACGIH's TLV had long been in a leading position until OSHA's direct control was enacted in 1970. NIOSH's proposal is closely related to OSHA's, and both of them are governmental bodies. The major advantage of a nonlegal standard limit is the easiness of revision or addition in accordance with the acquisition of knowledge and the availability of effective, autonomous participation by industries. On the contrary, legal control would make revision of the limits difficult, even though it be scientific, and would result in political biases. Nevertheless, there would be some merits, such as the advantage of collecting necessary information on industrial environments and the manageability of occupational health control and workers' compensation. In any case, the control limit should be used as a guide for health protection through the practice of industrial hygiene and should not be used as a sharp tool to demarcate individual health and disease.

For the Ministry of Labor of Japan, TLV legislation has been a pending problem. So they are now asking a professional committee if a regulatory TLV would be feasible, and, if so, how they would manage it technically and to what extent it would be covered in terms of the size or scale of the industry. Anyhow, the current means for setting the regulatory limit may be acceptable even from the viewpoint of an international trend. However, there are two diverse means: (1) standards for health protection should be controlled solely on the basis of the concentration of a certain chemical agent itself; (2) standards should be based on human exposure according to TWA's concept or Harber's rule, in which the exposure constant (k) is the product of concentration and time (c x t). Harmonization of the two concepts seems to be the key to use of TLV in administrative practice.

The concept of "action level," which has been initiated by NIOSH and the International Labor Office,(3)(4) may be the most promising and practical instrument when considering regulatory feasibility, judging from the present situation in Japan. The action level is usually one half of TLV (NIOSH) or between one third to one half (ILO). However, this is related directly to compliance or noncompliance tests which require relatively complicated measuring and statistical procedures at a designated work area; thus, this can be applied only to larger industries where a well equipped industrial hygiene service is available.

In regard to existing, adjacent regulations which might be related to TLV control, Japan has already had several such laws as designating hazardous places of work, requiring periodic measurement of the concentration of certain toxic agents, and certifying environmental technicians to perform air sampling and analysis.

Unfortunately, since Japan has no academic facilities for the training of professional industrial hygienists as does America, regulations in this field have been considerably lax. Thus, a small number of medical researchers and a few health engineers have organized the Society of Industrial and Occupational Health Engineering under the auspices of the National Research Institute of Industrial Health, headed by Dr. Hiroyuki Sakabe. Inspite of a shortage of qualified persons, the scientific level of industrial hygiene is fairly high in quality. Particularly, technological devices for measuring gases and aerosols are noticeably advanced.

In relation to the evaluation of the exposure-response relationship, which is the basic concept for setting limits, new research devices, such as personal samplers and badge-type dose indicators, have been introduced for intensive study. These have been enhanced also by simultaneous popularization of simple gas chromatography in the practice of routine industrial hygiene. We anticipate that this low-priced but useful technique will soon prevail in practical administrative use.

Finally, I would like to give you an example. We have had almost 30 years of experience with the postwar viscose rayon industry, in which the major hazardous agent is carbon disulfide. We investigated as to how MAC actually influenced factory management, its effect on environmental and health control, and how it was revised in the course of changing working conditions, as demonstrated in the Figure.[5]

The Figure shows the chronological changes in major adverse health patterns from the end of W W II to the present according to improvement in CS_2 concentrations in three different measurements; (1) average value with and arbitrary TWA occasionally reported by factory management (the thin line); (2) average values actually measured occasionally (the bold line);

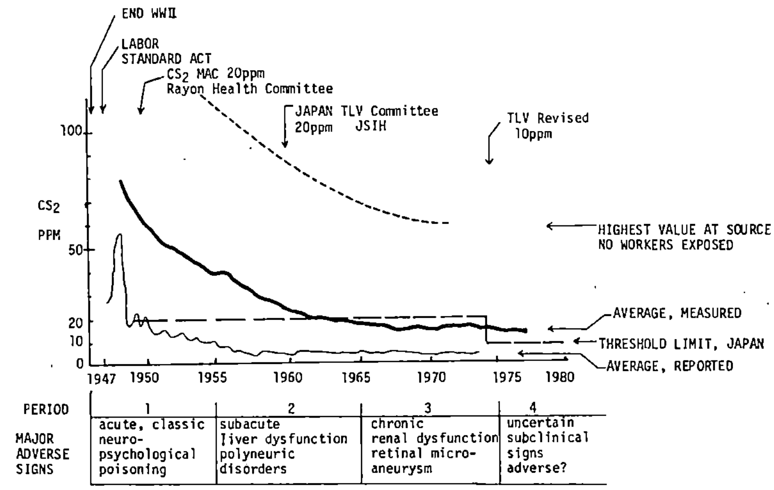

Fig. Postwar changes in CS_2 level and adverse signs in viscose rayon industry in Japan

(3) the highest peak source but no workers exposed (the dotted line). During the postwar period, working conditions were so bad that a typical, classical type of occupational disease with acute neuro-psychological disorders was prevalent. Therefore, in 1949 the industrial health advisory committee, of which I was a member, warned that a MAC of 20 p.p.m. for CS_2 should be used as a guideline. As a result, the concentration of CS_2 reported by factories has been ridiculously low since about 1950, as indicated in the figure. Nevertheless, quite a few illnesses such as liver dysfunction and polyneuritic disorders have been found since then through annual periodic health checkups. In fact, the actual level of exposed gas was fairly high, as shown by the bold line in the figure. In the next period, almost subclinical signs such as renal dysfunction and retinal microcirculatory disorders continued to be observed, and yet the average of CS_2 was reported to be below 20 p.p.m. For this reason, the TLV committee has changed the TLV of CS_2 from 20 p.p.m. to 10 since 1974 (the broken line). If we find any new uncertain diverse signs, we will have to consider a more stringent limit.

This example clearly shows us the extent to which plant health management reacted to the TLV concept, even though was it non-regulatory and had some weak points, and how plants cooperated in dealing with a difficult situation.

In conclusion, I would like to say that regulatory TLV is necessary provided it is used properly. The ultimate objective of TLV is to protect workers' health; this involves not only the prevention of acute clinical illnesses but also chronic, long-term, subclinical health risks. Thus, the primary purpose of control of the environment is to lower the exposure or intake below the TLV level as much as possible through industry's own endeavor, thereby making TLV a guideline rather than a strict benchmark.

References

(1) Recommendation of Permissible Criteria of Hazardous Working Environments for 1978, Jap. J. Ind. Health 20: 290, 1978 (in Japanese)

(2) Zapp, J.Z.: An acceptable level of exposure. Am. Ind. Hyg. Ass. 38: 425, 1977

(3) Leidel, N.A. et al.: Exposure measurement action levels and occupational environmental variability, NIOSH 1975

(4) Code of practice on occupational exposure to airborne substances harmful to health. ILO, Geneva, Dec. 1977

(5) Toyama, T.: Significance of acceptable level. Biotec. 4: 179, 1973 (in Japanese).

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NOTIFICATION AS A SOURCE OF INFORMATION ON OCCUPATIONAL DISEASES

Thomas K. NG., *Australia*

Introduction

One thing that always fascinates me, as an occupational physician, is information collection on occupational ill health. I do not think we have paid enough attention to this subject. When we need information, we usually try to get it from elsewhere. When we are asked to collect information, we often try to demand a system of notification.

Hong Kong has a voluntary system for the notification of silicosis and a compulsory system for the notification of a number of other occupational diseases. The objective of this paper is to make a brief critical study of both systems at work.

An ILO Recommendation

It is an ILO recommendation that has influenced greatly notification of occupational diseases in Hong Kong. This is Recommendation

No. 97, cited as the Protection of Workers' Health Recommendation, 1953. It deals with four matters: (1) technical measures for the control of risks to the health of workers, (2) medical examinations, (3) notification of occupational diseases and (4) first aid.

Regarding notification of occupational diseases, it states that national laws or regulations should require the notification of cases and suspected cases of occupational disease to the labour inspectorate or other authority concerned with the protection of the health of workers in places of employment. It further states that such notification should be required for four collated objectives on planning, investigation, information and compensation.

Period Before Legislation

With the establishment of the Industrial Health Office within the Labour Department in 1954 attempts to collect information on occupational diseases began. This was done in two manners. First, an agreement was made with the Government Chest Service to conduct annual chest x-ray survey in many places of work, including the stone quarries and to notify to the Industrial Health Service on any case of silicosis spotted (Ng, T.K., 1977). As to the other occupational diseases, an appeal was made to all the medical practitioners in Hong Kong to notify on a voluntary basis (Ng, T.K., 1976).

In 1965, notification for a number of occupational diseases was made compulsory under the Factories and Industrial Undertakings (Notification of Occupational Diseases) Regulations. Up to this point in time, a total of 347 occupational diseases were recorded, according to the annual reports published by the Labour Department (Table 1). Dermatitis accounted for 151 cases and silicosis, another 117 cases. The 'other' group included lead poisoning, manganese poisoning, chrome ulcer, metal fume fever and so on.

Period After Legislation

The reason why certain occupational diseases were made notifiable by law in 1965 was that in that year, these diseases were made compensable, for the first time, under the Workmen's

Table 1. Occupational diseases notified annually before the introduction of the compulsory system 1957 – 1965

Year*	Occupational Diseases Notified			
	Dermatitis	Silicosis	Others	Total
1957 – 58	53	13	11	77
1958 – 59	33	12	18	63
1959 – 60	30	12	1	43
1960 – 61	5	12	7	24
1961 – 62	12	7	16	35
1962 – 63	10	7	16	33
1963 – 64	4	17	2	23
1964 – 65	4	37	8	49
Total	151	117	79	347

*Year = Financial year commencing on 1st April and ending on 31st March

(Source: Annual Departmental Reports, Labour Department, Hong Kong Government, 1957 – 1965)

Compensation Ordinance. In other words, the list of notifiable occupational diseases was the same as the list of compensable occupational diseases in Hong Kong (Ng, T.K., 1976). Silicosis was considered to require a special scheme for compensation and for that reason, silicosis was not made notifiable in Hong Kong.

From 1964, when the compulsory system of notification was contemplated, to 1974, when I ceased to work in the Industrial Health Office, a total of 69 notifications were received (Table 2). Screening through these 69 notifications, I found that they came from 40 medical practitioners and that only one notification came from the only medical school in Hong Kong. What was even more interesting was that I was able to divide the 69 notifications into four categories: (1) notifiable and occupational in origin, 13, (2) notifiable but not occupational in origin, 2, (3) not notifiable but occupational in origin, 45 and (4) not notifiable and not occupational in origin, 9. The net yield was thus 13 cases only.

The situation remained more or less the same in 1975 and 1976. In 1977, the latest information available from the official publication, 450 notifications of occupational diseases were made in that year and 448 of them were 'confirmed' cases of decompression sickness.

Table 2. Notifications of occupational diseases received by the industrial health office 1964 – 1974

Year*	Number of Notifications Received
1964**	7
1965	13
1966	22
1967	14
1968	3
1969	4
1970	3
1971	2
1972	1
1973	0
1974	0

*Year = Calendar year

**In 1964, the period was from 1st September to 31st December

(Source: Register of Occupational Diseases kept by the Industrial Health Office of Labour Department, Hong Kong)

For silicosis, notification remained on a voluntary basis by doctors working in the Government Chest Service. Owing to the lack of local information, no satisfactory scheme of workmen's compensation has been worked out even now (Ng, T.K., 1977).

Discussion

In 1953, a joint ILO/WHO working committee was very critical of having one system of notification of occupational diseases under the national law to serve the four collated objectives on planning, investigation, information and compensation (WHO, 1953). In spite of the strong criticism, ILO went ahead to specify such a requirement in the form of a recommendation, though not in the form of a convention.

The experience in Hong Kong reflects the failure of this recommendation. Take occupational dermatitis for example. Hong Kong opts to use such a complicated machinery to bring cases into light for workmen's compensation. This result, as one can see, is that doctors are unwilling to label dermatitis as occupational.

This gives rise to an important issue. What is meant by a case of confirmed occupational disease? Confirmation can refer to the pathological entity or to the occupational exposure, or both. The system in the United Kingdom for the notification of "industrial diseases" requires medical practitioners to check on the pathological entity, leaving the confirmation of occupational exposure to the term of experts working in the Government. Moreover, the two lists of notifiable and compensable occupational diseases in that country are not identical, the former serving the purpose of early preventive action and the latter serving the purpose of facilitating claims for compensation (Health and Safety Executive, 1978).

Decompression sickness is a notifiable occupational disease in the United Kingdom, but only to the extent that it involves loss of working time in excess of one shift, requires special medical attention or involves symptoms other than simple bends (Ministry of Labour, 1963). In Hong Kong, there is no such restriction. Applying the UK criteria, majority of the 448 cases in 1977 need not be notified. Furthermore, they serve no workmen's compensation purpose because the law in Hong Kong provides compensation only if the injury or disease has incapacitated the worker for more than three days.

Health administrators usually make a mistake in taking the number of occupational diseases notified as the size of the occupational health problem in a particular place. If this is done, it is to the detriment of that place. The system of notification of occupational diseases works entirely different to the system of notification of infectious diseases.

Conclusion and Recommendation

We must remember that only the known and notorious occupational diseases become notifiable. What notification can do is similar to taking a picture of the tip of an iceberg. A good camera will give a good picture of the tip, but the tip remains the tip. To explore into the unknown problems in occupational health, training programmes and epidemiological studies are necessary.

Information utilization is a problem facing the health planners and administrators, if they are untrained in occupational health. All occupational health workers must work hard, not only in equipping themselves capable of collecting information whenever required, but also in weighing evidence obtained from epidemiological studies and statistical compilations, locally and abroad.

Lastly, it is recommended that in the near future, ILO should make a study on the effectiveness of its Recommendation No. 97, particularly the part on notification of occupational diseases.

References

Health and Safety Executive, 1978, Notification of occupational ill health, a consultative document, HMSO, London.

Ministry of Labour, 1963, Annual Report of the Chief Inspector of Factories on Industrial Health for the year 1962, HMSO, London.

Ng, T. K., 1976, An appraisal of the system of notification of occupational diseases by medical practitioners in Hong Kong, MFCM thesis, Faculty of Community Medicine, Royal College of Physicians, London.

Ng, T. K., 1977 Pneumoconiosis in Hong Kong: its epidemiology, control and compensation, MD thesis, University of Hong Kong, Hong Kong.

WHO, 1953, Second Report of Joint ILO/WHO Committee on Occupational Health, Technical Report Series No. 66, WHO, Geneva.

