Technical Study 61e

Techniques for Collection and Analysis of Data on Perinatal Mortality in Kinshasa, Zaire

D. Nzita Kikhela

Infant Mortality and Health Studies

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Originally published as *Techniques de collecte et d'analyse de données sur la mortalité périnatale à Kinshasa, Zaïre*

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IDRC-TS61e

Techniques for collection and analysis of data on perinatal mortality in Kinshasa, Zaire. IDRC, Ottawa, Ont., 1989. x + 88 p. : ill. (Technical study / IDRC) (Infant mortality and health studies)

/Research methods/, /infant mortality/, /maternal and child health/, /risk/, /towns/, /Zaire/ - /data collecting/, /observation/, /questionnaires/, /data analysis/.

UDC: 312.2-053.2(675) ISBN: 0-88936-529-6

Translation: Bureau of Translation, Secretary of State
Technical Editor: W.M. Carman

A microfiche edition is available.

This study was carried out with the aid of a grant from the International Development Research Centre. The views expressed are those of the author and do not necessarily represent those of IDRC. Mention of a proprietary name does not constitute endorsement of the product and is given only for information.

Abstract / Résumé / Resumen

Abstract -- In developed countries, mortality rates are well known and have declined sharply since the 19th century. In Africa, however, such rates are conjectural. Thus, in-depth research on this topic is needed because only with such research will it be possible to identify the components of a good social and health policy.

The methodological findings of a study in Kinshasa from 1981 to 1986 are presented here as a step toward the better study of mortality in the young. These findings focus on three topics: data gathering, the preparation and/or application of a conceptual framework, and the determination of which families are at risk.

In data gathering, experience in Kinshasa brought to light many precautions that should be taken, notably in the selection of those carrying out the enquiry, in the formulation of the questions, and in seeking out those persons to be questioned in an ongoing enquiry. On the subject of the conceptual framework, a methodology for its establishment is proposed, with careful attention given to the variables necessitated by its use and their importance.

Lastly, an appropriate methodology is presented for determining families at risk. This methodology, segmentation, is not novel. However, we believe that presenting its possibilities is likely to favour its greater use in developing countries where the design of an effective policy requires, as a prerequisite, the identification of the target groups.

Résumé -- Si, dans les pays développés, la mortalité est bien connue et a fortement diminué depuis le siècle dernier, dans les pays africains, elle relève encore du domaine des approximations. Ainsi, une recherche approfondie mérite d'être effectuée dans ce domaine, car elle seule permettra d'identifier les éléments d'une bonne politique sociale et sanitaire.

C'est donc dans un cheminement vers une meilleure étude de la mortalité aux jeunes âges qu'il a été retenu de présenter les acquis méthodologiques d'une étude menée à Kinshasa entre 1981 et 1986. Ceux-ci sont focalisés autour de trois thèmes : la collecte des données, l'elaboration ou l'utilisation d'un cadre conceptuel, ou les deux, et la détermination des familles à risque.

En ce qui concerne la collecte des donées, l'éxperience de Kinshasa a révélé de nombreuses précautions qu'on peut prendre, notamment pour le choix du personnel d'enquête, pour la formulation des questions et pour le repérage des personnes à interroger dans le cadre d'une enquête suivie. Une méthodologie a été proposée pour constituer un cadre conceptuel, et un accent particular a été mis sur les variables

qu'il impose d'utiliser et les niveaux où ces dernières interviennent.

Enfin, pour la détermination des familles à risque, une méthodologie appropriée a été présentée : la segmentation, qui n'est pas une nouveauté. Mais la présentation de ses possibilités est, nous semble-t-il, de nature à favoriser sa plus grande utilisation dans les pays en développement où l'élaboration d'une bonne politique d'action impose l'identification préalable des groupes cibles.

Resumen -- Si bien en los países desarrollados los índices de mortalidad son bien conocidos y han disminuido drásticamente después del siglo pasado, en los países africanos pertenecen al domino de las aproximaciones. Es necesario por lo tanto que se lleve a cabo una investigación profunda en este campo ya que solamente ésta última permitirá identificar los elementos de una buena política social y de salud.

Es por ello que como un paso hacia el mejor estudio de la mortalidad en edades tempranas se ha tomado la decisión de presentar los resultados metodológicos de un estudio hecho en Kinshasa entre 1981 y 1986. Estos resultados se centran alrededor de tres temas: la recolección de información, la elaboración y/o aplicación de un marco conceptual y la determinación de familias en riesgo.

En lo concerniente a la recolección de información, la experiencia de Kinshasa ha revelado numerosas precauciones que se deben tomar sobre todo en la selección del personal que realiza la encuesta, en la formulación de las preguntas y en la búsqueda de los encuestadores en el marco de una encuesta en curso. En lo que se refiere al marco conceptual, se ha propuesto una metodología para su establecimiento y se ha hecho énfasis en las variables que se requieren para su utilización y en los niveles en los que estas intervienen.

Finalemente, se presentó una metodología apropiada para la determinación de familias en riesgo. Esto, la segmentación, no es novedoso. Sin embargo, creemos que la presentación de sus posibilidades favorecerá un empleo más amplio de la misma en los países en desarrollo donde la elaboración de una política efectiva depende de la identificación previa de grupos-objetivo.

CONTENTS

FOREWORD

The Social Sciences Division of the International Development Research Centre (IDRC) set up the Population, Health, and Development Project in 1983. This project was intended to support researchers in developing countries and, provisionally, to increase the capacity of these researchers to conduct interdisciplinary studies on the persistent problems of poor health and high mortality rates among infants and children. With the dynamic participation of the Health Sciences Division, the project's leaders organized a number of activities that would bring together specialists in both the health and social sciences. The leaders organized a series of regional interdisciplinary workshops in Latin America and Africa. They also prepared two research bibliographies and sponsored the participation of several researchers in international conferences. In addition, the project's leaders commissioned a series of technical studies on problems and aspects of infant mortality that, although well known, have not yet been investigated. These studies, examined by peers, have been published in the IDRC series on infant mortality and health. They address specific methodological and conceptual questions of relevance in research and in the gathering and analysis of data.

It should be noted that the intention was never to base the series solely on fresh data. These studies seek rather to examine and present research into particular problems of methodology. The authors are researchers whose works have successfully married the methodological and conceptual bases of the health and social sciences. Depending on the nature of the subject matter, the authors have been encouraged to adopt either the presentation and style of a guide or that of a descriptive writer.

This study describes the plan, method of implementation, and results of a completed survey. It provides a good reference work for evaluating this type of methodological procedure, to say nothing of its helpfulness as a guide for future researchers. The author, Nzita Kikhela, is a professor in the Department of Demography at the University of Kinshasa, Zaire.

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ACKNOWLEDGMENTS

We wish to thank M.B. Lux and Mrs G. Masuy-Stroobant of the Louvain Institute of Demography for their valuable advice during the writing of this study and for their help in developing the computer programs. We are also most grateful to P. Kaunba, who read and reread the manuscript.

GENERAL INTRODUCTION

As the World Health Organization (WHO) has repeatedly stressed (WHO 1976, 1978), there are very few studies on the levels and differential variations of perinatal mortality in poor countries. Studies such as those of Pharoah (1976) and Hall (1976), although very general, therefore continue to be extremely interesting.

To stimulate researchers' interest in this type of mortality and at the same time standardize analytical techniques (WHO 1978), WHO undertook a pilot study in eight countries (Austria, Cuba, Hungary, Japan, New Zealand, Sweden, the United Kingdom, and the United States). Only one of these, however - the Republic of Cuba - is part of the Third World. This choice of countries was unfortunate: it resulted merely in a bolstering of already good statistics, with no light shed on the predicament of the poorest countries.

A more comprehensive knowledge is required of the phenomenon of perinatal mortality, and a wider dissemination of the methods of gathering and analyzing the relevant data. Believing experience to be the best teacher, the author presents in this technical study the methodology adopted for the EMOKIN study, *Étude de la mortalité périnatale à Kinshasa* (Nzita Kikhela 1982). Experience is said to be the best teacher.

We begin by examining a few general problems (such as the choice of a method for gathering and analysis, and of the variables to be used) encountered within the framework of such studies. We then outline the solutions adopted in the EMOKIN study, The two main objectives of which were to identify those families at risk and to attempt to account for their high mortality rates.

These two objectives are very important for developing countries, where mortality rates are such that action policies must be implemented. For such policies to be formed, we must distinguish not only those groups with the greatest need, but also the types of action to be taken. According to estimates collected by Eliwo (1985), most African countries have infant mortality rates higher than 120‰. It was thus decided, in dealing with the methodological findings that emerged from this experiment, to focus on three themes: precautions taken to gather data effectively, identification of families at risk, and development and use of a conceptual framework for analyzing perinatal mortality.

No doubt some people would have preferred that the proposed experiment deal with a rural region and with ages 0 to 5 (the group showing the highest mortality rates). Although we agree with this preference, it should be noted that the work in question was chosen for its uniqueness in the field of mortality studies in Zaire. Moreover, although causal links and other factors may alter in the transition from perinatal to infant or juvenile mortality, there is, throughout this period, great similarity among the risk indicators (Masuy-Stroobant 1985). Finally, the study treats on those factors (newborn's characteristics and mother's behaviour during pregnancy, at birth, and after birth) most strongly influencing rates of perinatal mortality; because these factors are also those determining the probability of death between 0 and 1 year or between 1 and 5 years, any action taken within the perinatal context will ultimately have a positive impact on mortality rates throughout the early years.