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AN EXPERIMENTAL STUDY ON THE EFFECT OF ENVIRONMENTAL TEMPERATURE TO THE MANIFESTATION OF METAL INTOXICATION DUE TO INTERACTION BETWEEN MERCURY AND SELENIUM.

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The effects of environmental temperature on the toxic manifestation of hazardous chemicals have attracted strong attention since the studies of the effect of temperature on the lead poisoning among children have been reported which showed the seasonal difference in clinical findings.

Therefore much precautions should be provided if the permissible exposure level in the working environment should be established which can be adopted not only in the temperate climate area but in the tropical or subtropical area, particularly in the territory where the most of developing countries are involved and the industrilization is being made a rapid progress.

The purpose of this study is to clarify the effect of environmental temperature on the toxicity of methylmercury and also on the interaction between methylmercury and selenium. The results obtained in this study will provide us with the possible parameters in establishing pertinent permissible levels of toxic metals to cope with the diversity of working environments.

Methods

Male Wistar JCL rats (total number 164, mean body weight 221.5g) have been used in this experiment. After the rats have been acclimated to the target temperature for 15 days, (21 out of 164 rats were eliminated because of an unfit body weight) five were killed for the initial control and the remaining 138 rats were divided into six groups for the experimental purposes. Experimental groups (A to E) have received the following chemicals respectively; Group A: 5mg methylmercuric cholride (MMC/kg, Group B: 5mg MMC plus 3.8mg sodium selenate (Se)/kg, Group C: 5mg MMC plus 1.9mg Se/kg, Group E: 3.8mg Se/kg and Group D: 1.9mg Se/kg. The chemicals were injected subcutaneously on the back once every three days for 60 days. The rate in Group F were used as a control. Five rats from each group were killed on the 15th, 30th and 45th day during the experimental period and the rest of survivors were killed on the 60th day.

The amount of food and water ingested was measured by each cage every three days. Food and water consumption per capita was calculated from the total consumption of each cage which holds three to five rats. Measurement of body weight and observation of general condition were carried out with special attention to the signs of methylmercury intoxication, on the previous day of administration of chemicals.

Representative signs of methylmercury poisoning in rats are considered as follows; crossing of hind legs when the rat was put up by the tail upside down, convulsion and ataxia of hind legs. The blood, brain, liver, kidneys, spleen and testicles were taken for the measurement of the concentration of total mercury, methylmercury and selenium. The weight of organs were also measured to see the biological effect of chemicals in experimental animals. The target temperature in this experiment was moderate temperature (MT: 22±2°C) and high temperature (HT: 33±2°C) respectively. The function and the capacity of specially designed, temperature controllable experimental apparatus mentioned in the pictures are as follows;

Capacity: 17.42 m^3

Controllable temperature: from -5°C to 60°C

Humidity: 30-80%, according to the temperature.

Results

General findings and mortality of experimental animals:

Clinical signs of methylmercury poisoning appeared more frequently in the rats group A, MMC alone, than in the rats of group B and C, MMC with Se, at the moderate temperature (MT) and also at high temperature (HT).

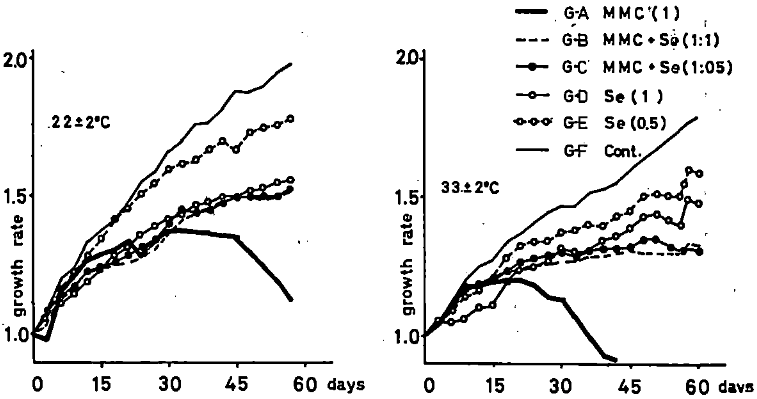
Group A (MMC alone): The first signs of convulsion and crossing of hind legs were observed on the 28th day and staggering signs were observed in all rats on the 60th day at MT, on the other hand, 2, 2 and 4 rats showed crossing of hind legs on the 24th, 27th and 30th day respectively and staggering signs were observed in 2 and 5 rats on the 33rd and 36th day respectively at HT. Minimum dose of MMC to show the earliest clinical signs of methylmercury poisoning was 13.09 mg at MT, and at HT it was 9.45-17.47 mg (average 13.08 mg), and significant difference was not found in the minimum effective dose between the MT and HT group.

No fatal case was found during the experimental period of 60 days at MT, while in the HT group most of rats except two died during the period from the 30th to 43rd day which was corresponded to 7.7 days on average after the appearance of clinical signs and two rats survived was killed on the 43rd day because of severe emaciation. Total dose of MMC administered was 11.67-18.93 mg, 15.13 mg on average, in group A at HT.

The appearence of early signs of poisoning and mortality in group B and C was as follows. At MT condition, the crossing of hind legs appeared in only one rat on the 28th day, when total dose administered was 15.81 mg of MMC and 11.91 mg of Se, and all remaining rats showed no signs of MMC poisoning and survived up to the 60th day in group B, and neither suspected or definite sign of poisoning nor even death case was found in group C. At HT condition, there were two deaths on the 2nd day, which however showed no signs of MMC poisoning, and only one rat showed signs of poisoning on the 27th day when total dose administered was 20.03 mg of MMC and 15.06 mg of Se in group B. And in group C, signs of poisoning appeared in 1, 1 and 3 rats on the 18th, 24th and 58th day, when the total dose administered was 13.14-26.51 mg (22.04 mg on average) of MMC and 4.94-9.97 mg (8.29 mg on average) of Se, but no death was observed during the experimental period.

Observation of body weight:

Body weight changes converted to a ratio for each rat in comparison with the initial body weight at the respected experimental period, were compared between each experimental and the control group. A two-way analysis of variance was adopted for a statistical study of the ratio calculated in this experiment. In the control group, the growth rate of body weight is larger at MT condition with statistically high significance than that observed at HT. Significant difference in growth rate was also observed between all groups respectively at MT condition,



and the significant difference was also recognized between each group except between group B and D, group C and D at HT condition. The growth rate of body weight of group B and C showed similar increase with that of group D.

Weight of Organs:

The weight of the brain, liver and kidney were compared among rats of all experimental groups by the statistical method of two-way analysis of variance. In the control group, the weight of all rats organs was heavier at MT condition than that at HT with the P value of less than 0.05 in the brains and less than 0.01 in the livers and kidneys. In addition to the statistical analysis on the weight of rat organs in the control group, a comparative analysis on the organ weight between each experimental group (group A to E) was carried out. The results obtained were as follows:

Brain: no significant differences among the groups at MT and HT condition.

Liver: significantly heavier in group D than in group C, and in group E than in group C and D at MT, however no significant differences at the HT condition.

Kidney: significantly heavier in group A and B than in group D at MT, and in group A than in group D, E and F, in group B than in group D and E, in group C than in group D and E, and group F than in group D at HT condition.

Food Intake:

The amount of food ingested per rat per day was as follows; 27.1 g in group F, 27.0 g in group E, 23.7 g in group D, 22.0 g in group B, 21.8 g in group C and 18.7 g in group A arranged in order of larger consumption at MT condition, and 17.7 g in group F, 15.3 g in group D, 15.2 g in group E, 13.51 g in group B, 13.48 g group C and 10.76 g in group A at HT condition.

Significantly larger consumption of water in HT condition was observed.

Discussion and Conclusion

1. The effect of environmental temperature on the appearance of signs of methylmercury poisoning between experimental animals raised in MT and HT was not clearly disclosed. However mortality during the experimental period was higher at HT than at MT condition.

2. The more stronger inhibitory effect of selenium on the manifestation of methylmercury poisoning was observed when selenium was administered together with MMC at 1:1 molar ratio than that of 1:0.5 both in MT and HT condition.

3. In control group, the body weight of rats was kept heavier in all groups at MT than at HT and a great part of this differences may be attributed to a decrease of food ingestion in rats at HT condition.

4. The toxic effect rather than preventive effect of selenium might be intensified at HT condition. This speculation was obtained from the experimental results by a statistical analysis of growth rate of body weight which showed similar behavior in the group B, C and D.

5. The kidney weight has significantly decreased by the administration of selenium but increased by the administration of methyl-

mercury at HT environment condition. The findings observed in this experiment might be characteristic systemic action of selenium and methylmercury chloride. The biological effect of the two chemicals thus demonstrated in the kidney was supposed to be intensified by a high environmental temperature.

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GENERAL CONCEPTS OF MPLs, TLVs, MACs AND EELs

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The usefulness of the concept of permissible levels of harmful agents in the working environment has been adequately demonstrated in many practical situation in which these has been a significant reduction or disappearance of occupational diseases following the adequate application of these levels. The main object of the application of permissible levels should be to main an optimum state of physical, mental, and social wellbeing in the working population. "Permissible level" has been well defined in the reports of WHO and ILO documents of Technical Report Series, No 415, 1969; No. 601, 1977; and Bulletin of WHO, 47, 1972.

Permissible level is a quantitative hygiene standard which is increasingly used by health services as guides for promoting safe conditions, expressed as a concentration with a defined average time. The term "permissible level for occupational exposure" can also be taken to mean "maximum allowable concentration," "threshold limit value" and "maximum permissible limit dose."

1. *Threshold limit values (TLVs):*

The average concentration in air of each substance, which is normally harmless on prolonged occupational exposure, forms a hygiene standard known as a threshold limit value(TLV). Such TLVs as have been ascertained by human and animal experiment and from industrial experience, are published for about 500 industrial materials and revised annually, by the American Conference of Governmental Industrial Hygienists (ACGIH).

The threshold limit values refer to a time weighted average air-borne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed to 8 hour-work, day after day, without adverse effect.

Threshold limit values are set at a concentration which will be safe for all but a small minority of susceptible individuals. There can exist wide variations in susceptibility in the general population to ill-effects from each substance. Determination of a TLV depends upon the criteria for the ill-effects, their health significance, and the proportion of people affected by a given exposure. Thus, for substances causing a high incidence of cancer in man (e.g. benzidine, β-naphthylamine) no occupational exposure or contact should be permitted. If the criteria relate to the earliest signs of disease before there is functional defect, as in byssinosis or asbestosis, the TLV might be set at a concentration where only a small proportion develop early signs after prolonged exposure, provided those affected (the most susceptible) could be identified by suitable periodic medical examination at a stage before progressive disease is established.

Threshold limit values represent a time-weighted average concentration above which excursions may usually be permitted, provided they are compensated by equivalent excursions below the limit. Some substances, because of their acute effects or irritancy, have TLVs above which excursions are not permitted, and are designated ceiling or "C" values, which are in effect maximum allowable concentrations. Some substances also have the appellation 'skin' to denote a risk from skin absorption or skin irritation, in addition to any airborne hazard.

Thus, these values are based on various criteria of toxic effects or on marked discomfort; they shouod not be used as a common denomination of toxicity, nor should they be considered as the sole criterion in proving or disproving diagnosis of suspected occupational disease.

These limits are intended for use in the field of industrial hygiene and should be interpreted and applied only by persons trained in this field. They are not intended for use, or for modification for use, (1) as a relative index of toxicity, by making a ratio of two limits, (2) in one evaluation or control of community air pollution or air pollution nuisances, (3) in estimating the toxic potential of continuous uninterrupted exposures, (4) as proof or disproof of an existing disease or physical condition, or (5) for adoption by countries whose working conditions differ from those in the U.S.A.

2. Maximal Acceptable Concentration (MACs):

MACs are standards for some chemicals that has adopted by the American Standard Association. The values represent the concentrations of contaminants below which ill effects are unlikely to be experienced by any but hypersusceptible individuals. The ASA Standards differ from the ACGIH Standards in that the ASA values represent a limiting concentration or ceiling, below which all concentrations should be maintained, where the ACGIH values represent the average of the time-weighted concentratons throughout the eight-hour daily operations. In other words, the ACGIH Standards allow the concentration of contaminants (except those marked with a C) to fluctuate a "reasonable" amount above & below the TLV, providing the average level for the 8-hour period does not exceed the standard. Under the ASA standards, the concentrations should not exceed the MAC values even momentarily. The amount by which these figures may be exceeded for short periods during the workday depends upon a number of factors, such as the nature of the contaminants, whether very high concentrations even for short periods produce acute poisoning, whether the results are cummulative, the frequency with which high values occur and for what periods of time. All must be taken into consideration in arriving at decision as to whether a hazardous situation is deemed to exist.

MACs are used in some countries, and indicate levels not to be exceeded. Those in the USSR, which has a list of about 700 MACs, tend to be based more upon the detection of minimum functional or physiological changes, rather than upon adverse effects.

To use MACs intelligently, it is necessary to understand the various methods for obtaining such values and their inherent limitations. MACs are also established on the basis of several types of data; animal experimentation, supplemented in some cases by human exposures, investigations of cases of occupational diseases and the related exposures, and surveys in industries where the concentrations of a substance in the air in compared with results of clinical and laboratory examinations on the workers. All of these methods have serious drawbacks. Experiments on human subjects must be limited to safe levels. Results obtained in animals can be applied to man only by making a number of assumptions, since different species and even different strains of the same species may react very differently to the same exposures. Surveys of industries are handicapped by the fact that the exposures are constantly changing, so that concentrations found at the time of the investigation may not be representative of those which existed in the past. This aspect is especially important when chronic diseases which develop slowly over a span of months or years are being considered.

The application of MAC values to practical conditions also presents problems. Too often the industries do not know the composition of the chemicals they are using, since many of these are sold under trade names, many are mixtures, and few are free of contaminants which in some instances may be the important toxic constituent.

Unless otherwise specified, all MAC values apply to on 8-hour exposure. Only a few figures have been suggested for shorter or continuous 24-hour exposures. Safe concentrations for shorter or longer exposures cannot be extrapolated safely from values recommended for an 8-hour exposures. For example, if 100 ppm is safe for 8 hours 12 ppm is safe for one hour.

It is not safe to assume that the concentration determined for one substance is applicable to even closely related chemical compounds; all new chemicals must be studies individually. To meet this problem, most of the large chemical industries maintain experimental laboratories to study the toxicological properties of their products, or they employ commercial laboratories for this work.

It is apparent from this discussion that maximum allowable concentrations are not fixed standards of safe working conditions. Some are based very sound evidence; others represent only the current opinion based on meager data available at the time; all are subject to constant revision. However, if used intelligently, they are invaluable guides to industries and health anthorities.

TLVs and MACs are both based on dose-response effects of human or animal exposure for each substance. Thus the permissible dose levels adopted will depend on the type of response used as an index. Other factors influencing limits laid down are as follows.

(1) The reliance placed upon animal experiments according to the species used.

(2) The size of the human population for which data may be available: the smaller the population exposed, the greater is the range of uncertainty.

(3) The constitution of the population, i.e. their biochemical individuality in genetic, immunological and nutritional terms.

(4) Associated exposures (community air pollution; etc.)

(5) The severity of effects, and how an 'acceptable risk' is defined – i.e. what proportion of the population are we prepared to allow to be affected?

Not surprisingly, there are often several scientific reasons for differences in national hygiene standards.

3. Emergency Exposure Limits (EELs):

Emergency exposure limits have been suggested by the AIHA for calculating risks from any large scale accidental air pollution, e.g. in the bulk handling, transport and storage of chemicals. They may be used in two ways; (a) to estimate risks to individual rescue workers; and (b) to anticipate community risks in the neighbourhood. EELs utilize information on reversible effects for short exposures to high concentrations, limits usually being expressed for periods of 10, 30 and 60 minutes exposure. These limits are not intended to replace accepted safe practices and should be accompanied by appropriate medical surveillance.

In Korea, an expect committee for MPLs has been organized as one of the standing committees in the Administration of Labor Affairs. At present MPLs for 57 kinds of chemical substances, 8 kinds of dusts and for physical conditions such as noise, heat, illumination etc. are set and recommended as a guidelines to control and supresses the toxic materials and harmful conditions. The values have been set by modification of the TLVs, but some are based on the data obtained through experimental studies in the research laboratories and epidemiological studies among working population in industry.

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PERMISSIBLE LEVELS IN OCCUPATIONAL EXPOSURE TO HARMFUL AGENTS

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One of the objectives of occupational health is the prevention of health impairment, and setting up permissible levels is one of the means of achieving this goal. The usefulness of the concept of permissible levels of harmful agents in the working environment has been adequately demonstrated in many practical situations in which there has been a significant reduction or disappearance of occupational diseases following the adequate application of these levels. The main object of the application of permissible levels should be to maintain an optimum state of physical, mental and social wellbeing in the working population. "Permissible level" has been defined in previous ILO and WHO documents; it is a quantitative hygienic standard for a level considered to be safe, expressed as a concentration with a defined average time. The term "permissible level for occupational exposure" can also be taken to mean "maximum allowable concentration", "threshold limit value", and "maximum permissible limit or dose".

There are many factors should be considered concerning permissible levels. The workers may often be exposed to more than one harmful agent and thus to a potentiation or synergism of harmful effect. Workers may also be exposed to occupational hazards for periods longer than 8-10 hours per day, and those exposed may include vulnerable people who may not have the advantage of preplacement medical examinations and who may be affected by endemic or chronic diseases. Permissible level therefore should not be rigidly fixed but should allow for adjustment, depending on the type of exposure, its complexity, the general environmental and living conditions, and other variables.

For developing permissible levels for a given substance the basic prerequisites are :

a. The physical and chemical properties of the substance, including the nature and amount of any impurities,

b. Toxicological investigations

- acute, subacute and chronic
- route of entry, respiratory, alimentary and dermal

c. Clinical and epidemiological information on human data.

Any data that may be available on human experience are of the utmost importance in establishing or revising permissible levels. Validation mainly depends on human observations and every effort must be made to obtain relevant clinical and epidemiological information.

Susceptibility to chemical compound may be affected by sex; sometimes female appear to be more susceptible than males (same response at lower dosage) and in other cases the reverse is true.

Epidemiological findings may indicate factors requiring special attention in setting permissible level: – variation in the vulnerability of the working population, the effect of work exertion, and the effect of exposure to a number of contaminants. In developing countries, where the nutritional status is often poor and the general level of health may be affected by endemic diseases, the increased vulnerability of the working population to chemical exposures is of special concern. Genetic difference in individuals or ethnic groups may also increase vulnerability to certain substances.

Regarding technical factor, sampling and analytical technique play a definite role in establishing standards. Sampling and analytical methods should be standardized and standards should refer to specific methods because there may be substantial difference between one method and another in precision, accuracy, and sensitivity.

A large number of developing countries are in tropical and subtropical areas where temperature and humidity and somtimes altitude may play a role in the absorption, metabolism, and elimination of toxic agents. Other factors bearing on the adoption and application of permissible levels are cultural attitudes to health and disease, socioeconomic structure, urbanization, level of education, and degree of skill.

The recommended permissible levels in use in highly industrialized countries tend to reflex the fact that workers in these countries are generally a selected population with respect to age and health status. In the developing countries this may not always be the case. The overwhelming majority of the working population are employed in agriculture and small industries and are unlikely to have received preemployment medical screening. A large part of the working populations in developing countries, even in large industries, may be affected by endemic diseases, including parasitic infestation, chronic diseases, and malnutrition. The workforce may include young children, elderly people, and partially handicapped workers. In addition, hours of work may not always be strictly regulated, and longer shift periods and longer periods of exposure to potentially harmful agents are encountered. In some instances workers may utilize the workplaces as their own dwellings or undertake certain hazardous operations in their homes. Permissible levels that assume an exposure of 8 hours a day for basically healthy individuals would therefore be inappropriate for more vulnerable workers in the developing countries.

Combined exposure to multiple stress in certain industrial operations is a problem with respect to recommendations for permissible levels of individual agents. Synergism and potentiation of harmful effects should be considered. In the developing countries simultaneous exposure to physical and chemical hazard appears to be greater that may influence the uptake of toxic chemicals. It is suspected that even minimal exposure to harmful agents for a short period of time, may produce a rapid aggravation of health problems. And many of the workers are exposed to organic dust such as textile dusts, wood dust, grain dust and other dusts of vegetable and animal origin which have not received adequate attention in research regarding biological effect.

It is important to account for these factors in making recommendations on permissible levels. It is essential to carry out a periodic re-examination of permissible levels in the light of new scientific findings and general progress of knowledge in toxicology and hygiene.

It is hope that international organization such as WHO and ILO will be able to make international recommendations based on a broad consensus among health scientist.

References

Hatch, T.F. : The role of permissible limits for hazardous airborne substances in the working environment in the prevention of occupational disease. : *Bull. Wld. Hlth Org, 1972 47, 151-159.*

WHO Expert Committee : Method used in establishing permissible levels in occupational exposure to harmful agents. : *Wld Hlth Org. Techn, Rep, Ser., No. 601 (1977).*

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MANGANESE: COMMENTS AND DISCUSSIONS IN ESTABLISHING MPLs

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Genetical or hereditary characteristics observed among miners suffering manganese poisoning in Cuba and Mexico are discussed in this paper.

individual susceptibility to any disease is difficult of definition, more so, in such cases as those of manganese poisoning, where the epidemiological variables are so many in number. In this occupational disease, while some workers are exposed for many years without disorders, as if they were immune, some others are intoxicated after brief occupational exposures. Many facts are to be considered, such as diet (iron deficiency, hypovitaminosis); chronic infections (syphilis, malaria); permeability of the upper respiratory tract; virus infections affecting the central nervous system; alcoholism; interactions with drugs and chemicals (carbon monoxide); age; sex. No development of tolerance to manganese has been reported.

In 1962, the first suggestions were made to identify those workers with a genetic potential to hyper-react to industrial chemicals. The objective is to apply the advances in human genetics during the last years to the identification of those workers who have the genetic potential to hyper-react to certain industrial substances and thus are not provided the protection offered to other workers by control procedures. Tests recommended for detecting specific disorders are: (1) the serum antitrypsin deficiency tests relating to chronic obstructive pulmonary disease, (2) the glucose-6-phosphate dehydrogenase deficiency and hypersusceptibility to hemolytic chemicals, (3) TETD test for hyperreactivity to carbon disulfide exposure, (4) immunologic tests for detecting hypersensitivity to organic isocyanates, and (5) tests for detecting sickle cell trait and anemia. Possibly in no other occupational disease is individual susceptibility more important than in manganese poisoning. If any means to determine the susceptibility could be found, it would be a great step toward its prevention.

Because of the variation of susceptibility between one individual and another, it again becomes paramount that periodic reexamination be done in parallel with environmental hygiene sampling.

Qualified personnel are essential to the development and operation of an Industrial Hygiene Program. For maximum effectiveness the industrial hygiene staff must coordinate their activities closely with those of the medical staff. Existing and potential health hazards must be identified. Documentation of excessive worker exposure is of limited value in the absence of a definite plan to reduce overexposures to manganese dust or fumes.

The midget impinger, the standard impinger and the electrostatic precipitator may be used for the collection of suitable samples of dust. For efficient collection of manganese fumes, glass-fiber filters with an efficiency of at least 99% for particles 0.3 μm in diameter or organic-membrane filters of equal efficiency are recommended.

The spectrographic method is still being used extensively for the analysis of samples. Neutron activation analysis, has been found most suitable for low concentrations of manganese. The atomic-absorption analysis is relatively simple to use and is highly specific for manganese.

The dust (suspension of particles whose diameter generally exceeds 5 μm) concentration alone cannot be expected always to give a complete assessment of the dust hazard. As the hazard is greater with inhalation of the smaller size particles of respirable dust, a size frequency distribution is also important. The introduction of pneumatic drilling, with an increase in dustiness, had led to such an outbreak of manganese poisoning in the Chilean mines, that after 3 months of the new procedure, the mine returned to manual drilling. Wet drilling was prevented by a water shortage in the region.

It is believed that newly drilled dusts are more poisonous than old dusts. Braunite is more poisonous than pyrolusite. The less oxidized the compound, the higher its toxicity.

The threshold limit value (a ceiling value) for manganese recommended by the American Conference of Governmental Industrial Hygienists is 5 mg/m^3. The Pennsylvania short term limit is 5 mg/m^3 minutes. As with many other substances there is a wide range in the amounts of manganese to which workers are permitted to be exposed. The maximum permissible concentration in Hungary, Poland and USSR is 0.3 mg/m^3. In Japan is the same as in the U.S.A.: 5 mg/m^3.

Monitoring the exposure of industrial workers can yield useful information as to their exposure to chemicals in the work environment, but environmental monitoring, i.e., analysis of air, water, or food for chemicals, does not always correlate well with individual exposure.

Biological Monitoring is the measurement of internal exposure of an individual to a chemical by analyzing a biological specimen such as the blood or urine. The objective is to determine the exposure of groups of subjects, and of individual members of each group.

Neutron activation analysis is by far the most sensitive method for manganese and been successfully used for analysis of a number of biologic materials. The sample is first subjected to neutron bombardment in a nuclear reactor. Then the radioactive manganese so formed is separated from other radioactive elements by flash ashing with oxygen, dissolving in acid, oxidizing to permanganate, precipitating with tetraphenylarsonium chloride, and measuring the radioactivity. Although the neutron-activation technique is both sensitive and specific, it suffers from the handicap that suitable neutron sources are not readily available.

Atomic absorption analysis of biologic samples, although not quite as sensitive as neutron activation, is more readily accessible.

A number of investigators have used a direct spectrographic technique that involves the concentration of the sample to a very small volume and the use of an internal standard. However, the spectrographic method, when used in this manner, does not have quite the sensitivity desired for such analysis. Cholak and Hubbard were able to improve the sensitivity of the spectrographic method by first removing the iron (in blood, liver, etc.) with cupferron (chelating agent), complexing the manganese with diethyldithiocarbamate, and then extracting with cholroform and concentrating to a small volume in nitric acid.

The periodate method has been used, but it is not the method of choice, because of its poor sensitivity.

Advantages, disadvantages and limitations to biological and environmental monitoring are summarized in this presentation.

General environment pollution: Pollution by manganese and other metals is much more serious problem than is pollution by organic substances. No metal is degradable. Concerns about public health are related to the aerial discharge of manganese substances that are then inhaled by persons who live in the vicinity and to the infiltration of local water systems with significant amounts of manganese. The concern for effects on the environment outside the plant and on people from general pollutants has increased very substantially.

Reference

Penalver, Rafael A.: "Manganese Poisoning, Proceedings of the 8th Asian Conference on Occupational Health, Page 240. Tokyo, Japan, 1976.

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SUMMARY

Moderator: Mustafo A. EL BATAWI

Conclusions

From the papers presented and their discussion the following conclusions were made:

1) To Harmonize Terminology:

Many terms have ben used to signify biologically safe levels of harmful agents in the working environment. These include, MAC, TLV, MPL etc. It was agreed that these terms be replaced by "Exposure Limit" which was adopted by the ILO and the Last Study Group of WHO. Other terms like "dose-response" may be replaced for occupational health purpose by "Exposure/Effect" and "Exposure/Response" as defined by WHO (TRS 601).

2) "Exposure Limits" for Developing Countries:

The potentially higher vulnerability of workers in developing countries due to endemic diseases or malnutrition should be dealt with by ensuring preemployment health examination and treatment. A safety factor which is already account for in setting health based exposure limits may be satisfactory to account for such additional environmental stresses as heat in the tropics. However, careful epidemiological observation of workers under such conditions would provide indications on whether to lower exposure limits; Developing countries should ensure on operational ability to supervise the working environment in the process of their adoptions of exposure limits from all source or the other.

3) In evaluating the magnitude of exposure by occupational hygiene methods and in personal sampling and protection techniques there is a need to develop appropriate simplified equipment and methods for use in developing countries. Many of the products of big manufacturers of such equipment require testing and trial to suit the needs in these countries. WHO and ILO are invited to facilitate this important task as well as develop guidelines in this respect.

4) The paper or Dr. NG relates an important practical problem in occupational health prac-

tice, i.e. occupational disease reporting. There are several difficulties in respect to reporting that can mainly be resolved through a system incorporating training of occupational physicians and the assurance of their freedom in reporting. Epidemiological surveillance is also a means towards better reporting.

Symposium 2. Education for Occupational Health Personnel

AN OVERVIEW OF OCCUPATIONAL HEALTH EDUCATION IN ASIA

Wai-On PHOON, *Singapore*

"In essentials, unity; in non-essentials, diversity; in all things, charity."

St. Augustine
(A.D. 354 – 430)

In recent years, there has been considerable attention paid to the subject of medical education. No longer is the wisdom of university professors, syllabuses and curricula sacrosanct and unchallenged. No longer is the excuse acceptable that simply because such and such a distinguished university (often situated thousands of kilometers away) follows a certain kind of curriculum or teaching method, that curriculum or teaching method must be good for another university. Teaching objectives, methods of teaching and curricula must be critically examined and overhauled whenever necessary.