The city of Kinshasa was chosen chiefly for the size and heterogeneity of its population. In conducting the differential mortality analyses required to identify families at risk, it is helpful to study an area that is socioeconomically diverse. In this regard, Kinshasa has a distinct advantage: it is the only region in which people of all ethnic origins and all socioeconomic categories live together (De Saint Moulin 1969-1970). Moreover, because this region has a population of nearly 2.7 million (10% of the population of Zaire), it is possible for us to learn very quickly about child mortality among a high proportion of the country's population.

OVERVIEW OF THE GATHERING AND ANALYSIS OF DATA ON PERINATAL MORTALITY IN SUB-SAHARAN AFRICA

Anyone undertaking a study of perinatal mortality must first ask the following questions:

1. What is meant by this type of mortality?
2. What indicator should be used to measure its extent?
3. What data should be gathered?
4. Upon what source should we draw?

Let us examine briefly the way in which these questions were answered in studies conducted in sub-Saharan Africa over the past 25 years. The area considered will exclude, in northern Africa, Algeria, Egypt, Libya, Morocco, the western Sahara, Sudan, and Tunisia, and in southern Africa, Lesotho, Namibia, the Republic of South Africa, and Swaziland. We shall refer to the data contained in a file of 33 studies (Table 1) on stillbirth and early neonatal mortality, published between 1960 and 1983, and listed under the heading "Prenatal

Table 1. Studies on sub-Saharan Africa, inventoried by country and year of publication.

Country	Year of publication	Number	References[a]
West Africa			
Ghana	1982	1	2
Côte d'Ivoire	1978	1	3
Nigeria	1970, 1971, 1971, 1977, 1978, 1979, 1979, 1982	8	11-19
Senegal	1971, 1971, 1971	3	37
Sierra Leone	1980	1	38
Togo	1983	1	29
East Africa			
Ethiopia	1977	1	1
Kenya	1964, 1968, 1979, 1980, 1983	5	4-6, 8, 10
Uganda	1964, 1966, 1967	3	22-24
Tanzania	1975, 1980	2	27-28
Zambia	1978, 1978, 1982	3	30-32
Central Africa			
Zaire	1966, 1968, 1974, 1985	4	33-36

[a] See Appendix 1.

and perinatal mortality" in the journals *Population* (France), *Population Index* (United States), and *Tropical Diseases Bulletin* (United Kingdom). This file does not include studies that have remained in mimeographed form (as, for example, the surveys by the Institute for Training and Demographic Research in Yaoundé). Neither does it include studies classified under a heading such as "Fertility": although such studies would contain certain data on perinatal mortality, they would deal primarily with the subject of the title. Nor does the file include studies published between 1960 and 1983 but indexed after 1984.

Place and significance of perinatal mortality

The term "perinatal mortality" refers to the risk to any child of stillbirth, in which a baby is born dead, or of early neonatal mortality, by which he or she dies within 7 days of birth (WHO 1978). The levels of such risk are calculated using the numbers of stillbirths, live births, and deaths occurring between the ages of 0 and 6 days. These three subsets must therefore be defined in the same way in every country. If, for example, by identifying a lower minimum gestational age, a country creates a less restrictive definition of stillbirth, its numbers for stillbirth, and thus its perinatal mortality level, will be overestimated (Hohn 1981).

According to WHO, the birth of a live child means "the complete expulsion or extraction from its mother's body of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life ... Any product of such a birth is considered live born" (WHO 1977). A still-birth is defined by WHO (1977) as the death of a product of conception with a minimum weight of 1000 g, gestational age of 28 weeks, or length of 35 cm (see Hohn 1981; Masuy-Stroobant 1985). In Africa, the international recommendations are, in theory, applied. Only 2 of the 33 studies inventoried report the use of different criteria. In one of these, the perinatal period was extended to the 10th day following birth (Lambillon 1963); in the other, it was extended to the 30th day (Koten 1968). When comparing perinatal mortality levels, we must therefore take into account the different definitions used.

Indicators used: rate and quotient

The two indicators used are the 'rate,' obtained by dividing the number of perinatal deaths by the number of the live births, and the 'quotient,' calculated by dividing the number of perinatal deaths (those that occurred under study) into the total number of stillbirths and live births (the total population subject to the risk). In Africa, as in other continents, the rate is the most widely used indicator (WHO 1976). Of the 33 studies on sub-Saharan Africa, only 2 were based on quotients: the WHO study of Freetown (WHO 1980) and Tshibemba Wa Mulumba's study of Kinshasa (1985). Because the denominator for the rate represents only a part of the

population at risk (i.e., fetuses surviving to birth, rather than all fetuses reaching 6 months' gestation), we prefer the quotient as a measurement of the probability of death during the perinatal period.

Type of analysis conducted

As a general rule, differential mortality analysis is not carried very far in studies of sub-Saharan Africa. Such analysis describes variations in the phenomenon in relation to particular characteristics of the parents or child; it does not, however, seek out the interrelations between these two groups of variables. Such research is, on the whole, confined to the study of the mortality level and the way in which it varies according to the demographic, economic, social, and cultural characteristics of the parents (Kikhela 1986). In short, nearly all these studies go no further than single-variable analysis.

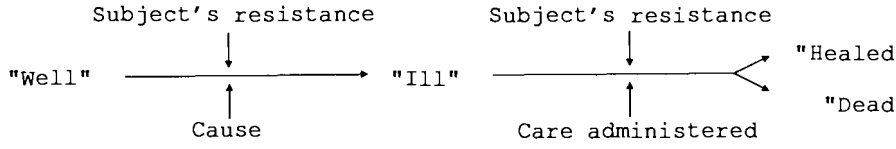
In our opinion, a more explanatory analysis is needed. To achieve this, we must determine a chain of causality, and this requires that we begin with a conceptual framework.

We prefer to speak of a 'conceptual framework,' rather than a 'general theory.' As Thinès and Lempereur (1985) observe, a theory is a coherent, explanatory system consisting of several logically articulated hypotheses; if one of these hypotheses is proved false, then the entire theory must be dismissed. If, however, some of the hypotheses within a conceptual framework prove incorrect, the entire framework may not need to be rejected. By conceptual framework we mean with Blalock (1971:5), "a number of definitions, assumptions and propositions modeled after the ideal of a completely deductive system of thought."

Although in recent years strong interest has been expressed in explanatory analysis, no framework for perinatal mortality has, to our knowledge, been published. In the studies of child mortality published during the last 5 years, we note six conceptual frameworks that have been put forward, by S.A. Meegama (1980), I. Pool (1982), A. Hill and S. Randall (1984), W. Mosley (1985), and A. Eliwo (1985). Very little work has been done, however, in developing a methodology for formulating conceptual frameworks. We therefore offer a few suggestions derived from our own insights and from principles put forward by the Department of Demography of the Catholic University of Louvain (CUL 1983).

Some methodological principles

To explain or research the death of a child (individual analysis) or the difference in mortality levels between two groups (aggregate analysis), we must, in effect, describe the mechanisms by which one moves from 'well' to 'ill,' from 'ill' to 'healed' or to 'dead' (Masuy-Stroobant and Tabutin 1982). Schematically, this may be represented as follows:



Thus, to draw up a conceptual framework, we may proceed as follows:

1. The starting point is the phenomenon under study. In the case of the EMOKIN survey, for example, this phenomenon is stillbirth and early neonatal mortality. Let us remember that one of the objectives is to explain differences in levels of mortality between types of families. An aggregate approach is therefore taken.

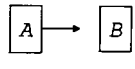
2. The next step is to examine the chain of causality whose constituent elements are occurrence of an illness and the quality of care given to prevent that illness from leading to death. Because it is difficult, if not impossible, to list every factor that may influence these two elements, it is advisable that we confine our attention to those factors that seem most important (Hill and Randall 1984; Vallin 1984). We therefore seek the variables that most affect the quality of care and those most conducive to the occurrence of the main illnesses during the period under consideration.

   To this end, we proceed step by step. When studying, for example, the occurrence of an infectious disease in a child, we first identify the variables that cause the disease; these will include the child's resistance to the disease and the healthiness of the environment in which he or she lives. We then consider these two factors as dependent variables and examine the independent variables that influence them directly.

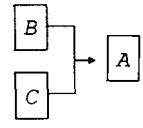
3. The breakdown continues in this way until it reaches the limits set in accordance with the research objectives. For each step, we have identified a number of rules.

   a. To indicate that a variable *A*

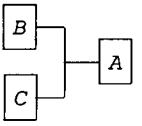
      - affects a variable *B*, we use an arrow, as follows:



      - results from the interaction of factors *B* and *C*, we represent them as follows (*B* and *C* interact when the effect of one of them on variable *A* depends on the level of the other variable):



- corresponds to the sum or product of the data provided by variables *B* and *C*, we represent them as follows:



b. A variable *A* will be said to influence a variable *B* (Boulanger 1980) if, in the chronology of events, it appears before *B*, and if any change in variable *A* is liable to cause a change in variable *B*. To show that a correlation may be assumed to exist between them, a reference will be given. Thus, Fig. 1 is accompanied by Table 2, in which the references can be found.

An analytical framework for perinatal mortality

The first step in the process was to break down the phenomenon under study into its two components, stillbirth and early neonatal mortality. We then determined for each the leading causes of death identified in our review of the available studies of sub-Saharan Africa (Nzita Kikhela 1986) (Appendix 1). These causes of death can be grouped into four categories: category 1, the largest category, accounting for at least 30% of deaths, comprises those causes relating to delivery (obstetrical trauma and prolonged labour); category 2, responsible for 5–36% of deaths (Kenya 1980 and Uganda 1964, respectively), relates to the child's characteristics; category 3 comprises placenta and cord abnormalities (10–20% of deaths); and category 4 represents the residual group (infections and accidents).

Thus, for early neonatal mortality, we identified infections of the newborn, its characteristics, delivery-related causes, and illness contracted by the mother during pregnancy (such as placental diseases). For stillbirth, we distinguished between two categories of causes: those relating to delivery complications and those relating to the mother's illness during pregnancy.

Finally, we prepared a conceptual framework for the study of perinatal mortality (Fig. 1). This figure presents the sequences of events that can lead to the appearance of either neonatal mortality or of stillbirth.

To develop these sequences, we formulated 17 numbered hypotheses, documented by references (Table 2). Which of these should be used? And what criteria can we formulate?

In this framework are clearly marked the two paths by which we may intervene to affect mortality levels: either we attempt to prevent an illness, or we attempt to save those who have contracted it. These directions correspond to two concepts that are well known in medicine but very little used in demography: incidence (the frequency of a disease in a

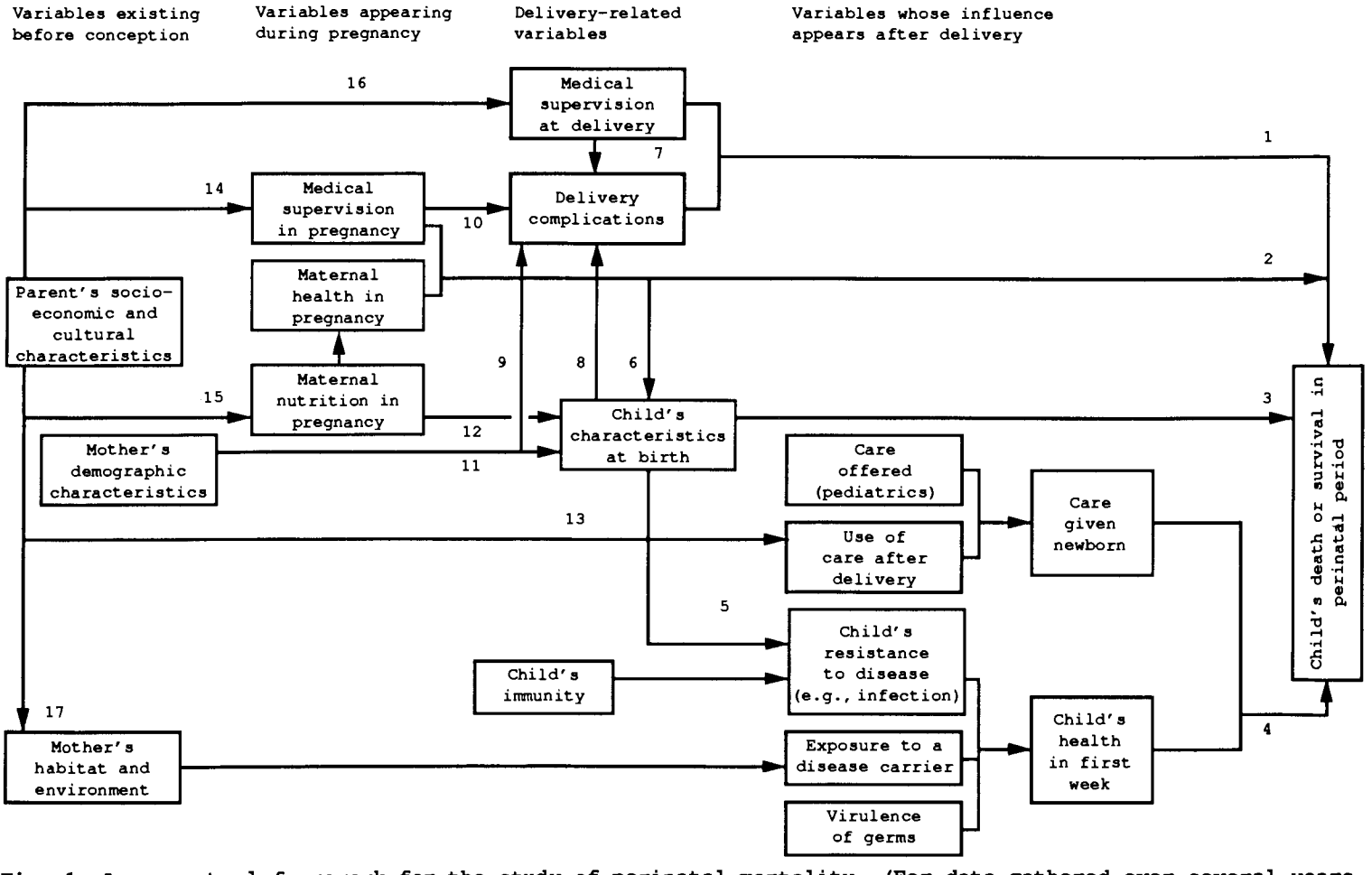


Fig. 1. A conceptual framework for the study of perinatal mortality. (For data gathered over several years, the central year is noted.)

Table 2. Bibliographical references for the 17 hypotheses in the conceptual framework.

No.	Dependent variable	Independent variable	References[a]
1	Early neonatal mortality	Child's health during 1st week Care given newborn	39
2	Perinatal mortality	Medical supervision at delivery Complications at delivery	40
3	Perinatal mortality	Mother's health during pregnancy Medical supervision during pregnancy	41
4	Perinatal mortality	Newborn's characteristics (congenital malformations)	42
5	Child's resistance to disease	Child's characteristics at birth	43
6	Child's characteristics at birth	Mother's health during pregnancy	44
7	Complications at delivery	Medical supervision at delivery	45
8	Complications at delivery	Child's characteristics at birth	46
9	Complications at delivery	Mother's demographic characteristics	47

(continued)

Table 2. Concluded.

No.	Dependent variable	Independent variable	References[a]
10	Complications at delivery	Medical supervision during pregnancy	48
11	Child's characteristics at birth	Mother's demographic characteristics	49
12	Child's characteristics at birth	Mother's nutrition during pregnancy	50
13	Use of care	Socioeconomic and cultural characteristics	51
14	Medical supervision during pregnancy	Socioeconomic and cultural characteristics	52
15	Mother's nutrition	Socioeconomic and cultural characteristics	53
16	Medical supervision at delivery	Socioeconomic and cultural characteristics	51
17	Habitat and environment	Socioeconomic and cultural characteristics	54

[a]See Appendix 1.

population during a given period) and lethality (the frequency of deaths among patients).

Thus, as is stressed by Meegama (1980) in his study of Sri Lanka, data must be gathered not only on mothers' behaviour and on demographic, economic, and social characteristics, but also on the infrastructures of obstetric units.

Note that there are two broad categories and five subcategories of variables to be researched. Category 1 consists of variables relating to care services, Category 2 of those relating to individuals. The latter may be classified in five subcategories: those variables that influence the child's risk of dying after birth (habitat and quality of care given to the newborn if he or she becomes ill); those that pertain specifically to the child (weight, height, sex, multiple birth); those that relate to delivery (complications); those originating during the pregnancy (prenatal consultations, mother's nutrition); and those that existed before the child was conceived (i.e., the variables, such as education, social status, marital status, and number of pregnancies, by which the parents are identified).

Let us point out that, because these variables intervene at different points in the chain of causality, we must avoid comparing the influence of two factors that do not act at the same level (e.g., birthweight and mother's education). In the EMOKIN study on differential variation in mortality and on families at risk, the author proceeded by using the variables that had existed before the child was conceived. Most of these variables correspond to the data by which people are identified socially. These data enable us to measure the social disparities that, according to the conceptual framework presented here, underlie differences in types of infant mortality. To account for differences in mortality observed between types of families, we use variables relating to pregnancy, delivery, and the early neonatal period; in the future, these will be known as intermediate variables.

A basic hypothesis emerges from this framework. In this hypothesis, the families with the highest levels of mortality are those families at risk, i.e., those with a higher percentage of difficult deliveries, of delivery complications that are not treated appropriately, and with low children birthweight. These risk factors derive from a set of social disparities, existing at conception, that affect the mother's health, her use of care services, and her nutrition during pregnancy.

How to gather all these data

There were eight methods that we applied:

1. To interview women who give birth in obstetric units;

2. To interview women who give birth in obstetric units and to follow up at their homes on the 7th day;

3. To take details of women at their first prenatal consultation and to follow up to the end of the early neonatal period, either by visits at home or by interviews at subsequent consultations;

4. To effect a retrospective survey into births from the last 12 months;

5. To conduct a multiphase survey of women of reproductive age;

6. To examine the records of obstetric units;

7. To examine the records of vital statistics; and

8. To collate data from several sets of records (e.g., marriage and burial records).

If we classify studies of sub-Saharan Africa according to these methods, we find that data have never been gathered by a retrospective survey, and that records of vital statistics have been used very rarely; the most commonly used method is that of interviewing women in obstetric units (Table 3).