A careful scrutiny of the published literature in Occupational Health revealed to me that there are relatively few published papers on the subject of Occupational Health education. Yet there is no doubt, in my mind, that without improvements in Occupational Health education there cannot be very much improvement in either Occupational Health practice or research.

There are, of course, all sorts of people who require to be trained in Occupational Health. Professional personnel like physicians, nurses, hygienists and safety officiers, auxiliary health personnel, trade unionists, employers, managers, supervisors, workers and others can all benefit from some Occupational Health education.

General Considerations

Starting with personnel in the Occupational Health team, there are several considerations to be taken into account when drawing up an educational programme.

Relationship to Public Health

Traditionally, Occupational Health has often been regarded as an offshoot of Public Health, Community Medicine or whatever it is called nowadays. Sometimes Occupational Health is regarded as a subspeciality within environmental health.[1] On the other hand, there is usually a strong element of clinical medicine in the practice of Occupational Medicine. This was stated to be one of the main reasons why the Faculty of Occupational Medicine of the Royal College of Physicians of London was started in 1978. At first there were attempts to link Occupational Medicine in the United Kingdom with the Faculty of Community Medicine of that country. "The main stumbling block was that the faculty was unable to modify its training programme for a discipline with such a strong element of clinical medicine, and many occupational physicians orientated towards Clinical Medicine were reluctant to link Occupational Medicine with the Faculty of Community Medicine."[2] I am convinced that, at least for developing countries, there should be sizeable modules of teaching in both public health and nutrition. "It is obvious that in many situations, such as rubber plantations and tin mines, the doctor looking after the workers have to know about malaria, sanitation, malnutrition from protein-calorie deficiency or hookworm infestation, as well as occupational ailments in the narrow sense, such as silicosis and work injuries."[3]

This problem has partly led some countries, mainly in Eastern Europe, to have two streams of Occupational Health education for physicians. The stream, dealing mainly with the preventive aspects of Occupational Health, is labelled Occupational Hygiene, though the meaning is rather different from that in Western Europe and U.S.A. The other stream deals mainly with the diagnosis, treatment and rehabilitation of occupational conditions, and is concerned mainly with the aspects of Occupational Pathology and Diseases.

Academic or in-service training

There is a great diversity of training programmes, even for the same category of personnel. For example, the training of occupational health physicians or nurses range from absolutely no formal specialist training to very prolonged training carried out solely or mainly in academic institutions. In many countries, including several in Asia, learning is simply by experience, sometimes unfortunately at the expense of the works. In general, however, there is broad agreement that Occupational Health training should be a "sandwich" course. There should be practical training on the job as well as academic training in a university department or other similar institution.

Experience before or after formal training

Our institute in Singapore requires a minimum period of one year's experience in Occupational Medicine or Public Health and another year of postgraduate experience before candidates are admitted into our course for the Master of Science in Occupational Medicine (M.Sc. in Occupational Medicine) degree. I am aware, however, that many other institutions do not insist on experience as a prior requirement for admission.

Duration of formal full-time courses

Some institutions require at least a two-year full-time course for a Master's degree in Occupational Medicine. Other institutions, including ours, have a M.Sc. course lasting one year only. Full-time formal courses are rare in Asia, but in other parts of the world vary from usually three months to a year. Probably the duration is determined to a large extent by the educational philosophy of the teaching institution. Courses of shorter duration are usually regarded as "topping-up" programmes, whereas longer ones may cover the various subjects in a more thorough way.

Thesis/dissertation or classwork

It is obviously possible to require both classwork as well as submission of a thesis or dissertation as requirements for completion of training. The argument, however, is over the relative proportion of time spent or the weightage given to each requirement. Classwork in the form of didactic lectures, seminars, clinic or laboratory sessions gives a broad insight into the wide spectrum of Occupational Health practice, whereas the preparations and defence of a thesis or dissertation constitute useful training in literature search, collection and analysis of new data, the drawing of appropriate conclusions and recommendations. It is probably better, in usual circumstances, to have the trainees complete their classwork first and then concentrate on the preparation of the thesis or dissertation subsequently. One common problem, however, arises from the fact that trainees are dispersed to remote areas after their classwork and may experience great difficulties in finding time, proper supervision, libraries or equipment thereafter.

Relevance of teaching programmes

At a previous international conference, I have drawn attention to the fact that the practice of Occupational Health in the Tropics can be quite different from that in temperate countries, which are largely developed.[4] Many of these differences probably apply to other less developed countries as well, even if not situated in the tropical zone. However, most of the existing courses for Occupational Health personnel are conducted in developed countries.

Until recently, there has been a tendency in less developed countries in Asia and elsewhere to accept rather uncritically the curricula of these courses as appropriate to their own circumstances. Sometimes this attitude of mind is promoted, intentionally or otherwise by Occupational Health educators in developed countries. As Bryant put it, "Educators of health personnel in the more advanced countries have not generally appreciated the extent to which their educational systems do not fit the needs of the developing world. One reason for this is their unabashed convictions that theirs are the best educational systems in the world and therefore provide the best preparation for facing health problems, whatever they are and wherever they are."[5] We need, therefore, to be not only selective in following the teaching programmes of foreign lands but also to innovate new methods of approach and teaching which are appropriate to our own setting, either nationally or regionally.

Difficulties in establishing or conducting Occupational Health courses

It is not easy to start Occupational Health courses in any country without a climate favourable to Occupational Health practice. Usually, moreover, such a climate has to be promoted by the few Occupational Health practitioners in each country. One of the ways to do this is the establishment of a professional or scientific body in Occupational Health, such as a Society in Occupational Health or Medicine. Another way, not necessarily exclusive of the first, is to start a National Safety Council to stimulate general safety consciousness. In Singapore we have found that the creation of such bodies a decade ago has led to a great boost in awareness concerning Occupational Health, and in many respects have paved the way for formal courses for physicians, safety officiers, nurses, trade unionists and others subsequently.[6]

In general, it can be said that Occupational Health courses still find great difficulty in gaining widespread acceptance in most Asian countries. Even in advanced countries like Japan, there was until as recently as 1969 or later, "neither the system of professional physicians of industrial health and industrial medicine nor expert hygienists."[7] There is an overall lack of experienced teachers, suitable textbooks, laboratory and field equipment, reference books and often a very small student body, which adds to the overhead costs per trainee. To help overcome such problems, collaboration and technical assistance from international agencies, such as the W.H.O. and I.L.O., have proved extremely useful. Nationally, all Occupational Health facilities in the government, university and private sectors should be mobilized to implement teaching programmes for all members of the Occupational Health team. Regionally, we in Occupational Health teaching or service sectors should actively seek ways and means to cooperate for the mutual benefit of us all.

The Training of Physicians

Felton stated very succinctly that the roles of the occupational health physician are that of the administrator, supervisor, interpreter, teacher, counsellor and social worker.[8] If we accept this, it stands to reason that the training of the occupational health physician should equip him with the skills to perform these very varied tasks. Suskind has discussed in detail the educational objectives of the Occupational Medicine programme in an American University. Quite rightly, he stated that "the general objective of the programme is to provide qualified physicians with a high level of scientific and clinical competence for effective professional service and for research in occupational medicine."[9] Nonetheless, there may be different requirements in Occupational Health education for different physicians. For example, at our institute we give Occupational Health teaching for physicians and would-be physicians at four different levels of expertise:

(a) Undergraduate level (for medical students). The emphasis is on consideration of occupational factors in diagnosis, treatment, rehabilitation, follow-up and job placement.

(b) Core course in the M.Sc. (Public Health) curriculum. The emphasis is on the community health aspects of Occupational Health. Although our institute commenced postgraduate public health teaching in 1952, we started teaching

Occupational Health only in the 1960's.

(c) Elective subject in the M.Sc. (Public Health) curriculum. The emphasis is on the organizational and epidemiological aspects of Occupational Health. To date students from Hongkong, India, Malaysia, Thailand, Philippines and Singapore have taken this elective subject. This elective subject was established in 1971.

(d) Course leading to the degree of M.Sc. (Occupational Medicine). The emphasis is on the practical aspects of Occupational Health and on the needs of less developed countries. To date we have had students from Indonesia, Vietnam, Cambodia, Philippines, Korea, Thailand, Malaysia, Burma, Sri Lanka, Bangladesh and Singapore attending the Course, which was established in 1973.[10]

The Training of Nurses

It is very surprising and disappointing to me to discover that so few Asian countries have any Occupational Health training for nurses. In many schools of nursing, there is very little or no emphasis on Occupational Health Nursing at the basic level. There are, moreover, very few courses in that subject at the postbasic level. Yet it is essential that some training in Occupational Health Nursing should be given to trainee nurses and specialist training to nurses wanting to follow a part-time or full-time career in Occupational Health nursing. It is so true that the nurse entering a manufacturing, commercial or agricultural enterprise for the first time has to adjust herself to a completely different environment and develop a new attitude of mind and skills.[11] Unfortunately, even in developed countries, such as U.S.A., educational opportunities to prepare Occupational Health Nurses for their jobs have been very limited, though great strides are being made in those countries to remedy the situation.[12]

As in the case of all Occupational Health personnel, the educational programmes for nurses should be geared to their service functions, which have been outlined as follows:

(a) Emergency and palliative care

(b) Follow-up and health counselling

(c) Worksite inspection visits

(d) Keeping of records and reports

(e) Maintenance of the worksite health facilities

(f) Conduct of special activities, such as asisting with health examinations, immunizations, health education programmes and attending safety committee meetings.[13]

The Training of Occupational Hygienists

There are many definitions of what an occupational hygienist is. He is also often known as an industrial hygienist instead. Basically, perhaps we can consider that industrial hygiene, or occupational hygiene, is primarily concerned with the control of environmental health hazards that arise out of or during the course of employment.[14] Physicians, safety officers, engineers, physicists or chemists in Asian countries often perform some of the functions of an occupational hygienist. On the other hand, in countries such as U.S.A. and Great Britain, occupational hygienists are required to undergo special training courses.

The Training of Safety Officers

Although this Conference is more concerned with Occupational Health than Safety, I do not think anyone would question the validity of including the Safety Officer in the Occupational Health team. The Safety Officer performs the task of helping to create safe, healthy working conditions and reduce accidents. His responsibilities have been held to fall into three distinct areas. He acts as:

(a) Adviser to his management on safety

(b) Consultant to the line organization in safety

(c) Co-ordinator of the plant safety programme.[15]

To my mind, it is not sufficient for Safety Officiers to learn from experience alone, even if they have an adequate training in technology. They need to undergo further specialized training in Safety Promotion and Accident Prevention.

The Training of other Members of the Occupational Health Team

There is a great need for a multi-disciplinary approach to both Occupational Health practice and education. "The safeguarding of the health of the worker cannot be done by the physician in isolation. The latter needs to work in active collaboration with many other people such as nurses, safety officers, physiologists, ergonomists, behavioural scientists, personnel officers, trade union leaders, managers, health educators and others."[16] Evidently, all these categories of personnel would require some input of Occupational Health knowledge if they are called to play meaningful roles in improving the health of the working population.

Quo Vadis?

Where do we in Asia go from here, insofar as Occupational Health education is concerned? As we shall hear during this Symposium, great advances in this respect have been made during recent years in many Asian countries. Many institutions have devised excellent curricula and teaching programmes. However, there has been very little co-ordination between the different institutions in Asia. As a result, there is very little uniformity of syllabus, teaching methods, entrance requirements or standards. There has been very little exchange of views and sharing of solution to common problems.

I feel that the time is ripe for us in Asia and Australasia to intensify our collaborative efforts in Occupational Health education. Much of our Region is included in the fastest developing area of the world in economic terms. We need to pay far more attention to Occupational Health problems than most Asian or Australasian countries are doing today. Yet the key to improved Occupational Health practice must lie with improved Occupational Health education. Individually, each of our countries may have scant resources for training in Occupational Health. It behoves us, therefore, to pool our resources, experiences, wisdom and expertise to further the laudable goal of making the worksite a safer and happier place for all our workers. It is my earnest hope that this present Symposium on the Education for Occupational Health Personnel will mark the beginning of a great Asian and Australasian co-operative effort in Occupational Health education, and that the wise words of our distinguished speakers at this Symposium shall be translated into effective actions by all concerned in the near future.

Acknowledgements

I wish to record my deep gratitude to Professor K. S. Cho and the Organizing Committee of the IXth Asian Conference on Occupational Health for kindly inviting me to organize this Symposium; to my fellow-members on the Education Committee of the Asian Association of Occupational Health for their very useful information and advice; and to Miss Mary Kang for typing this presentation.

References

1. Nelson, N. (1974) "Future roles of Schools of Public Health," in "Schools of Public Health: present and future" (ed. J. Z. Bowers and E. F. Purcell), New York: Josiah Macy, Jr., Foundation, 83-85.
2. Schilling, R.S.F. (1976) "The Future of Occupational Medicine," J. Soc. Occup. Med., *26,* 125.
3. Phoon, W. O. (1976) "The Role of the University in Promoting Occupational Health and Safety and Productivity" in "Occupational Safety and Health in Relation to Productivity," I. L. O., 211.
4. Phoon, W. O. (1977) "Occupational Health in the Tropics," J. Occup. Med., *19,* 458-463.
5. Bryant, J. (1969) "Health and the Developing World," Ithaca and London: Cornell University Press, 201.
6. Phoon, W. O. (1972) "Some experiences in the teaching of occupational health," in Proceedings of 1st Symposium on Occ. Health in S. E. Asia, Singapore, 42-45.
7. XVI International Congress on Occupational Health (1969) "Occupational Health in Japan" (a special document compiled on the occasion of the Congress), Tokyo, 206-209.
8. Felton, J. S. (1976) "The multiplicity of roles of the Occupational Physician," J. Occup. Med., *18,* 94-97.
9. Suskind, R. R. (1977) "Perspectives in Education: Occupational Medicine Graduate Training," J. Occup. Med., *19,* 211-214.
10. Phoon, W.O. (1979) "The First Decade of Occupational Health and Safety Education in Singa-

pore", in Proceedings of the Regional Seminar on Occupational Health, 1979, Singapore (in the press).
10. Tyrer, F.H. (1961) "Occupational Health Nursing," London: Bailliere, Tyndall and Cox, 44-46.
11. National Institute for Occup. Safety and Health, U.S.A. (1978) "The New Nurse in Industry," Cicinnati: U.S. Dept. of Health, Education and Welfare, 4-5.
12. U.S. Dept. of Health, Education and Welfare (1965) "Nursing Part-time in Industry," Washington: U.S. Dept. of Health, Education and Welfare, 25-26.
13. Olishifski, J. B. and McElroy, F. E. (ed.) (1971) "Fundamentals of Industrial Hygiene," Chicago: National Safety Council, 1-7.
14. Singam, V. V. and Chua, E. B. (1977) "The Safety Officer and the Safety Committee," in "Manual on Occupational Health and Safety" (ed. W. O. Phoon), Singapore: National Safety First Council, 126-129.
15. Phoon, W. O. (1978) "New Perspectives in Occupational Health," in Proceedings of Second World Safety and Accident Prevention Congress, Singapore, 1978, 50-52.