Each of these methods has its own advantages and disadvantages (Table 4). As a general rule, the multiphase survey ought to be the best method (Tabutin 1980); it is often abandoned in developing countries, however, because of its cost. Moreover, because natural movement tends to be underreported (Kabasele 1970; Cantrelle 1971), the data contained in records of vital statistics are unreliable.

Given the present state of our knowledge, it seems that greater use should be made of the data available in obstetric units. It is true that these data will contain no information on children who are born at home and who are not taken to obstetric units; can we assume, however, that many such cases remain, particularly in the cities? Do we believe, moreover, that the characteristics of these mothers differ greatly from those of mothers who give birth in obstetric units and have high levels of mortality?

We consider that the least problematical method, particularly in the cities, is that of interviewing women in obstetric units and then surveying them at home on the 7th day. In several African countries, a mother and her child, if they are healthy, leave the obstetric unit 3 or 4 days after the birth (Cantrelle 1971; Hodonon 1983; Tshibemba 1985). To determine whether the child dies before the 7th day, it is therefore necessary to follow up the mother at home. Although it would be still more interesting to monitor women throughout their prenatal consultations, the women usually begin these consultations late (after the 6th month [Tshibemba 1985]), and do not necessarily give birth at the centre attended during pregnancy; birth data might therefore be very difficult to gather by this method.

Table 3. Studies of sub-Saharan Africa by origin of data and by country.

Gathering technique	Studies		Country (year of publication)
	No.	%	
Interviews with mothers delivering in obstetric units	14	42	Kenya (64),(80); Nigeria (70),(77),(78),(79),(79),(82); Uganda (64); Somalia (81); Zambia (78), (78); Zaire (66),(85)[a]
Birth and death records of obstetric units	8	24	Ethiopia (77); Kenya (68); Nigeria (71); Uganda (66); Tanzania (75); Togo (83); Zambia (78),(78)
Records of vital statistics	2	6	Côte d'Ivoire (78); Senegal (Dakar) (78)
Multiphase survey of those of reproductive age	4	12	Kenya (79),(83); Senegal (Paos Koto-Niakhar) (80); Sierra Leone (80)
Interviews with women in obstetric units, plus survey at home on 7th day	1	3	Zaire (74)
Records of prenatal consultations, plus monitoring of recorded patients	1	3	Senegal (Khombole) (80)
Comparison of data from three sources: obstetrical records, multiphase survey and cemetery records	1	3	Zaire (73)
Studies listed but not available	2	6	

[a] In 1981, we found an initial, unpublished report from Zaire.

Table 4. Advantages and disadvantages of some methods of gathering on perinatal mortality data.

Method	Advantages	Disadvantages
Interviews with mothers in obstetric units	• Questions are put to the subject herself; answers are therefore more reliable • Sound medical data can be collected, especially on circumstances of delivery • Inexpensive	• Children born at home and not taken to obstetric units are omitted • Occurrences during pregnancy must be recorded retrospectively. Some factors, such as state of health, cannot be recorded accurately in this way • Method is only attractive if the mother remains until the 7th day
Search of birth and death records in obstetric units	• Inexpensive • Substantial time savings in data gathering	• Same disadvantages as preceeding method • Risk of underreporting of births, especially stillbirths
Multiphase survey of women of reproductive age	• Enables longitudinal analysis • Data on progress of pregnancy are accurate	• Expensive • Sample subject loss
Searches of records of vital statistics	• Inexpensive • Data gathered quickly	• Births tend to be underreported, and deaths even more so • No information on occurrences during pregnancy

(continued)

Table 4. Concluded.

Method	Advantages	Disadvantages
Interviews with mothers in obstetric units, plus surveys at home on 7th day	• Same benefits as first method • Enables all deaths in early neonatal period to be recorded (especially useful if mother stays only a few days after birth)	• In addition to the first method's disadvantages, the survey sample is subject to loss
Searches of records of prenatal consultations, plus monitoring of women surveyed	• Very useful if all women consult health professionals • Gives access to medical data on progress of pregnancy	• Excludes women who do not consult professionals • For those women who do not give birth where they have consulted professionals, sample is subject to loss
Collation of data from several records	• Less expensive than a survey	• Records are of uneven quality, creating bias • Files are not computerized in Africa, therefore, problems of collation • Difficulty of finding data that meet research requirements
Retrospective survey	• Less expensive than multiphase survey	• Stillbirths underreported • Difficulty of finding sound data on progress of pregnancy and delivery

Conclusion

In contrast to studies published before 1970, those released during the last 15 years show steadily growing interest in the explication of mortality levels (Eliwo 1985). Although many conceptual frameworks have been proposed for infant and child mortality, none has yet been published for perinatal mortality. We have proposed such a framework and, most important, have suggested a procedure that may be of use to other researchers in the field.

We have also reviewed the various methods that could be used to gather data on perinatal mortality. To assess the advantages, disadvantages, and, above all, costs (a very important factor in developing countries) of these methods, we chose a two-phase survey. The first phase takes place in the obstetric unit and consists of recording births and also data by which the mother can be identified. The second phase takes place in the homes of the mothers thus identified and consists of collecting all the necessary data that have not been obtained in the obstetric unit.

Such a survey was carried out in Kinshasa. We present here the main findings of this experiment.

THE SURVEY OF PERINATAL MORTALITY IN KINSHASA: METHODOLOGY AND MAIN FINDINGS 2

We shall begin our presentation of the survey carried out in Kinshasa in 1981-82 with a brief look at the questionnaires that were used. We shall then outline the provisions made to organize the field work and to edit and correct the data. After explaining the way in which the survey was conducted, we shall study the two methodological problems posed by our procedure, together with any other difficulties that arose. To conclude, we shall present some data on the population surveyed.

Survey questionnaires

As noted in connection with the conceptual framework, two types of questionnaire were developed: an obstetrical-unit questionnaire and an individual questionnaire (reproduced in Appendices 3 and 4). The first was completed only once for each obstetric unit. It includes questions on the number of beds, of medical staff, and of births per year, and on the type and quantity of equipment available to treating staff.

The second questionnaire comprises those questions relating to individuals and their characteristics. It has 13 pages, 12 of which cover parents' identity, progress of pregnancy, and newborn's characteristics. The 13th page contains information on the child's survival and on the mother's state of health during the early neonatal period.

Few problems arise in the formulation of questions concerning intermediate variables: because these variables are of a medical nature, the same data can be used to gather them, whether in a rich country or a developing one. This was not always the case, however, for identification variables such as socioeconomic level. In developed countries, the question, "What is your occupation?" may be sufficient to determine income levels; this does not hold true in Kinshasa or in many African cities. We see two main reasons for this: according to Houyoux (1970), a high proportion of the labour force engage in activities that bring in supplementary income; and there exists a strong solidarity between people in the same clan that makes the rich share their property with their "brothers."

Two extracts from conversations illustrate these points. "I ask him why he is at home after 10 a.m. He tells me, 'Yes, I didn't go to work today. I had a bag of cement from a friend to make bricks. My family is supported by this extra work, instead of waiting for the pittance the government gives me

after working hard for 30 days.'" "I'm still waiting for a job promised me by a friend in OTRACO. But you see, I'm having a hard time here with the children. I'm waiting for a bag of foufou [manioc flour] that is supposed to come from the village, because the children are bugging me for food. Yesterday we had nothing to eat; luckily the wife received a present of 30K [Zaire currency] from her uncle" (Houyoux 1970).

Further study is needed to develop questions that will enable these two types of income to be recorded. For the EMOKIN study, we eventually decided to use education and social status to determine an individual's socioeconomic level. For this variable, only three categories are used: managers and independents with employees, unemployed, and others.

For all the other variables, Tables 5 and 6 show the data taken into account in formulating questions.

The survey

General observation procedure

In a region where all women give birth in obstetric units, and where mother and child must remain in the unit throughout the early neonatal period, all the data are obtainable from the same place and are therefore relatively easy to gather.

In the case of the city of Kinshasa, the situation is somewhat more complicated. According to the results of sociomedical surveys conducted by the public health department, comparatively few women give birth at home rather than in obstetric units. Despite this fact, a problem arises in gathering data on early neonatal mortality: if mother and child are well, they leave the obstetric unit 3 days after the birth; to learn what happens between the 3rd and 7th day, we must therefore obtain the mother's address and go to interview her in her home.

Because these home visits were necessary, and because so many babies are born every day (at least 200, of whom 85 are born in the Mama Yemo hospital obstetric unit alone (Tshibemba Wa Mulumba 1985:1), we chose the women who were to be surveyed at home by taking a sample of one-fifth of those whose children were alive on the 3rd day after birth. The survey was conducted as described below and as shown in Fig. 2.

1. For a given day, d, A births occur.

2. On day $d+1$, interviewers draw up a list of the women who gave birth on day d, noting names, addresses, results of pregnancy, and children's sex and birthweight. The interviewers also complete a questionnaire for those women who had stillbirths and for those whose children died on the day d of birth.

Table 5. Data to be gathered for identification variables.