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TRAINING AND SERVICE IN EDUCATION

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It is my greatest pleasure and previlege to deliver to you the key note remarks on Training and Service in Education in connection with occupational health. I fully realize that the speakers on this matter are those distinguished experts from both Asia and Australia.

I wish first of all to express my highest appreciation on the fact that in the IXth Asian Conference on Occupational Health occupational health education has received a considerable attention. This fact has been due to the activities of the Education Committee led by Prof. W.O. Phoon.

May I also convey my thanks to Prof. W.O. Phoon, the Chairman of the Education Committee on the honour that he has offered me to present this address.

Education in occupational health covers a very broad meaning and is of paramount importance in promoting the occupational health practice. Education in broader sense involves the educational activities for employers and employees, training of professionals in lieu with certification, undergraduate and post graduate occupational health education. By education, there would be positive changes on attitude towards occupational health, improvement and increase of manpower and promotion on of both occupational health practice and scientific background.

The topic selected is "Training and Service in Education." Speaking of education with respect to employers and employees education, it is a very important part to facilitate the occupational service to be a real success. By education, both employees and workers will be aware, support and fully participate in the occupational health programme. Only by good understanding from the employers an employees occupational health programme reaches the goal.

To elaborate on occupational health education for employers and employees, we have to consider many techniques which have been used by Asian countries either as a separate or as an integral part of general employers and workers education. I would say that the time has come to exchange our different experience in this Round Table Conference. I have to emphasize, however, that the most successful education of this type is for groups of small number with more audiovisual demonstrations and particular attention on the aspects that the employers or workers really face on their daily work.

One component of "Training and Service in Education" is to educate professionals involved in the service, by short term trainings. This means that whoever including physicians render health services to the working population should participate in the occupational courses and have certificate. Education could be done by Universities or Occupational Health Institute. There are only few countries in Asia which have taken this as a policy. No doubt, such a practice has accelerated the growth of occupational health in the countries concerned.

Several considerations should be taken to accomplish the trainings for physicians as follows:

1. Time schedules which do not disturb the medical programme due to the part time nature of the occupation of the physicians.

2. Curricula which suit the needs for the actual practice.

It is now the challenge to the members of the Asian Occupational Health Association to adopt this kind of practice and persuade the countries concerned to proceed with the programme. Despite the fact, I am aware that such a principle of training all physicians in occupational health has not been accepted by all or us in Asian countries.

Trainings of professionals also include the nurses, engineers with well-equipped knowledge and skill for industrial hygiene assessment, technical people, etc. Some Asian countries have a lot of experience in these kinds of training.

Mr. Moderator,

Now I come to the last part i.e. education in more academic sense both under and post graduate. Here as it is true for any other fields of health, education should lead to the promotion of both practice as well as the scientific background. In the opinion of most of us, the development of scientific and academic part of occupational health is only meaningful if it ensures the improvement of services rendered to the working population. Only by those services, the workers will enjoy better health and welfare and hopefully the work efficiency will also increase. To provide better occupational health services, education including different aspects of trainings leading to the improvement of the practical skill plays a very important role.

By "training and service in education," we have the common understanding that occupational health education should arise from and meet the actual need of the country depending on the stage of industrializing process and development. This fact has been reflected by the creation of under and postgraduate cources due to the existing requirements of the countries. In addition to that, however, there should be an early forcast on the expansion of the future need due to the fact that the economic development continually presents fast adoption of new technology creating new occupational health hazards and problems. Education in this case would also provide the occupational health personnel with knowledge and skill to face such problems.

In some Asian countries, undergraduate teachings in occupational health are done in public health programme and the Medical Faculties have done so. Postgraduate teachings exist in Japan, Korea, India, Singapore, Philippines, Indonesia, and others.

The education should be generally speaking service oriented leading to more skills actually required for practical assessments of the service programme. There are centres, however, having further emphasis on research works and programme. The curicula of course differ from one country to another indicating the national need. Since these under and postgraduate teachings have emerged from the country needs, they usually suit their requirements and expand or change depending on the conditions. Despite the fact, I used to observe that different universities in one country do not have the same philosophy on the matter but remain of benefit for the communities concerned.

Speaking about the curicula, it seems only of significance if we refer to the characteristics of the actual needs of the country as revealed by their stage of social, economic, and technological development. We hope a lot of discussions would reveal more clarification on these needs as further impetus for members of Asian Occupational Health Association to enlarge the programme of education in our respective countries.

We both Asian and Australian are fortunate enough that there are already educational centres in our countries. This fact is very important in the creation of the occupational health skilled personnel for better occupational health services. I still feel, however, that we need more centres especially for those who are not members of our Association or to recommend the wide use of the present existing centres. I believe that the opportunity for exposure in occupational health education in more advanced countries would lead to better knowledge and improved skills as well as the scientific assessment on the occupational health problems.

I should mention a little the problems of education in other countries. Due to different needs and languages in particular, the trainees used to face difficulties. This matter would hopefully be discussed here and some kinds of recommendations to solve the problems would be helpful.

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OCCUPATIONAL HEALTH EDUCATION IN KOREA

Seung Han LEE, *Korea*

1. Education in school

There are 19 medical schools, 8 dental schools and 52 nursing schools in Korea. We have 21,734 physicians, 2,899 dentists, 70,504 nurses and 6,926 medical technicians. They work in 8,066 hospitals and clinics mostly offering curative medical services in urban and industrial areas. 198 public health centers across the nation, on the other hand, provide public health services to the general public.

Of these medical and paramedical manpower, physicians are apparently playing the most important role in the practice of occupational health within the firms, because the number of physicians in the government occupational health services are very small and, at the same time, the existing labour law specifies that a health officer or the person in charge of occupational health activities in a firm shall be a physician. Also, many physicians are keeping a very close connection with industry through their curative services of worker's injuries and diseases and, therefore, act as part-time health officers, though their role in preventing occupational diseases and injuries in the firm is frequently quite minimal.

In medical schools, six to eight hours of occupational health courses are included in the undergraduate curriculum in addition to twenty-six hours of environmental health courses. These courses are part of preventive medicine and public health courses which are offered approximately 220 hours in total during undergraduate studies. Visits to factories or industrial health centers are also organized for the students in some medical schools.

Professional occupational health education starts at a postgraduate level. Catholic Medical College opened in 1969 a two-year postgraduate course leading to Master of Occupational Health degree. The course is open to both medical and non-medical college graduates who wish to specialize in occupational health. The students may major in occupational health, occupational health nursing or industrial hygiene depending upon their backgrounds. The course offers lectures and opportunities of research in the field of general public health, work physiology, industrial mental health, occupatioal safety, labour law, occupational diseases, occupational health services, occupational hygiene engineering, evaluation of work environments, air and water pollutions, etc. Catholic Industrial Medical Center, which consists of Institute of Industrial Medicine and Industrial Accident Hospital, provides these students with an excellent opportunity to widen their field and clinical experiences.

Public health schools, leading to Master of Public Health, also give occupational health lectures to their students. School of Public

Health, Seoul National University offers the lectures to those students who wish to major in environmental health (two hours per week for one semester). It is an elective for other students. Graduate School of Health Science and Management, Yonsei University opened last year two one-semester courses of occupational health (three hours per week). Here, course 1 is required for all students and course 2 is required for the students who major in occupational health.

Many universities have post-graduate courses for physicians who wish to win Master be given to the students who major in preventive medicine and public health.

Some universities give occupational health lectures to both under-graduate and graduate students in engineering. However, it is rather an exceptional occasion.

Generally speaking, the post-graduate occupational health education in this country tends to be concentrated more in theoretical aspects. The opportunities of their employment in industries are limited, also Reorganization of the course so as to provide more practical field works is now sincerely considered in order to meet the growing need of the industry.

2. Training of occupational health workers

In Korea, the labour law requires the firms of 50 and more workers to employ a physician as a health officer who carries out occupational health activities which range from environmental measurement to first aid and health education. Their work is assisted by several paramedical assistants, the numbers varying according to the scale of firm. The registered industrial health officers and their assistants (nurses, hygienists and medical technicians) numbered 6,247 and 6,794 respectively in 1977. Among health officers, however, only 172 physicians were full-time employees and the rest was part-time physicians who run their own private clinics. There were also 5,824 safety officers employed in industry.

In 1969, Administration of Labour Affairs stipulated a new regulation regarding the occupational health training of health officers and their assistants in industry. The regulation showed that there may be three types of training, i.e. environmental control, occupational disease control and occupational health nursing. The topics in the training may be chosen by Director of Labour Affairs from the subjects which include health administration, health statistics, principles of epidemiology, environmental hygiene, communicable disease control, non-communicable disease control, health education, health management, labour laws, industrial sociology, work physiology, occupational injury control, occupational disease control, environmental measurements, aptitude tests, etc. Korean Industrial Health Association, which had already such a training course since 1964, started again to organize short-term courses in this regard, with the cooperation of Catholic Institute of Industrial Medicine, at the request of Labour Affairs Administration. The course for health officers lasted for one week and that for their assistants (certificate course) for three weeks. Labourer's Welfare Cooperation took over the courses from last year and shortened the courses to one day and one week respectively. The number of trainees who finished the course in 1977 was 375 health officers and 2,621 assistants.

Nevertheless, the industry's participation in these training programmes is usually passive at this stage and they are not eager to employ trained personnel. The course itself has so far placed more emphasis on philosophical and theoretical aspects of occupational health and had limitations in delivering practical instructions and trainings which are urgently needed in carrying out daily occupational health works in firms. The preparation of proper teaching materials is to go ahead with the help of teaching staffs of medical schools, who have already considerable experiences in the field occupational health activities.

3. Persuation in occupational health

It is true that a successful development of occupational health programmes in an individual firm depends largely on the employer's understanding and decisions.

There are 43,416 industrial undertakings in this country with their 2,158,064 employees. Approximately 52% of undertakings and 70% of workers come under the category of manufacturing industries, and many firms are small in scale. As they are growing so rapidly, the managements are often eager only in the expansion of their businesses and facilities in spite of the fact that occupational injuries and diseases increased hand in hand with the increase of production. They were neither generous enough to place some priorities on the protection of worker's health nor were accustomed to make use of occupational health works in upraising productivitiy. However, it is happy to say that their attitudes are gradually changing in recent days.

The government lays down Safety Month regularly in July and honours the factories in recognition of the reduction of accident rates. Seminars for case studies are held from time to time in order to stimulate the industries. However, enforcement of occupational health regulations is still lukewarm, partly because labour inspectorate is suffering from shortage of skilled hands.

With regard to labour unions, there are 4,092 labour union branches organized in our industry, covering approximately one million workers. There were, of course, a number of labour disputes which were ultimately settled through mutual agreement or authority adjustment. The issues were wage and allowances, working conditions, management and personnel affairs, etc. Surprising, however, occupational health problems have almost never aroused labour disputes in this country, reflecting the fact that workers and labour unions are rather indifferent to these problems.

Communities surrounding the industries showed occasionally their interests in workers' health problems but usually more in air and water pollutions outside the firm.

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EDUCATION FOR OCCUPATIONAL HEALTH PERSONNEL COUNTRY REPORT – JAPAN

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1. Introduction

During the period of about one hundred years since the beginning of industrialization in Japan, importance of occupational health education has not widely been recognized until some 25 years ago when nationwide industrialization took place. Occupational health is now taught in all the medical schools as well as dental, pharmaceutical and health science schools. An occupational health-oriented new medical school opened in 1978.

The Japan Medical Association provides seminars annually for physicians who wish to work in the field of occupational health. The Japan Association of Industrial Health provides an educational program for occupational health personnels on the occasion of its annual scientific meeting. The Japan Association of Industrial Health has also been providing seminars for public health and clinical nurses in industries.

In this short paper, general aspect of occupational health education in medical schools with a profile of the above-mentioned new school, short courses for practicing physicians, education and training of nursing personnel in industry, and legislated curricula for industrial hygienists and foremen who are responsible to control harmful environmental conditions in work places would be stated.

2. Teaching Occupational Health to Medical Undergraduates

Professor Shinhachi Nishikawa of Nihon University reported current status of occupational health education in medical schools in his special lecture entitled "Medical Education and Industrial Health" on the occasion of the 51st Annual Meeting of the Japan Association of Industrial Health in 1977.

In Japanese medical schools, occupational health is taught under the program of hygiene and public health. Based on his questionnaire survey on 57 out of 73 medical schools in Japan, Professor Nishikawa indicated that 225 hours in average were used in the teaching of hygiene and public health. The proportion of hygiene and public health to whole professional medical education was about 4-5% in 49% of 57 medical and 3-6% in 85% of them.

Proportion of occupational health to the entire program of hygiene and public health was about 15% in terms of teaching hours. But this percentage was different school to school. As far as the laboratory and field practices were concerned, divergency among schools was smaller. As to the subjects taught, teaching hours were spent for the most part in occupational diseases, then occupational health administration including laws and regulations, general theory of occupational health, and health care programs in industry were following.

As stated above, a new occupational health-oriented medical school opened on April 1, 1978 with 104 students. The school makes the core of the University of Occupational and Environmental Health. Dr. Kenzaburo Tsuchiya, the First President of the University, addressed that the aim of the university was to strive four major goals for the purpose of establishing a new society and a better life for all, acting as a pioneer in the field of health sciences in the 21st century.

The four goals shown by President Tsuchiya are as follows:

1. To educate physicians to educate themselves and to have their lifelong philosophy and utmost humanity,
2. To develop and integrate the field of environmental science with life science,
3. To develop a new discipline of ecology which incorporates economic factors,
4. To integrate an industrialized and post-industrialized society with comprehensive community health services.

President Tsuchiya placed his emphasis on the role of medicine in a society with a new type of social welfare in which man must be able to enjoy a better quality of life.

3. Short Courses for Practicing Physicians

The Japan Medical Association has been providing seminars on industrial medicine each year for practicing physicians who wish to work in the field of occupational health. In June 1979, a three-day seminar was held in Hiroshima, and another seminar was held in Tokyo in July under the same program. Attention in these seminars was particularly placed on the role of epidemiology in occupational health. Those who completed the seminar courses are qualified to take an oral examination of the legislated occupational health consultant. A similar seminar is offered by the Japan Dental Association.