Variable	Data to be gathered
1. Demographic variables of the mother	
• Age at birth of surveyed child	• Mother's date of birth • Child's date of birth
• Age difference between father and mother	• Mother's date of birth • Father's date of birth
• Mother's parity	• Number of previous pregnancies • Results of previous pregnancies
• Previous deaths of children	• Mother's reproductive history • Survival of each child
• Length of last interval between births	• Previous child's date of birth • Surveyed child's date of birth
• Marital status	• Single, married, divorced, or widowed • If married, number of co-wives
2. Parents' socioeconomic status	
• Mother's education and social status	
• Father's education and social status (if mother married)	• Last year of schooling completed by each
• Education and social status of person (if any) with whom parents live	• Manager or independent with employees, ..., office worker or unemployed
3. Mother's sociocultural variables	
• Mother's education	• Last year of schooling completed by mother
• Mother's nationality and ethnic origin	• Mother's country and tribe

(continued)

Table 5. Concluded.

Variable	Data to be gathered
• Length of stay in Kinshasa	• Date of last move to Kinshasa • Child's date of birth
4. Father's sociocultural variables	
• Father's education	• Last year of schooling completed by father
• Father's nationality and ethnic origin	• Father's country and tribe
• Father's previous residence	• Kinshasa. Urban or rural?
• Length of stay in Kinshasa	• Date of last move to Kinshasa • Child's date of birth
5. Habitat and environment	
• Type of house	• Materials with which walls are made
• Drinking water supply	• Water source: tap, well, or potable stream • Location of water source
• Occupancy or housing density	• Number of rooms in dwelling • Number of people in dwelling
• State of neighbourhood dump	• Is there a dump? • How often was garbage removed in last 6 months?
• State of drain adjoining mother's property	• Is there a drain? • Is it blocked?
6. Mother's anthropometry	• Mother's height and weight
7. Obstetrical history	• Mother's reproductive history • Complications at prior births

Table 6. Data to be gathered for intermediate variables.

Variables	Data to be gathered
1. Medical supervision of pregnancy	• Month in which prenatal consultations began • Time between consultations • Number of consultations • Reasons for first prenatal consultation of surveyed pregnancy
2. Mother's state of health during pregnancy	• Mother ill? • Type of illness • Care given to ill mother • Length of pregnancy when illness occurred
3. Mother's nutritional state during pregnancy	• Changes in mother's weight/height ratio during pregnancy • Hemoglobin count • Skin fold, proteinaemia
4. Circumstances of birth	• Place of birth (obstetric or not) • Type of service: standard or private • Type of complications at birth • Type of birth • Time of birth • Obstetrician's qualifications • Place of birth same as location of prenatal consultations? • Reasons for choice of obstetric unit
5. Newborn's characteristics at birth	• Sex • Weight • Length • Cranial perimeter • Congenital malformations • Multiple birth

(continued)

Table 6. Concluded.

Variables	Data to be gathered
6. Newborn's health during first 7 days	• Child ill? • Type of illness • Type of care given ill infant (treatment by lay practitioner or by physician)
7. Result of pregnancy	• Child dead? • Cause of death • Date of death
8. Child's survival during early neonatal period	• Child dead? • Cause of death • Date of death
9. Mother's health during 7 days following birth	• Mother ill? • Type of illness • Type of care given mother

3. On day *d*+3, the interviewers go over the list drawn up on day *d*+1 and complete the following pages: (a) the 13 pages of the questionnaire for the mothers of children who have died on day *d*+1 and on day *d*+2; and (b) the first 12 pages of the questionnaire for the sample of women whose children have survived until day *d*+3.

4. For women who had stillbirths and for those defined under points 2 and 3a above, the survey ends; it continues for those defined under 3b. On day *d*+7, the interviewers go to the mothers' homes and complete the 13th page.

Obstetric units selected for survey

In addition to the large obstetric units run by the Public Health Department, by religious institutions, and by universities, Kinshasa has several small nursing homes that are privately operated. Although the Department is aware that these nursing homes exist, it has no record of their number or of their locations, and therefore cannot monitor their work.

Because this lack of information prevented our obtaining a good sample, we confined our attention to the nine largest obstetric units — the Barumbu, Bumbu, and Kingasani nursing homes; the University, Kinoises, and Ngaliema clinics; the Ndjili Medical Centre; and the Mama Yemo and Kintambo hospitals. Because these units are scattered throughout the city (Fig. 3), it is possible to survey women from all zones (communes).

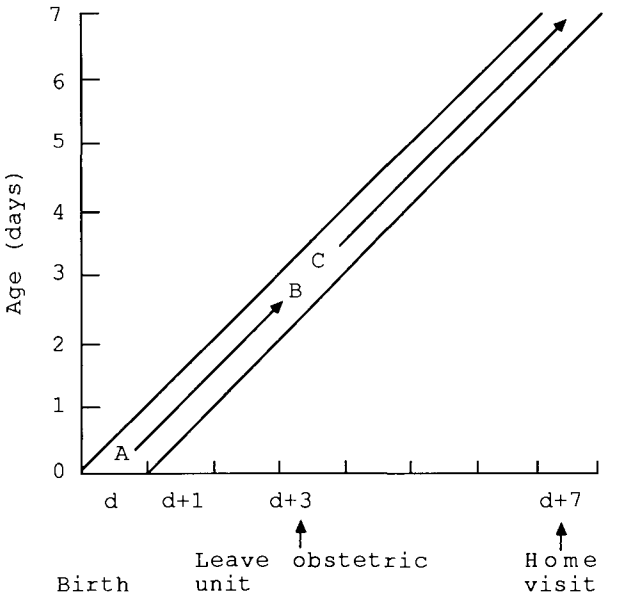


Fig. 2. Representation of the various operations. (A = births recorded in obstetric units; B = children alive 3 days after birth; C = sample of B on 5th day.)

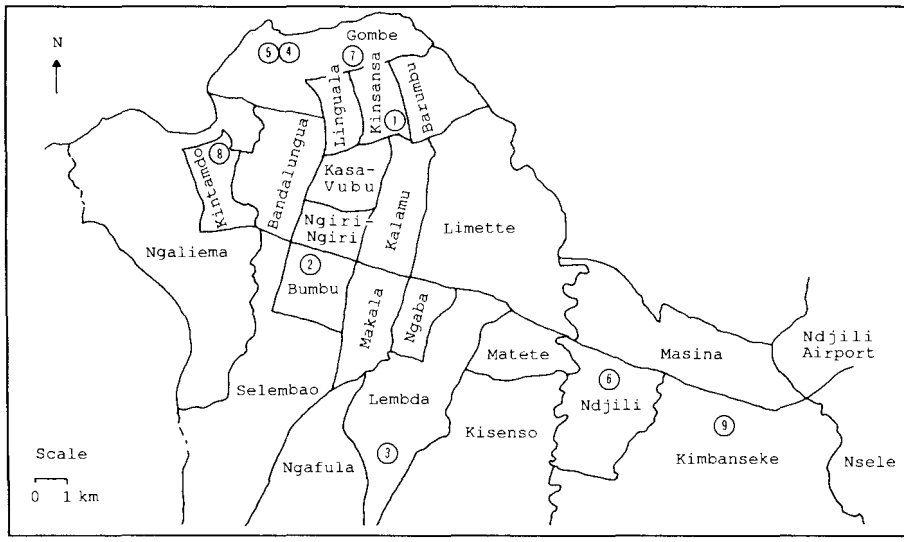
Survey staff

Following a competition organized by the Department of Demography at the University of Kinshasa, 19 nurses at the A2 level were trained as interviewers and placed in the obstetric units under the supervision of physicians in obstetrics and gynaecology unit (Nzita Kikhela 1982). The interviews were scheduled as follows: in the morning, the nurses interviewed the women in the obstetric units; in the afternoon, 9 nurses continued with these interviews while the other 10, organized in two teams, conducted home visits.

Data editing and correction

As Van de Walle and Heisler (1980) observed, the quality of a survey's data depends very much on the provisions made for editing and correcting the answers. There are no universal rules for this process. In the Kinshasa survey, the data were edited at three stages: while being gathered in the field, when captured, and at the outset of electronic data processing.

At the time of gathering, data were edited after the mother had been interviewed in the obstetric unit. At the end of the day, all completed questionnaires were forwarded to three coders, who checked the forms for internal consistency and isolated questions to be asked again in the home. After



1. Barumbu Nursing Home
2. Bumbu Nursing Home
3. University Clinics
4. Kinoises Clinics
5. Ngaliema Clinics
6. Ndjili Medical Centre
7. Mama Yemo Hospital
8. Kintambo Hospital
9. Kingasani Nursing Home

Fig 3. Obstetric units used for the Kinshasa perinatal mortality survey.

the interview with the mother on the 7th day, the questionnaires were again given to the coders, who reported possible inconsistencies to the project leader; the leader then decided whether the mother should be interviewed again. *At the time of computer capture,* the number of errors were minimized by coding in the data from each questionnaire twice and by using "intelligent capture" material, enabling the results of the two codings to be compared. *After capture,* a final edit was carried out by a program that checked each questionnaire for internal consistency.

Some methodological problems

Relating to the procedure

Instead of questioning mothers who have just given birth, we could begin contact with the women when they are in their 6th month of pregnancy and follow them to the end of the early neonatal period. By proceeding in this way, we would be working by pregnancy cohorts and would be able to calculate risks of death in the strict sense.

Because of the procedure adopted for the EMOKIN survey, that in researching stillbirths uses data from a transverse rather than a longitudinal study, the perinatal mortality observed may be assumed to have a certain bias.

This bias could be significant if the period were one of substantial increase or decrease in stillbirths. This could be demonstrated by making simulations on a table showing fluctuations in stillbirths between the 28th week of gestation and birth (Nzita Kikhela 1986). Because the available data on Kinshasa and sub-Saharan Africa seem, however, to indicate in general that stillbirths have remained constant (Fig. 4 and Appendix 5), we may consider such fluctuations to be negligible. Although it is true that none of the regions was surveyed on successive dates, the range of stillbirths remains at 25-47‰, enabling us to accept the above conclusion.

Weighting factors and sampling error

The group of infants to be surveyed on the 7th day comprised one-fifth of those who had survived until the 3rd day; we can therefore use all the survey data only by applying weighting factors. By one method, we apply a factor of 5 (the inverse of the sampling factor) to data on infants surveyed at home on the 7th day, and of 1 to data on stillbirths and deaths between 0 and 2 days. By the other method, we use a weighting factor of 1 for data on children surveyed at home on the 7th day, and 1/5 for stillbirths and deaths between 0 and 2 days. Whichever method is used, the sampling error must be calculated and taken into account.

The first of these methods was used in the EMOKIN study. By this method, numbers are generated of approximately the same size as would have been produced had all children been included to the end of the early neonatal period. Because a sample never precisely reflects the initial population (Deroo and Dussaix 1980), a sampling error, or error related to the method of sampling used, becomes inevitable. We found the sampling error in this case to be very small: 1.5‰ for the perinatal mortality quotient (Appendix 6). We may therefore conclude that sampling on the 3rd day does not introduce substantial error into the data gathered.

Some experiences in the field

In presenting the main problems encountered and the solutions applied, we shall focus on four questions: (1) What biases should we anticipate in such a data-gathering operation? (2) Was it wise to have nurses conduct the survey? (3) What can be learned from the experience of editing and correcting the data? (4) What questions posed problems, and what solutions did they make necessary?

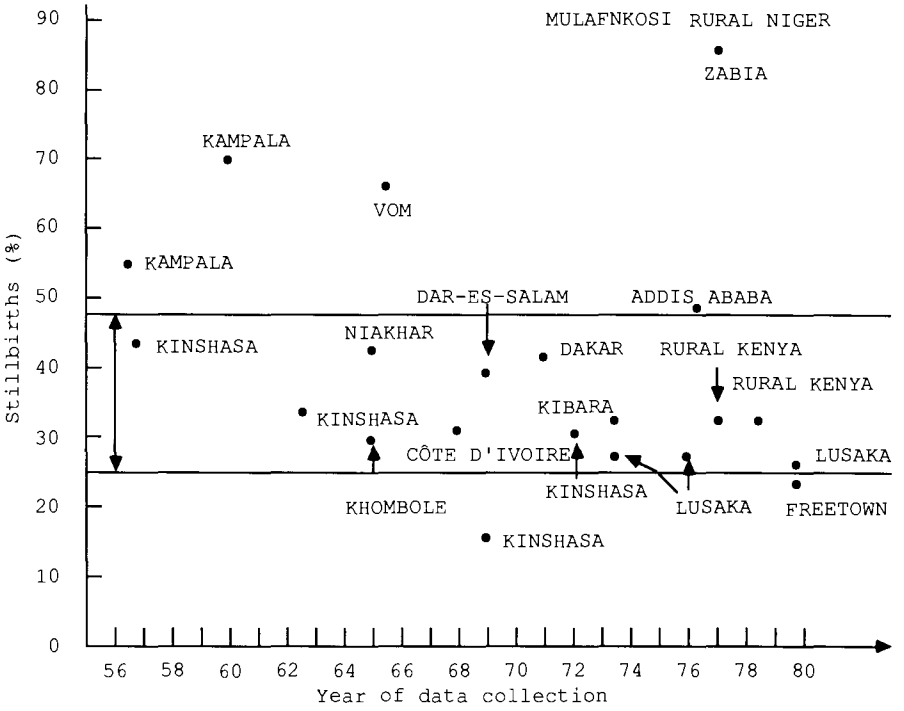


Fig. 4. Stillbirth rates in some sub-Saharan African regions. (For data gathered over several years, the central year was used.)

Potential biases

Home births and births in small nursing homes

According to corrected demographic forecasts (Boute and De Saint-Moulin 1978), 90 360 births occurred in Kinshasa in 1981 and 92 330 in 1982. In the nine obstetric units covered by the study, 79 634 and 79 817 births took place during those 2 years, respectively (data obtained from the Institute of Statistics).

From these figures, it would appear that the population interviewed represents a very high proportion of the children born during the survey. At least 85% of births occurred in these obstetric units (88% in 1981 and 86% in 1982). We must emphasize, however, that home births constitute an area requiring further study: were a similar experiment to be carried out in Kinshasa or elsewhere, it would be interesting to conduct a pilot study to compare mortality rates for home births with those of births in obstetric units; one would also wish to determine whether, as we suspect, the characteristics of mothers giving birth at home do not greatly differ from those of women at risk who give birth in obstetric units.

Inclusion of children born to nonresidents

Many women leave the interior of Zaire simply to come to Kinshasa to give birth. We excluded these women from the EMOKIN survey by asking two preliminary questions: "How long have you been in Kinshasa?" and "Do you plan to stay here more than 6 months?" It was impossible, however, to solve the problem posed by residents who had given birth abroad or in the interior of the country; these births are not reported anywhere. They may, however, constitute a substantial number in areas inhabited mainly by senior officials: to receive the best medical care and, we believe, to gain prestige, many rich men send their wives to Europe or even to the United States to give birth. Although no statistics are available on this phenomenon, it is known to occur; it would be interesting to determine its extent.

False stillbirths

If a child has died a few minutes after birth, medical staff may find it simpler to declare that child stillborn. We cannot, therefore, assert that stillbirths and live births are distinguished strictly according to WHO recommendations. In the EMOKIN survey, we attempted to minimize this error by use of the Apgar score: a score, ranging from 0 to 10, is assigned to each infant; if he or she shows no sign of life (i.e., is genuinely stillborn), then the score assigned is 0. There seems to be less temptation toward falsification with this method. When 57 infants with Apgar scores greater than 0 were declared to be stillborn, we attached greater reliability to the scores than to the declarations, and considered these infants to have died after birth.

Secret departures from obstetric units

We found that 127 women (primarily those with stillborn infants) had left their obstetric units before the interviews could take place. Because addresses are taken on admission to the units, we were able to contact these women at home. This reinforces the advisability of taking a woman's address at the first meeting with her.

Sample loss

Four precautions were taken to reduce the number of children not found when their homes were visited. Each woman was notified, in the obstetric unit, of the day that she would be visited. As far as was possible, each woman was interviewed at home by a nurse assigned to the obstetric unit where that woman had given birth. (Quite often, a woman would recognize and call to our interviewer while the latter was still looking for the right house.) Women who were planning to move house were asked on the survey questionnaire to give their new address or that of someone who could give directions to their new home, or both. Women who already had one or more children were asked to give the child's name by which they could be identified. (In Africa, a woman is far more often identified by the name of one of her children than by that of her husband.) Following these precautions, we found all but 230 of the children 7 days after birth. This represents a very small loss rate of less than 1%.

Was it wise to have nurses conduct the survey?

In selecting survey staff, we asked three main questions:

Were people of the same sex needed?

Yes, according to the Institute for Training and Demographic Research survey that showed all the female staff on mixed teams to have become pregnant by the end of a year's work.

Were women needed?

Yes, for two main reasons: in most obstetric units, the first interview was to be held in a place near the delivery room; and women seem to speak more frankly about their fertility when interviewed by women than by men (Tambashe 1984).

Why A2-level nurses?

There were two reasons for this choice: the type of data to be gathered (some of it medical in nature) and the fears expressed by obstetric unit officials. These officials insisted that the survey neither disrupt normal work nor bring underqualified people into the units; our 'good-neighbour' policy, whereby we encouraged our nurses to help care for the patients, made the choice of A2-level staff particularly important.

Despite the relatively high cost of such staff, we can conclude that it was a wise choice, given how well the survey functioned. Reassured by the nurse's white blouse, women interviewed at home (on the 7th day) welcomed our interviewers cheerfully. They were genuinely surprised at being visited by these nurses: usually patients wait for long hours in hospital corridors, hoping that a member of the medical staff will be kind enough to attend to their problems. Many women offered money and food; some even concluded that "things were really moving in Zaire."

We believe that it was because of our staff's qualifications that no one refused to reply, or that potential refusals were avoided. In the replies recorded for each variable, the proportion of "no answer" and "indeterminate answer" is rarely greater than 3%. Several women who left the obstetric unit secretly without being interviewed (most of them after a stillbirth) were followed to their homes by our interviewers; until these interviewers explained that they were nurses, however, and had come to help them overcome their health problems, the women would not answer questions.

There was a very great fear that the disappointment and the weight of social rejection that follows a stillbirth would prevent such women from responding. In Zaire, and probably in every other African country, a woman who bears a stillborn child is strongly censured by society, in particular by the members of her husband's family. These women were touched to find that a nurse was there to listen and to console them.

We should perhaps add that an atmosphere of open cooperation readily developed between our teams and the medical staffs of the obstetric units. This cooperation meant that we had access to all the records we needed.

What can be learned from the editing and correcting of the data?