The Japan Association of Industrial Health has been providing an educational program for practicing physicians and other occupational health presonnels once a year as a part of programs of an annual scientific meeting. In 1979, a one-day seminar was held in Tokyo under the main subject of evaluation of the work environment.

4. Education and Training of Nursing Personnel

The Japan Association of Industrial Health provided annual two three-day seminars for public health and clinical nurses in industry from 1976 to 1978. The seminars developed from the former seminars for industrial physicians and nurses lasted three years. The lecture note of the former seminars was published as a guide to occupational health practice.

Seminars for public health and clinical nurses in industry from 1976 to 1978 were always full of participants as a result of an increasing demand for refresher courses of occupational health for nursing personnel in industry. Lectures and symposia on current problems in the field of occupational health were highly appreciated by many attendants. However, it was also indicated that reconsideration of effectiveness of the seminars and evaluation of the curriculum should be made.

The Education Committee of the Japan Association of Industrial Health is now concentrating on establishment of a relevant curriculum of postgraduate education for nursing personnel and has no plan to offer seminars for public health and clinical nurses in 1979.

5. Legislated Curricula for Industrial Hygienists and Foremen

Training of industrial hygienists and foremen who are going to control harmful environmental substances or other conditions has been legislated and the curricula are designated by Ministry of Labour.

Required teaching hours for each category are as follows:

Industrial hygienist (engineer); laws and regulations 6 hrs., health engineering and occupational diseases 8 hrs., work physiology 2 hrs.

Foreman responsible to control designated chemicals; industrial toxicology 4 hrs., control of work environment 4 hrs., use of protecting devices 2 hrs., laws and regulations 2 hrs.

Foreman responsible to control alkyl lead; toxicology of alkyl lead 4 hrs., control of work environment 4 hrs., use of protecting devices 2 hrs., laws and regulations 2 hrs.

Foreman responsible to supervise dangerous work in ambient air deficient in oxygen; symptoms and first aid of anoxia 2 hrs., cause and prevention of oxygen deficiency 3 hrs., use of protecting devices 2 hrs., laws and regulations 2 hrs.

Employers are requested to arrange a special program to teach and train workers in each of the above stated or other designated enviromental conditions.

6. Concluding Remarks

Through an overview of present situation of occupational health education in Japan, it is concluded that teaching and training of occupational health personnels must be promoted further. Because, relevant educational programs elevate quality of occupational health services to workers. It should be emphasized particularly that improvement of curricula and teaching facilities is of urgent importance.

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EDUCATION IN OCCUPATIONAL HEALTH IN AUSTRALIA

Thomas. K. NG, *Australia*

Australia is a country large in area and small in population. Politically, there are three tiers of goverment: federal, state and local. The Constitution defines the power of the Federal Government, leaving the residual powers to the various States. Each government in power has a tenure of not more than three years. Many activities in Australia, political or otherwise, including medical education, are still maintaining a linkage with those in Great Britain, no matter how loose that linkage may be. Only 22% of the 6.2 million working people are in the manufacturing industry and on the average there are 44 workers per manufacturing establishment. With this brief introduction, I shall proceed to examine education in occupational health in Australia.

As an educationist in occupational health, I have taken up a realistic but unconvertional approach in my examination. Instead of using a checklist to tick what we have and what we have not, I prefer to examine how education in occupational health fits in with the general trend in education.

At this point in time, we have neither a national institute of occupational health nor a national employment medical advisory service. The School of Public Health and Tropical Medicine, which will become the Commonwealth Institute of Health next year, is staffed by the Federal Department of Health and located in the University of Sydney. It used to run a British style of Diploma in Public Health course until 1978 when it was replaced by the Master of Public Health degree course. In 1974, it started a *one-year Diploma* in Occupational Health course as well and now this has also been absorbed into the Master of Public Health degree course, with occupational health converted into an elective in the M.P.H. programme.

The School of Public Health and Tropical Medicine is the only postgraduate public health education institution in Australia. We have students coming from all the States. It is now too early to evaluate whether the M.P.H. programme is a successful one so far as contribution to education in occupational health is concerned. What I can say from impression at this stage is that it is good to have medical and non-medical graduates trained together and that the M.P.H. course we offer forms an essential but not sufficient programme for specialists in occupational medicine. Thus, we are making efforts towards the formation of a college of occupational medicine in Australia.

The School also contributes to teaching occupational health to undergraduate medical studetns in the University of Sydney, but the latter dictates the number of hours we have with the students and this is below what the W.H.O. has recommended in 1957. To my understanding, there is no full time lecturership in occupational health in any of the other 10 medical schools in Australia, though the University of Newcastle, the youngest of all, innovates to train its medical students, not just seeing patients in the hospitals, but interviewing and studying them in their living and working environments.

To satisfy the needs of the scientists who have practised occupational hygiene for some years, the School has conducted a 13-week intensive course annually for these practitioners since 1977. There are also courses available for technicians in occupational hygiene in Sydney and Melbourne. The occupational hygienists are also on their way to form a professional body.

More and more nurses are now employed in industry. The divisions of occupational health in the more populous States conduct a two-week orientation course two to three times a year. Some colleges of advanced education provide a one-year course in community health nursing with occupational health nursing as an elective among others. The orientation course is very popular but there are problems in the occupational health nursing training in the community health nursing course, facility-wise, staff-wise and student-wise. We have an intention to run a 13-week course for the nurses in industry next year in the School, with a view to helping the States run their own courses later on.

The safety practitioners association is known as the Safety Institute of Australia. It does not run training courses directly but gives recognition to certain courses conducted by some technical colleges as the minimum requirement for its membership. Such courses contain 600-700 hours of study, normally spread over 8-10 subjects and of four years' duration for part-time students. One college of advanced education in Victoria offers a postgraduate diploma course in Safety Administration.

The School intends to provide an elective in ergonomics and safety in its M.P.H. programme in the near future. Meanwhile, ergonomics is taught to engineering students in a number of institutions depending upon whether there are experts available. In Sydney area, staff of the School of Public Health and Tropical Medicine provide teaching in occupational health to undergraduate social work, architecture, and mechanical engineering students.

In the School, we have a one-week course in occupational health for managers, foremen, workers, union officials, etc. The last one was run in February this year with 250 participants. We also provide support in various apprenticeship training schemes and career education courses on matters related to occupational health. We believe that in this era of industrial democracy, only the well-informed workers can provide genuine contribution towards health at work.

No account on education is complete without mentioning continuing education. The Australian and New Zealand Society of Occupational Medicine has since 1978 provided a journal, issued quarterly, for all occupational health workers in both countries. I happen to be the editor for that journal. The School of Public Health and Tropical Medicine has since 1978 conducted a monthly seminar on the advancing edge of occupational health for all occupational health workers who happen to be in Sydney on the last Wednesday of each month. We have also a three-week refresher course for occupational physicians.

Regarding regional co-operation, I believe that our 13-week occupational hygiene course will be very useful for the practitioners but not the beginners. We believe each country should train its own occupational health workers, but our M.P.H. programme is flexible enough for us to accept the prospective trainers in other countries. As to short courses, we have two in mind to offer, around four weeks each, to be held either in Australia or elsewhere: one is on ergonomics and the other is on occupational epidemiology and statistics.

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OCCUPATIONAL HEALTH EDUCATION IN THE PHILIPPINES

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History and Background

Occupational health in a formal way can be said to have begun in the Philippines in the early years of the American occupation (1900-1920) when company dispensaries were gradually established to treat workers at their places of work. Shortly thereafter, the Section of Industrial Hygiene of the Bureau of Health and the School of Hygiene and Public Health were established.

It was however in the late sixties and early seventies when occupational health education started its spurt towards its present status. The impetus was given by the formation of various occupational health associations which started their own educational programs. Dr. Gregorio Dizon was the spearhead in this drive to promote occupational health education in our country.

Finally, with the enactment of the New Labor Code and the Health and Safety Code of the Philippines, occupational health education got its badly needed governmental support and emphasis.

Current Status

The current status of occupational health education is directly attributable to the New Labor Code and the Health and Safety Code. These Codes require that occupational health personnel should undergo proper training in occupational health and safety. This particular provision was the result of a campaign by a group of occupational medical practitioners who worked tenaciously for the inclusion of such a provision in the Codes.

To accomodate the training needs of occupational health workers, various programs have been introduced by the different occupational health associations and institutions. These programs can be roughly divided into three categories:

1. Programs offered by professional groups;
2. Programs given by established institutions of learning;
3. Courses offered by the government ministries of labor and health as well as by labor unions.

Programs by Professional Groups

The following organizations are presently pursuing various educational activities on occupational health.

1. Philippine Occupational & Industrial Medical Association
2. Occupational Health Nursing Association of the Philippines
3. World Health Foundation of the Philippines
4. Philippine Association of Industrial Dentists
5. Safety Organization of the Philippines

These educational activities consist of the following:

1. crash courses in Occupational Health and Safety
2. a 2-year residency training program in occupational health

3. certification examinations for the specialty of Occupational Medicine.

4. quarterly and annual scientific meetings on occupational health and safety.

5. post-graduate course for 6 weeks at the Institute of Public Health on Occupational Health.

Programs by Educational Institutions

The Institute of Public Health is the only institution that offers a post-graduate degree course in occupational health. It's Master in Occupational Health (M.O.H.) course consists of one full academic year of residential study with the student required to complete 24 units of formal courses and 6 units of thesis.

In the undergraduate level, occupational health receives very little emphasis. It is usually taught in the third year as part of either the Public Health or Community Medicine courses. In the College of Medicine of the University of the Philippines, formal lectures in occupational health consists of 3 hours as part of the Public Health course. The only other exposure of medical studensts in occupational health is a 1-day visit to a factory and industrial medical clinic during their clinical clerkship in their fourth year.

Programs by Government Ministries & Labor Unions

The Ministry of Health has a Division of Occupational Health which also maintains a modest Industrial Hygiene laboratory. It conducts periodic seminars on occupational health and safety for municipal health officers.

On the other hand the Ministry of Labor, through its Bureau of Labor Standards and Institute of Labor and Manpower studies, has several training courses in occupational health and safety. These are geared towards training of labor inspectors and safety committee mebers in industry. Trade unionism does its part also in occupational health education. Some of the larger labor unions in cooperation with the Asian Labor Education Center conducts seminars leaders and labor representatives in the safety committee.

The latest educational innovation was the series of seminarworkshops for management initiated by the newly-formed National Tripartite Committee for the Improvement of Working Conditions. The aim of the workshop is to increase awareness among the decisionmakers in industry of the need for proper occupational health services and the latter's contribution towards productivity; and to motivate managers to allocate more financial resources for health services.

The Future of Occupational Health Education in the Philippines

At present, we realize the need for greater emphasis in teaching occupational health in the undergraduate level. Our association, the POIMA, has arranged dialogues with the deans of the major medical schools to look into the problem and work out some possible solutions. The Philippine Medical Association has recently created an ad-hoc committee on occupational health and industrial medical practice. One of its projects is to study how to expand the teaching of occupational health in the undergraduate level.

The residency training program in the Institute of Public Health is a pilot project. If found successful, the program will be extended to other medical institutions of learning. To help out in this project, the POIMA is looking into a plan to subsidize physician-trainees enrolled in the program.

Finally, the establishment of the Occupational Health and Safety Institute by the Ministry of Labor later this year will advance further the cause of occupational health education in our country. With the availability of a well-equipped Industrial Hygiene Laboratory, research will be stimulated and more capable and well-motivate people will be attracted to the field of occupational health.

The outlook therefore for occupational health education in the Philippines is very bright. I sound optimistic because we have been assured of tripartite support. Management, labor and enlightened Ministries of Health and Labor are all contributing their share and resources to push training in occupational health. Lastly, but most important of all reasons, we have dynamic leaders in the helm of occupational health associations who are relentlessly pursuing a program of occupational training throughout the country.

Benito R. Jr. REVERENTE: Philippine Occupational and Industrial Medical Association, c/o Philippine Refining Co. Inc. 1351, United Nations Ave., Manila, Philippines

OCCUPATIONAL HEALTH IN INDIA

Jayanti, C. KOTHARI, *India*

Historical Background

Cherak and Sushruta are considered the pioneers of the ancient Indian sciences called Ayurveda—the science of life. With the advent of 2 centuries of British rule, western medicine came to India in the 17th centuries. The Factory Act of 1948 (subsequently amended in 1976) and the Workmen's Compensation Act of 1923 can be considered the beginning of Occupational Health in India. The Indian Association of Occupational Health was founded in the steel city of Jamshedpur by Dastoor and Nagib Khan in 1948. Thus the foundation was laid for occupational health in our country. Since then there have been rapid strides made in this direction. But nonetheless, the recognition of occupational health in medical circles and Government health and labour agencies is rather slow in coming.

Present Status

At present the health of the worker is largely the responsibility of the Government both at the Centre and State levels. The Ministry of Labour operates the health programme for the workers through the Employees State Insurance Scheme. Over 6 million industrial workers from 20 states throughout the country are covered under this programme. There are 405 outpatient diagnostic clinics and 936 dispensaries for treatment for minor illness/injuries. Major illness, injuries are treated in 24 hospitals having a total of 17,000 beds distributed in each major state. The scheme is staffed by 1,500 specialists, 4,650 Medical practitioners. The scheme looks after occupational as well as non-occupational illness and injuries. The bulk of the problems are non-occupational in origin.

The Factories Act regulates the conditions of work at the factory level. General, and industrial hygiene, safety, and health are covered under the Act. First enacted in 1935, and later amended in 1948 and 1976, the Act has now made it mandatory to have a qualified safety officer in any factory employing 1,000 or more workers. The Act provides for first aid treatment facilities in all factories and ambulance room in factories employing more than 500 workers. In plant full fledged medical facilities with medical officers not compulsory. However, it is hoped to make this mandatory by law in the near future. Every state has a Medical Inspector of factory who is responsible for implementation of the provisions of the Act. He visits the factories and carries out inspection.

The Workmen's Compensation Act of 1923 has been revised incorporating the recommendations of a high powered committee in which the author representing the Indian Association of Occupational Health made significant contribution. Basically the Act provides for monetary compensation for an illness or injury or death arising out of work in a factory. It also provides for rehabilitation.