We have learned that by reconstructing a woman's reproductive history, we can determine more accurately the number of children she has than by asking her how many times she has given birth. (For 1.5% of the women surveyed, the answer to this question was found to be inconsistent with the reproductive history data.) We have also learned that care must be taken with dates: in the EMOKIN survey, a date in January 1981 was assigned to 3.1% of the women surveyed in January 1982. The third point to note is that codes must be standardized for questions that are similar: when, for example, the questionnaire was drawn up, the same codes were assigned for the father's and the mother's social status, but different codes were used for the head of the household (who might not be either of these two); after the consistency test, it was found that for 3.7% of heads of households, the codes used corresponded to those assigned to the parents.

Some problem questions

Questions on nutrition during pregnancy

To evaluate nutrition during pregnancy, certain data (on changes in hemoglobin count, proteinaemia, and weight/height ratio (Jelliffe 1969), would have had to have been available for the period preceding conception. The survey method used made it impossible, however, to obtain these data for the period in question. Moreover, because the laboratories at the obstetric units surveyed were not well enough equipped both to meet our requirements and to carry out their normal work, it was impossible to gather medical data on hemoglobin count and proteinaemia.

In view of these problems, our nurses attempted, on the advice of colleagues, to identify undernourished women by examining the colour of their conjunctiva. From the outset of the survey, these examinations were well received by the mothers, who saw in them an indication that we were interested in their health as well as that of their children. Accordingly, we took care that, even during home visits, conjunctiva be examined systematically. We felt that these examinations had become a means of creating mutual confidence between interviewer and interviewee. We believe, however, that the collection of such data poses too many problems to be useful: standardizing the colour scales, for example, is difficult (Jelliffe 1969).

Because of the difficulty in identifying undernourished women, we must admit that in the EMOKIN study we dispensed with this variable in accounting for differences in mortality between families.

Questions relating to the mother's health during pregnancy

To capture this item accurately, we needed to do more than identify those women who were ill: the ideal would have been to follow each woman throughout her pregnancy and, by means of medical examinations, identify the various illnesses from which she suffered, the seriousness of these illnesses, and the points at which they struck. Given the nature of our procedure, these data could not all be gathered. (What credibility should we have assigned, for example, to women who told us that they had been healthy during pregnancy, or had suffered from such and such an illness?)

We must therefore admit that in the EMOKIN survey, "mother's health" is another variable that cannot be used to account for differences in mortality between families.

In a study conducted in Nigeria, Gilles et al. (1969) showed that few perinatal deaths are caused by malaria in the mother; such illness is mainly a prematurity factor. Severe anemia, however, creates a very high risk of placental hypertrophy and, hence, high rates of intrauterine death (Beischer et al. 1970).

Thus, we see two important issues related to the period of pregnancy -- that of nutrition and that of the mother's health -- for which highly relevant data could not be collected. We must conclude that this was due to weakness in the survey method.

Some data on the surveyed population

From 15 October 1981 to 14 March 1982, 26 329 births were recorded, including 2 369 in October, 5 321 in November, 5 363 in December, and 2 700 in March (Table 7). In short, a monthly average of 5 300 births were surveyed, except in October 1981, when seasonal variation caused a significantly lower number, 4 738 (extrapolation: 2 369 x 2) (Nzita Kikhela 1986).

Among these births were 25 670 single infants, 658 sets of twins, and one set of quadruplets. The main characteristics (Nzita Kikhela 1984) of the women interviewed showed the population to be young (average age, 21.5 years), well educated (50% with at least 1 year of secondary schooling), and fairly fertile (25% of the women pregnant with at least their fourth child; Table 8).

If marital status and data on husbands are to be taken into account, we should add that 7.6% were single, 0.6% widowed or divorced, and 91.8% married, including 12.7% whose husbands were polygamous. On average, husbands were 7 years older than their wives, and were more highly educated, with 4 years of secondary school to the women's 1 year. (It will be interesting to determine whether, although mothers have less education, their education level affects infant mortality more

Table 7. Births by survey month.

	Survey month						
	15-31 Oct. 1981	Nov. 1981	Dec. 1981	Jan. 1982	Feb. 1982	1-14 Mar. 1982	Total
No.	2 369	5 321	5 363	5 275	5 301	2 700	26 329
%	9.0	20.2	20.4	20.0	20.1	10.3	100.0

Table 8. Structure of surveyed population by age, education, and number of live births (not including surveyed birth).

	Percentiles of surveyed population							
	P_5	P_{10}	P_{25}	P_{50}	P_{75}	P_{90}	P_{95}	Average
Mother's age (years)	17	18	20	23	28	32	35	25.1
Father's age (years)	21	23	26	31	35	41	45	31.4
Education[a]								
Mother's		A	E	H	J	K	L	
Father's	A	E	H	K	M	P	Q	
No. of earlier live births	0		1	2	4	6	7	2.2

[a] A, Illiterate; E, 4 years primary school; H, 1 year secondary school; J, 3 years secondary school; K, 4 years secondary school; L, 5 years secondary school; M, 6 years secondary school; P, 2 years university; Q, 3 years university.

than that of the father). Unmarried women will be grouped together (since there are only 157 widows and divorcees), and a distinction maintained between monogamous and polygamous marriages. This will enable us to see whether, as with fertility (Ngondo A. Pitshandenge 1982), there is a significant difference in levels of perinatal mortality between these two matrimonial systems.

Conclusion

It is undeniable that, over the past 15 years, great efforts have been made to make data more available in Africa. We see this particularly in the many censuses that have been conducted. If, however, we wish to account for a given phenomenon such as infant and juvenile mortality, we shall for many years have no choice but to conduct specific surveys. To study perinatal mortality in Kinshasa, a survey was therefore conducted between 15 October 1981 and 30 April 1982.

In the course of this survey, we soon realized the wisdom of relying on nurses to gather data. Smooth teamwork was quickly established between our interviewers and the medical staffs of the obstetric units, and the women interviewed responded to our nurses with frankness and confidence. We believe, therefore, that in building up statistics on developing countries, it would be well to examine the use that could be made of the many mobile health teams that exist in those countries.

According to the objectives and conceptual framework of the study, our first concern is to develop a typology of families. Such a typology may then allow us to account for differences in levels of mortality observed between families. Before discussing specific variables (such as infants' weight and mothers' behaviour during pregnancy), however, we require confirmation that, in the population in question, there is sufficient variation in levels of mortality to justify an identification of disadvantaged groups. There are, accordingly, three main points to be examined: mortality level and differential variation, determination of families at risk, and explanatory analyses of such families.

Level and differential variation of perinatal mortality

General level of perinatal mortality

Among the 26 900 children born during the survey, there were 612 stillbirths, 178 deaths from 0 to 2 days, and 385 deaths from 3 to 6 days (Table 9). The stillbirth rate is 22.7‰ and the early neonatal mortality rate 21.5‰, constituting a perinatal mortality rate of 44.2‰.

This is, to be sure, a very high rate in comparison with those in developed countries; if, however, we compare it with those observed in sub-Saharan Africa (Fig. 5), we see that it is scarcely different from rates in other African regions.

Because 230 single births could not be traced at the home interview on the 7th day, we considered whether these births might correspond to a high-risk group and their loss lead to a significant underestimation of early neonatal mortality. Benzécri et al. (1980) have shown how, in such situations, death risks can be estimated for untraced children by using coefficients derived from an analysis of multiple correspondences. Because the phenomenon under consideration is rare and the population small (230 children), we did not feel it advisable to use such an intensive method as was proposed by Benzécri et al. We therefore referred to two hypotheses. In the first hypothesis, we broke down the group of children by mother's age and education; we assumed their mortality rate to be similar to that of children surveyed on the 7th day, whose mothers had presented the same characteristics as those of the first group (Table 10). In the second hypothesis, we assumed that all the lost children had the same mortality rate as children of illiterate mothers.

Table 9. Numbers of births and deaths recorded.

		Children's age (days)			
	Birth	0-2	3 (exactly)	3-6	7 (exactly)
Living children	26 378		26 200		25 585[a]
Dead children	612	178		385[a]	
Untraced children					230

In quotients -- stillbirths: 22.7‰
death at 0-7 days: 22.5‰
perinatal mortality: 44.2‰

As rates -- stillbirths: 23.2‰
death at 0-7 days: 21.5‰
perinatal mortality: 44.7‰

[a] Data from the sample interviewed at home.

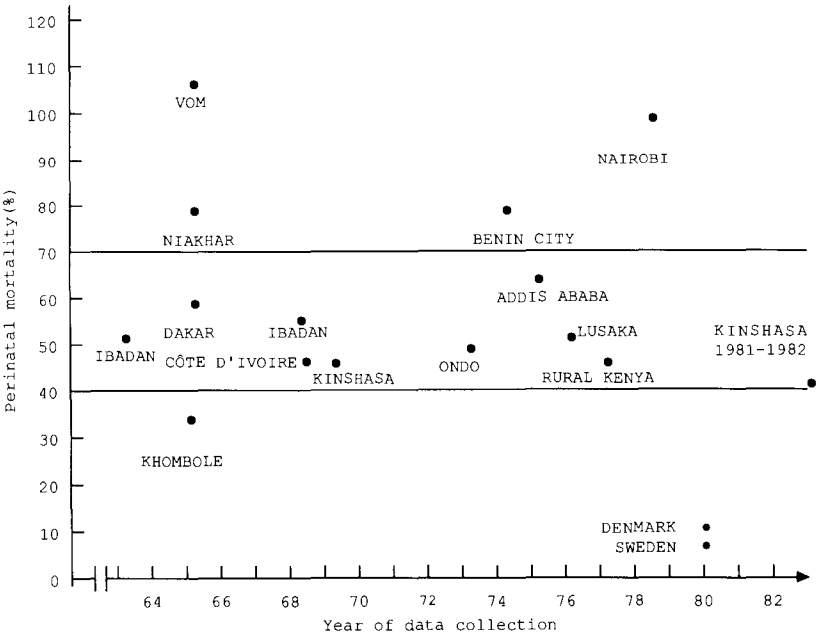


Fig. 5. Perinatal mortality levels in some sub-Saharan African regions, 1963-1983.