So much for the role of the Government. The private organized industrial sector has been making significant contribution in the field of occupational health. There are at least 100 private organization having well equipped in plant medical centres staffed by full time or part time medical or paramedical personnel. Some of these centres are model clinics. However most of these look after non-occupational illness/ injuries. Some of them have their own hospitals. Very little is done by way of study and management of occupational disorders. The Labour Ministry has an advisory cell. The Central Labour Institutes in various states entertain queries from industries regarding problems of occupational hazards, carries out a survey and renders advice about appropriate preventive measures. They also carry out research and survey in relation to specific occupational problems.

The Industrial Toxicology Research Centre at Lucknow is a pioneering centre carrying out basic research in occupational health problems and industrial toxicology.

The National Institute of Occupational Health at Ahmedabad and the Institute of Public Health and Hygiene at Calcutta are among the leading centres engaged in research in occupational health.

The Government has established a Water Pollution Board. This board will study the pollution by industry of wage with resources of the country and suggest legislative remedies.

Similarly the Society for Clean Environment is a semi-government organization devoted to the study of air pollution.

Education in Occupational Health

There is no provision for teaching of occupational health at graduate level. The nearest to this is the subject of public health and community medicine. At post graduate level there are 3 courses in Industrial Medicine leading to a Diploma in Industrial Health-DIH.

There are courses and diplomas for Safety officers conducted by the National Safety Council.

There are no courses for Industrial nursing.

The Industrial Toxicology Research Centre runs a course in Industrial Hygiene. Regular Refresher courses lasting 2 to 3 weeks are held in Bombay in collaboration with Central Labour Institutes and Indian Association of Occupational Health.

Occupational Health Programme in Industry

Pre-employment examination is carried out in most large corporations but is not mandatory.

Periodic examination of employees is also carried out in all large seaters. Specific examination in hazardous jobs is mandatory by law e.g. pesticide industry, lead workers, TEL etc.

Health counselling and family welfare programmes are a part of the Occupational Health Services.

The Future of Occupational Health

The Indian Association of Occupational Health is constantly endeavouring to gain recognition of occupational health as a speciality at post graduate level. The need for doctors qualified in occupational health is increasing with the rapid industrial expansion in the country. The Annual Conferences of the Association are a meeting ground where over 300 physicians interested in the subject present papers on occupational health and exchange ideas. The Association is affiliated with AAOH and International Association of Occupational Health and Permanent Commission. Thus it is able to keep abreast of the current trends on the subject.

The Government and the employees, the worker and the trade unionists are being made aware of the importance of occupational health.

Occupational Health in Other Asian Countries

In developed countries like Australia, the occupational health services are well developed. In Australia, the Australian and New Zealand Society of Occupational Medicine is the premier body engaged in this field. At least 20 major industrial corporations have well equipped in plant medical services. There is no statutory provision for occupational health service. However there are statutory provisions for special examination in hazardous occupations. There are over 180 specialists rendering various types of occupational health services. Preventive care is being provided in many large corporations.

In the Phillipines, implant health services in establishments employing 100 or more workers is required by law. Occupational health programme varies in different situations—ranging from full fledged hospital facilities, company clinics and retained facilities. Preventive programmes are carried out in large establishment.

There are at least 7 organizations actually engaged in the field of occupational health.

In Iran, every factory has a doctor. In 1960

University of Tehran started teaching occupational health at undergraduate level. A separate department of Industrial Medicine was started in the School of Public Health.

There are 29 doctors qualified in industrial health and 300 engineers in safety and industrial hygiene.

The Ministry of Labour and Social Affairs, The Social Insurance Organization, Ministry of Health look after the various programmes.

There is undergraduate 12 hours lecture on occupational health. It is proposed to start M.Sc. in Occupational Hygiene and Safety. There is a B.Sc. in Occupational Health given by the Institute of Hospital Science. Iran look forward to the future in which occupational health and safety will develop still further.

Conclusion

In most Asian countries, the legal requirements for implant medical sources are not there. Education in occupational health is, with few exceptions, very rudimentary.

Occupational health is not a recognized speciality in most developing Asian countries that were studied by the Committee.

The need for trained personnel to organize occupational health services is urgent and great. Research in this field is also not comparable to that of the level in developed countries.

It is hoped that the AAOH will device ways and means of promoting cooperational health in developing countries of Asia.

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GENERAL COMMITTEE MEETING

The General Committee Meeting was held three times during the period of the 9th Asian Conference on Occupational Health. The first meeting was held on October 22, 1979, from 14:00 to 17:00, at Pine Room of Hotel Shilla. The second meeting was held on October 24, 1979, from 17:30 to 18:30 at Cherry Room of Hotel Shilla and the third and final meeting was held on October 26, 1979, from 14:20 to 15:30 at Pine Room of Hotel Shilla. The minutes of the meetings are as follows:

Minutes of the 1st General Committee Meeting

The meeting was called to order by the Chairman, and after the Chairman's opening remarks and special address by Honorary President Dr. Kubota a one minute's silent tribute was paid to the late Dr. Dizon who had passed away during the interim in 1978.

Dr. Cho, Secretary General-Treasurer, made a report and reviewed the details of the Conference, the proposals and the agenda which had been formerly circulated among the Committee members.

Dr. Phoon next made a report as Chairman of the Education Committee in which he explained the activities, problems and prospects, etc. of his Committee. Dr. Denehy asked a question whether any information was available as to the training courses of occupational health education in different countries of Asia and Australia. Dr. Phoon said that he had collected some information by means of questionnaire, and that he would report to the members of the General Committee when the information becomes available in a few months.

Dr. Yamaguchi made a report concerning the International Liaison Committee activities.

Dr. Phoon expressed his idea about the character of the General Committee and wanted that all the member countries be represented in the General Committee for pooling information, consultation and strength. Dr. Reverente noted that the number of Council members should be limited in order to avoid confusion between the General Committee and the Council. Dr. Denehy supported Dr. Reverente's opinion and, in addition, explained the situation in Australia. There was more discussion about the distinction between the General Committee and the Council among Drs. Suma'mur, Yamaguchi and Phoon, generally supporting the present system.

Dr. Reverente further explained that the increase of the number of representatives in the Council would cause confusion between the General Committee and the Council. He proposed that the Council membership should be limited to Honorary President, President, 5 Vice-Presidents, and Secretary General-Treasurer so that the functions of the Council as an executive body, such as making decisions in the interim between conferences, could be carried out effectively. This proposal was accepted unanimously. Dr. Phoon recommended Dr. Reverente to make drafts of the proposed changes and submit them in the next meeting at 5:30 p.m., Oct. 24. Dr. Choi asked Drs. Suma'mur and Yamaguchi to work with Dr. Reverente on this matter.

Dr. Suma'mur expressed his idea about award-giving and the presentation of plaques of gratitude. He stated awards and plaques should be given to:

1) Present and past Presidents
2) Persons who made remarkable contribution to health development in Asian countries
3) Distinguished scientists who contributed to the improvement of health of the working population
4) Persons (less than 10) selected from among the members of the Asian Association by the Committee and approved by the General Committee.

He added that the award or the plaque of gratitude should be given to one person only once. Dr. Phoon agreed to this idea and further proposed a prize system for young scientists under the age of 35 years to encourage the younger generation. Dr. Yamaguchi supported both proposals. Dr. Phoon made a motion, Dr. Reverente seconded the motion, and the proposals were passed.

Then the discussion moved on to the problem of amending the Constitution. To prepare the amended Constitution and By-laws a working committee was organized by Drs. Phoon, Suma'mur, Yamaguchi, Reverente and Denehy, with Dr. Suma'mur heading it.

Dr. Denehy raised a question as to the distinction between honorary membership and qualification for receiving the plaque of gratitude. Dr. Phoon proposed a motion to consider the relationship between the two in drawing up By-laws. Dr. Suma'mur and Dr. Reverente seconded the motion and all agreed. It was decided to present plaques of gratitude to:

The Late Dr. K.M. Bhansali (India)

The Late Prof. Gregorio D. Dizon (Philippines)

Dr. Suma'mur P.K. (Indonesia)

Prof. Juko Kubota (Japan)

Dr. M.A. El Batawi (WHO)

Dr. Suma'mur suggested that the Constitution be named after the place where it was amended such as Seoul Constitution, Singapore Constitution, etc. After further discussion among Drs. Choi, Phoon and Cho, Dr. Denehy proposed to specify the time and place of the amendment and all agreed to it.

The Secretary General-Treasurer announced that Saudi Arabia and Kuwait participated in the Conference for the first time and he proposed to accept them as national members of the Association if formal letters regarding the formation of their national association are received.

Dr. Phoon, Dr. Reverente and Dr. Sonthorn expressed their desire to host the next Conference in their respective country in 1982. However, with Drs. Reverente and Sonthorn making a concession and withdrawing their proposals, it was unanimously agreed to have the next Conference in Singapore.

Prof. Choi, Chairman, stressed that all members should strictly abide by the regulations for fee payment for solidifying the foundation of the Association as an international organization. There was lively discussion among Dr. Choi, Dr. Suma'mur, Dr. Phoon, Dr. Fernando and Dr. Yamaguchi in full support of this. Dr. Phoon suggested that a bank account be established to receive membership fees by the Secretary General-Treasurer in the name of the Association. It was consented to by all. Dr. Reverente suggested that, in the interim between conferences, whoever is the representative of a country should be responsible for collecting membership fees from the individual members of his country.

The discussion then moved on to the use of the fees. Dr. Cho suggested that membership fees should not be used as Conference expenses, but only for limited purposes, such as printing membership lists, preparation of plaques of gratitude, making correspondence, and so forth. Dr. Phoon supported it and proposed that admission and membership fees should be separated from Conference expenditures and all agreed.

Dr. Denehy made a proposal that Australia and New Zealand be entered as a single member under the name of Australia. In fact, when he attended the Tokyo Conference in 1976, he participated as representative of the Australian and New Zealand Association of Occupational Health. No objection was raised against this. It was further decided that the representative of Australia and New Zealand should have only one vote.

Dr. Denehy further expressed his desire to remain as an individual member because the future President of the Australian and New Zealand Association would automatically become the Australian representative. Dr. Phoon said in response that he felt it should be left entirely up to the association of that country, that whoever is nominated as the representative by the national association should be a member of the General Committee. Dr. Reverente supported this saying that he was no longer the head of his country's association but was designated to represent his country's association. Dr. Suma'mur said that this was actually the system. Upon Dr. Cho's request to make the matter of representation clear, Dr. Phoon proposed that before each Asian Conference, each country should inform in advance who has been nominated as the representative to the General Committee, and that this should be formulated. Dr. Reverente seconded the motion and it was agreed to.

Dr. Suma'mur brought up the matter of limiting the service of the Vice-President to two terms only. This was accepted by all and it was decided to establish this by law.

Dr. Ng who was supposed to represent Hong Kong stated that he had left Hong Kong two years before and was now in Australia and that he took part in the Conference merely as observer. Upon Dr. Phoon's inquiry as to the membership of Hong Kong, Dr. Ng suggested that the Asian Association write to the two societies in Hong Kong and see what their responses are.

After some more exchange of information and announcements the meeting was adjourned at around 5:00 p.m.

Minutes of the 2nd General Committee Meeting

The Chairman announced that the amended Constitution, By-laws and Resolutions would be discussed in this meeting. Upon the Chairman's request, Dr. Reverente explained that the polishing of the Constitution and By-laws was done by Drs. Phoon, Suma'mur and himself as was designated at the first General Committee meeting.

Dr. Phoon pointed out that some points were clarified with regard to membership and award-giving, with some changes made in the wording, and that one sentence was added to the Honorary Membership provision. He further said that the changes were mostly a matter of terminology to eliminate confusion. Dr. Kothari made a motion to pass the amended Constitution and By-laws. Dr. Suma'mur seconded, and the Constitution and By-laws were accepted.

Dr. Choi mentioned that the Resolutions of the 9th Conference was drafted by Dr. Suma'mur and himself based upon the spirit of the Resolutions of the last meeting held in Tokyo. Upon Dr. Choi's request, Dr. Suma'mur explained that the idea of the drafted Resolutions was to fill gaps between working places and training or counselling centers by having regional institutions close to working places, and that the institutions do not mean buildings but community health bases or community medical services.

There were some questions as to the nature of the regional institution. Dr. Choi explained the Korean situation and said that the regional institution should be different from the health center, the health center being operated by the government whereas the occupational health center is under responsibility of employers.

Dr. Phoon said he felt that everyone was concerned about the terminology too much. The name is not so much important as the service itself or the way of service, and efforts should be made to draw a generalized formula, which can be applicable to different situations in different countries, somehow reconciling the situations. Dr. Suzuki, who replaced Dr. Yamaguchi as an alternate member, suggested using the term of 'regionalization of occupational health services' instead of 'regional institutions,' which was very favorably accepted. Dr. Choi asked Drs. Sumamur, Phoon and Kothari to work out a modified draft, and it was accepted. Dr. Kothari suggested that since the Resolutions was proposed by the Chairman, the three people appointed to do the modification should carry the main message as well as some of the views expressed in this meeting.

Dr. Choi brought up the matter of payment of membership fees. There was discussion as to the method of paying, the period to be covered by one payment, etc., and it was decided that the Secretary General-Treasurer should send a request for payment of fee to each member nation and the country should pay the fee to the account in Switzerland, and upon receiving notification from the bank, the Secretary General-Treasurer should issue a receipt. The meeting was adjourned at 6:30 p.m.

Minutes of the 3rd General Committee Meeting

After the opening remarks of the Chairman, a plaque of gratitude was presented to the late Dr. K.M. Bhansali for his distinguished service in the field of occupational health. Dr. Kothari from India received it and thanked on behalf of the late Dr. Bhansali, Mrs. Bhansali and his Association.

The Chairman then made an announcement that Dr. Phoon would be the next President. Dr. Phoon cordially invited all the Committee members to the next Conference to be held in Singapore, and announced nomination of Dr. Roy Pall as new Secretary General-Treasurer to work with him. He said that Dr. Pall would be the acting Secretary General-Treasurer and that he would inform the Committee later whether Dr. Pall would continue or someone else would take over the job of the Secretary General-Treasurer. All Committee members agreed to this. (Dr. phoon finally nominated Dr. Chuo Tze Cheng as Secretary General-Treasurer in January 1980.

The Chairman next announced that Dr. Suma'mur and Dr. Kubota would automatically become honorary members, Dr. Choi would become Honorary President, and Dr. Cho a Vice-President according to the Constitution.

The following persons were recommended as members of the General Committee as approved by their national associations:

Dr. Yamaguchi (Japan)
Dr. Suma'mur (Indonesia)
Dr. Sonthorn (Thailand)
Dr. Reverente (Philippines)
Dr. Kothari (India)
Dr. Denehy (Australia and New Zealand)
Dr. Fernando (Sri Lanka)
Dr. Cho (Korea)

The nomination of these General Comiittee members was approved unanimously.

A question was raised about the membership of Malaysia and Hong Kong. Dr. Phoon said he would look into the matter of membership of these countries as well as that of Bengladesh and Saudi Arabia. Other members asked questions about the possibility of inviting as members Pakistan (Dr. Fernando) and Burma (Dr. Cho and Dr. Phoon), and Dr. Phoon said he would also explore this matter. Dr. Reverente asked about the membership of Dr. Parvizpour of Iran, and the Chairman said that Iran, as soon as her national association is organized and an official letter of notification is received, would be admitted as a member nation.

As the election of five Vice-Presidents, according to the Constitution the Chairman recommended as Vice-Presidents Dr. Cho (Korea), Dr. Yamaguchi (Japan), Dr. S. Anhar (Indonesia), Dr. Denehy (Australia and New Zealand) and Dr. Reverente (Philippines). The recommendation was fully approved by all the members. Dr. Denehy said that there might be somebody else who will represent Australia and New Zealand at the next Asian Conference, and Dr. Choi stated whoever will represent at the next Conference, he should be a Vice-President. Dr. Phoon wanted to know who would be the Vice-President representing Australia and New Zealand, and Dr. Denehy assured him that he would help in the background and notify him of the new delegate as soon he takes over his place.

As the first Vice-President, Dr. Reverente recommended Dr. Cho. Dr. Kothari seconded the motion and Dr. Cho was accepted as the first Vice-President.

The meeting then moved on to the establishment of new Technical Committees in addition to the already established ones to strengthen the Association's activities. Dr. Suma'mur proposed establishment of a Plantation Health Committee. Dr. Reverente wanted to change the name into an Agricultural Committee since the term 'agriculture' is more inclusive. However, there was a strong opinion among the members that plantation health service should be independent. Dr. Reverente motioned that a separate Technical Committee should be established on agriculture, and Dr. Phoon proposed establishment of a Technical Committee on Ergonomics. All these three Technical Committees were accepted by the General Committee and the number of Technical Committees increased to six.

To the Chairman of the Education Committee, Dr. Suma'mur proposed to elect Dr. Phoon and this was unanimously accepted. Dr. Phoon recommended Dr. Yamaguchi as Chairman of International Liaison Committee, which was also accepted. To the Chairman of the Occupational Health Services Committee, Dr. Cho was recommended by Dr. Suma'mur and accepted by all. For the Chairman of the Plantation Health Committee, Dr. Suma'mur recommended Dr. Nursasongko who is working in this field, and was taking part in the Conference. Dr. Reverente was recommended to the Chairman of the Agricultural Committee by Dr. Suma'mur and Dr. Phoon. For the Chairman of the Ergonomics Committee, Dr. Phoon recommended Dr. Kogi, an ergonomist widely known in Asia and well recognized by WHO and ILO. These three chairmen were favorably approved by the General Committee also. Dr. Suzuki expressed his approval and appreciation on behalf of Dr. Kogi.

Then came the last agenda of the General Committee – adoption of resolutions. Upon request from Dr. Choi, Dr. Phoon explained that the first draft was submitted by Dr. Choi and Dr. Suma'mur, and a working committee composed of Drs. Fernando, Kothari, Reverente, and Suma'mur amended and enlarged the original draft. After some discussions, the resolutions were unanimously passed. Before the meeting came to a close, each member took turns in saying eulogies for the fine organization and hospitality of the host country to Dr. Choi and Dr. Cho, who in turn thanked for their cooperation which made the 9th Conference a success.

President of the Council and Chairman of the General Committee
Prof. Choi, Y.T.

Members of the General Committee
Prof. Cho, K.S. (Korea)
Dr. Denehy, H. (Australia & New Zealand)
Dr. Fernando, L.V.R. (Sri Lanka)
Dr. Kothari, J.C. (India)
Prof. Phoon, W.O. (Singapore)
Dr. Reverente Jr., B.R. (Philippines)
Dr. Sonthorn, P.L. (Thailand)
Dr. Suma'mur, P.K. (Indonesia)
Prof. Yamaguchi, S. (Japan)

Honorary President
Prof. Kubata, J. (Japan)

Alternate Member for Japan
Prof. Suzuki, T. (Japan)

The New Officers of the Asian Association of Occupational Health (1980 – 1982)

Honorary President:	Prof. Choi, Young Tai (Korea)
Honorary Members:	Dr. Suma'mur, P.K. (Indonesia) Prof. Kubata, J. (Japan)
President:	Prof. Phoon, W.O. (Singapore)

Vice-Presidents:	Prof. Cho, K.S. (Korea) Dr. Anhar, S. (Indonesia) Dr. Denehy, W.H. (Australia & New Zealand) Dr. Reverente Jr., B.R. (Philippines) Prof. Yamaguchi, S. (Japan)
Secretary General:	Dr. Cheng, Chae Tze (Singapore)
Members of the General Committee:	Prof. Cho, K.S. (Korea) Dr. Denehy, W.H. (Australia & New Zealand) Dr. Fernando, L.V.R. (Sri Lanka) Dr. Kothari, J.C. (India) Prof. Phoon, W.O. (Singapore) Dr. Reverente Jr., B.R. (Philippines) Dr. Sonthorn, P.L. (Thailand) Dr. Suma'mur P.K. (Indonesia) Prof. Yamaguchi, S. (Japan)
Chairmen of the Technical Committees:	
Education:	Prof. Phoon, W.O. (Singapore)
International Liaison:	Prof. Yamaguchi, S. (Japan)
Occupational Health Services:	Prof. Cho, K.S. (Korea)
Plantation Health:	Dr. Nursasongko (Indonesia)
Agricultural:	Dr. Reverente Jr., B.R. (Philippines)
Ergonomics:	Dr. Kogi, K. (Japan)

RESOLUTIONS

Resolutions Passed at the 9th Asian Conference on Occupational Health
on Oct. 22-28, 1979, Seoul, Korea

WHEREAS, the 9th Asian Conference on Occupational Health held in Seoul on Oct. 22-28, 1979 feels that considerable development and progress of Occupational Health in Asian countries, Australia and New Zealand have taken place during the last decade.

WHEREAS, the Conference further deems it necessary to solve the most significant problems involved in the rapid promotion of occupational health in the region to attain the goal of better health, safety and welfare of the working population, as its contribution to the social and economic progress of the countries in the region.

WHEREAS, the Confefence would like to emphasize to all international agencies and national funding and cooperative agencies that no real progress in development in the countries of the region can be attained without adequate attention and stress being paid to occupational health and safety and that, therefore, all development grants and schemes of cooperation on either a multilateral or bilateral basis should consider primarily the health and safety of the working population.

Now Be It RESOLVED As It Is Hereby RESOLVED That:

1. For more effective programmes of occupational health services, it is desirable to establish localized institutions of occupational health in different regions of each country with the following functions:
   a. To conduct more scientific investigations.
   b. To provide advisory services and counselling by the occupational health specialists of the institution.
   c. To help solve problems promptly and effectively in the regional level.
   d. To carry out more effective training programmes.
   e. To organize seminars for factory physicians and other responsible people in industry.
   f. To help those engaged in occupational health to further their professional careers.
2. The administrative pattern of these local institutions would have to conform to the existing legislation and administrative system of the country concerned with the following provisions:
   a. Depending on the circumstances, the local institutions should be supported by the employers particularly in terms of finance.
   b. The government may be requested to support these institutions by means of subsidies.
   c. Whenever possible, those local institutions of occupational health should be set up by the National Association of Occupational Health of the country, working in close collaboration with the employers, the workers organizations and the government.
   d. Strong appeals by these local institutions of occupational health through their national associations of occupational health and the AAOH should be made to international agencies and national agencies for international cooperation to give substantial financial support and technical assistance.
3. Occupational health services in industrial plants and other institutions concerned with occupational health in the area should be affiliated and cooperate closely with the local or regional institutions of occupational health.
4. The government of each country is strongly urged to pass the necessary legislation to support the establishment of these institutions, encourage scientific research in occupational health by these institutions and create the proper climate atmosphere for the promotion of occupational health and safety among employers, labor leaders and the general population.

CONSTITUTION
OF
THE ASIAN ASSOCIATION OF OCCUPATIONAL HEALTH

as amended October 23, 1979, in Seoul, Korea

Chapter I. General Provisions

The Fourth Asian Conference on Occupational Health in 1964 in compliance with the Tokyo Proclamation of Nov. 3, 1956 resolved to establish an Asian Association of Occupational Health.

The Seventh Asian Conference on Occupational Health in 1973 held in Jakarta adopted the Constitution of the Association.

In 1976, the Eighth Asian Conference on Occupational Health held in Tokyo deemed it necessary to make certain provisions and amendments to adapt its instruments to the prevailing conditions in Asian countries.

Finally, the Ninth Asian Conference on Occupational Health held in Seoul in 1979 decided to amend the Constitution further and to adopt the By-Laws of the association.

Chapter II. Name of the Association

The association shall be known as the Asian Association of Occupational Health.

Chapter III. Objectives

The objectives of the association are:

1. To imrpove health, welfare & safety of the working population in Asia, Australia and New Zealand through development of occupational health activities in industry and agriculture.
2. To establish and promote permanent relations among individuals working in the field of occupational health in Asia, Australia and New Zealand.
3. To help improve the standards of living and to help eliminate the social factors leading to poverty and backwardness of the working population.

Chapter IV. Membership

The membership of the association shall be the following:

1. National Member Committees or Associations:
   a. National Committees or Associations of Occupational Health which initially signed the Tokyo Declaration on Nov. 3, 1956 on the occasion of the First Asian Conference on Occupational Health.
   b. Other National Associations or Committees of Occupational Health of Asian Countries, as may be accepted to join later. The application for admission of new National Associations or Committees would require the endorsement of at least five other national members.
   c. In countries where National Associations do not exist, a candidate may apply to the Secretary General-Treasurer of the Asian Association for election as a member in the manner noted in paragraph b) above.
2. Associate Member Associations or Institutions:

   Any national association, organization, institution or industry in member countries, interested in the aims and objectives of the Association can be nominated as associate member through its National Member Association who shall then forward the same to the Council of the Asian Association for final approval at the next meeting of the Council.

3. Individual Members:
   a. Full Individual Members: Occupational Helath Professionals in Asia, Australia and New Zealand, who are recognized by virtue of their training or experience as fully qualified occupational health professionals in their own countries, shall be eligible to apply for individual membership of the Association. Such applications shall be subject to the approval of the Council.
   b. Associate Individual Members: All persons interested in occupational health and engaged in work connected with Occupational Health in Asia, Australia and New Zealand may apply to be Associate Individual Members of the Association. Such applications shall be subject to the approval of the Council.
4. Honorary Members:
   All past presidents of the associations shall automatically become honorary members. Any other members or individuals in recognition for their outstanding contribution to the activities of the association may be nominated as honorary members with the approval of the Council. All recipients of plaques of distinction and recognition shall become honorary members.

Chapter V. The General Committee

There shall be a General Committee of the association composed of one delegate from each national member. The committee shall elect the Council of the association in a meeting where at least five member countries are present. Each delegate shall have one vote.

Chapter VI. The Council

The Council shall consist of the following officers of the association:

Honorary President
President
First Vice President
Four Vice Presidents
Secretary General-Treasurer

The President and the Secretary General-Treasurer shall be elected from one country and the five Vice Presidents from five other different countries.

A First Vice President shall be elected from among the five vice presidents by the General Committee and shall assume the duties of the President in case of temporary incapacity of the latter.

The President and Secretary General-Treasurer shall be elected from the country responsible for the holding of the next conference. The President shall appoint the Secretary General-Treasurer. The Council members shall hold office for a period of three(3) years and may be re-elected. It is desirable that two council members be re-elected for a further period of three years in order to maintain continuity of routine activities.

Chapter VII. Joint Session of the General Committee and Council

1. There shall be a Joint Sessions of the General Committee and Council at least once every three years.
2. In the year of the Asian Conference, the General Committee & Council shall hold a business meeting.
3. The decisions at these Sessions shall be binding and valid if at least 2/3 of the members of the General Committee are present. In the event is no such quorum, approval of pending matters may be obtained by referendum. Failure by any national member to answer the referendum within two months will be construed as approval.
4. The Secreatry General-Treasurer on the advice of the President shall convene the Joint Session. The date, place and agenda of the Session shall be circulated to the members at least two-months prior to the Joint Session. The agenda shall consist of
   a. Annual Report

b. Audited Accounts
c. Any resolutions that may be brought with proper notice and
d. Any other matter that may be brought up at the discretion of the President

5. The members of the General Committee shall send their replies at least thirty(30) days before the date of Session.

Chapter VIII. The Secretariat

The Council shall establish a Secretariat with the President and the Secretary General-Treasurer, who shall carry on the routine work in compliance with the Council's approved policies. Its duties will be:

1. To keep in constant contact with member countries and non member Asian countries, in order to exchange information and literature and to promote supply and exchange of scientific appliances needed by any Asian countries.
2. To publish annual reports of the activities of the Association and of the countries affiliated to it.
3. To be responsible for collecting the subscriptions, subsidies, donations, etc. and for administering the finances of the Association.

Chapter IX. Finances

The sources of income of the Association shall be from:

1. Membership and admission fee:
   a. Trieneal Membership fee shall be 75 US dollars from each national or associate member and 15 US dollars from each individual member.
   b. Admission fee shall be 10 US dollars for both national and associate members and 5 US dollars for every individual member.
2. Donations, Subsidies and Grants
3. Sale of publication and/or journals

Chapter X. The Asian Conference on Occupational Health

1. The Conference shall be held once every three years.
2. The Council of the Association shall have the responsibility of organizing and convening the next Asian Conference.
3. Any National Association shall have the privilege of proposing the holding of an Asian Conference in its own country and of helping in organizing the Conference.
4. The Council and the National Organizing Committee shall work in close liaison for the success of the Conference.

Chapter XI. Amendments

This constitution may be amended during the Joint Session of the General Committee and Council of the Association provided, however that the Council must have received a motion for alteration or amendment at least three months before the Joint Session, has first circulated the same among the members and approved it for placing before the General Committee. Alterations or amendments shall be valid if passed by two-third of all members present during the Joint Session.

Chapter XII. Technical Committees

The Council may from time to time form Technical Committees and appoint the Chairman who will in turn appoint their respective committee members. The decisions of the Technical Committees shall be submitted to the Council for approval. The Chairman of each Technical Committee shall submit a report of its activities to the Council during the Joint Session every three years.

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