Table 10. Estimated number of deaths of children not traced on 7th day.

	Breakdown of children	Children found on 7th day		Children not found on 7th day	
		No. [1]	Mortality 3-6 days (%) [2]	No. [3]	Estimated no. of deaths [4 = 2 x 3]
Hypothesis 1	By mother's education				
	Illiterate	3 110	11.3	50	1
	Primary school				
	1-4 years	2 925	10.3	30	0
	5-6 years	4 796	13.6	50	1
	Secondary school				
	1-3 years	9 276	12.9	75	1
	4 years and over	4 835	9.3	25	0
	Total	24 942	11.8	230	3
	By mother's age (years)				
	Under 20	5 306	15.1	85	1
	20-24	8 890	9.0	65	1
	25-29	6 460	12.4	60	1
	30-34	2 851	5.3	15	0
	35-39	1 070	18.7	0	0
	40 and over	365	54.8	5	0
	Total	24 942	11.8	230	3
Hypothesis 2	By mother's education (assuming all mothers are illiterate)	24 942	11.3	230	3

In both cases, we found that the loss of the sample does not cause significant underestimation of mortality (Table 10). The number of deaths not recorded is estimated to be only two or three infants.

Some data on differential variation in mortality

Before examining the way in which levels of mortality vary with parental characteristics, let us consider the possible existence of factors affecting the level of mortality that do not depend on a mother's behaviour during pregnancy. If we find any such factors, we ought to verify their influence before looking for factors relating to the parents' identity. Among the factors for which we have data, there is only one that fits this description: twin birth. We shall therefore consider whether this phenomenon leads to a substantial increase in levels of mortality in the surveyed population.

Influence of twin birth

In developed countries (Tabutin 1977; Masuy-Stroobant 1985) and in underdeveloped countries (Nylander 1971; Voorhoeve et al. 1983), a marked difference in levels of mortality emerges between single and multiple births. This was confirmed by the data gathered in Kinshasa, where the level of perinatal mortality is 39.9‰ for single births and 113.6‰ for multiple births.

Given the difference between these two quotients (their ratio is 1:3) and also the physiological differences between these two groups of infants, it was decided that multiple births constitute a group at risk, and that allowance must be made for the influence of multiple birth before seeking to determine the influence of mothers' characteristics and behaviour during pregnancy. The main difference that characterizes these two groups of infants is birthweight. At the same gestational age, twins are distinctly lighter. This difference has been demonstrated in, for example, the work of Wilcox (1981). There can also be weight differences between twins: during the prenatal period, the first twin may monopolize the nutritional substances coming from the mother and may thereby cause the second twin to atrophy. What shall we say, then, of the gap between a singleton and the weaker twin of a pair? Accordingly, in all the analyses of differential mortality that follow, we shall confine ourselves to single births.

Variation in mortality by parents' identification data

According to the χ^2 tests conducted with a degree of confidence of 95%, mortality varies with all the identification variables considered, except place of origin (Table 11a,b,c). Because this population includes disadvantaged people, a family topology should be drawn up. Sala-Diakanda (1981) demonstrated that this variable significantly affects fertility in Kinshasa; we therefore expected that it would also act on the risk of death. Accordingly, we reviewed mortality variation in relation to length of stay in Kinshasa. In our findings, only one group shows high levels of mortality (Appendix 7); this

Table 11a. Perinatal mortality levels by mother's demographic characteristics.

	Quotient (‰)	Births	
		No.	(%)
Mother's age (years)		All births[a]	
Under 20	50.9	5 506	21.4
20-24	32.7	9 108	35.5
25-29	35.3	6 614	25.8
30-34	33.7	2 935	11.4
35-39	60.8	1 118	4.4
40 and over	113.1	389	1.5
Total	39.9	25 670	100.0
Parity		Married women's children[b]	
1	49.7	5 751	22.4
2	37.1	4 585	17.8
3	36.6	4 044	15.8
4	35.9	3 454	13.5
5	23.6	2 755	10.7
6	36.1	1 909	7.4
7 and over	50.8	3 172	12.4
Total	39.9	25 670	100.0
Prior to death of a child		Second and subsequent births[c]	
Yes	49.8	9 132	45.8
No	26.1	10 787	54.2
Total	39.9	19 919	100.0
Last interval (months)		Second and subsequent births[d]	
Under 18	37.9	2 610	13.1
18-23	44.8	3 456	17.4
24-29	28.7	4 944	24.8
30-35	33.3	3 181	16.0
36-47	33.9	3 007	15.1
48-59	40.3	1 398	7.0
60 and over	60.1	1 323	6.6
Result of last pregnancy		Second and subsequent births[e]	
Stillbirth	66.4	2 185	11.0
Live birth	33.3	17 734	89.0
Total	37.0	19 919	100.0

[a] $\chi^2 = 107.0$, significant.
[b] $\chi^2 = 113.3$, significant.
[c] $\chi^2 = 91.4$, significant.
[d] $\chi^2 = 37.7$, significant.
[e] $\chi^2 = 31.4$, significant.

Table 11b. Perinatal mortality levels by parents' socioeconomic characteristics.

	Quotient (‰)	Births	
		No.	(%)
Mother's education[a]			
Illiterate	48.3	3 232	12.7[f]
Primary school (1-4 years)	43.0	3 025	11.8
Primary school (5-6 years)	42.3	4 940	19.2
Secondary school (1-3 years)	40.1	9 538	37.1
Secondary school (4 years and over)	29.6	4 936	19.2
Postsecondary	—	—	—
Total	39.9	25 670	100.0
Father's education[b]			
Illiterate	60.0	1 284	5.4[g]
Primary school (1-4 years)	36.4	1 117	4.7
Primary school (5-6 years)	43.6	2 686	11.3
Secondary school (1-3 years)	42.6	4 208	17.7
Secondary school (4 years and over)	34.7	11 412	48.0
Postsecondary	21.0	3 067	12.9
Total	36.8	23 774	100.0
Mother's tribe and nationality[c]			
Lower Zaire tribes	45.3	8 910	34.7[f]
Kwango tribes	44.7	3 266	12.7
Kwilu tribes	41.6	3 610	14.1
Central basin, Ubangi, Itimbiri, and Kivu tribes	33.7	5 128	20.0
Kasaï and Shaba tribes	27.3	3 517	13.7
Foreign	43.3	1 229	4.8
Total	39.9	25 660	100.0
Father's tribe and nationality[d]			
Lower Zaire tribes	40.1	7 908	33.5[g]
Kwango tribes	34.7	3 227	13.7
Kwilu tribes	40.2	3 834	16.3
Central basin, Ubangi, Itimbiri, and Kivu tribes	33.3	4 232	18.0
Kasaï and Shaba tribes	27.0	3 145	13.3
Foreign	46.8	1 196	5.1
Total	36.7	23 542	100.0
Father's employment[e]			
Manager, independent with employees	21.0	2 116	8.9[g]
Office workers and independent without employees	36.6	10 033	42.2
Labourers	36.4	8 083	34.0
Unemployed	47.4	3 542	14.9
Total	36.8	23 774	100.0

[a] $\chi^2 = 46.6$, significant.
[b] $\chi^2 = 49.4$, significant.
[c] $\chi^2 = 29.8$, significant.
[d] $\chi^2 = 17.9$, significant.
[e] $\chi^2 = 25.8$ significant.
[f] All births.
[g] Married women's children.

Table 11c. Perinatal mortality levels by parents' marital status and place of origin.

	Quotient (‰)	Births No.	Births (%)
Mother's place of origin[a]			
Kinshasa	40.9	8 984	35.0[d]
Urban	40.5	10 194	39.7
Rural	37.2	6 492	25.3
Total	39.9	25 670	100.0
Father's place of origin[b]			
Kinshasa	46.1	4 944	21.0[e]
Urban	35.8	11 248	47.7
Rural	35.3	7 397	31.3
Total	37.8	23 589	100.0
Mother's marital status[c]			
Single, divorced, widowed	75.0	2 081	8.1[d]
Monogamous	36.6	20 946	81.6
Polygamous	24.9	2 644	10.3
Total	39.9	25 671	100.0

[a]
[b] $\chi^2 = 1.5$, insignificant.
[c] $\chi^2 = 3.6$, insignificant.
[d] $\chi^2 = 17.9$, significant.
[e] All births.
Married women's children.

group comprised children whose fathers had come from a rural area and had been in Kinshasa less than 10 years. Because 63.4% of these people are unemployed, however, this greater risk may be related to social status.

Much emerges from this table, which has been analyzed elsewhere (Nzita Kikhela 1984, 1986). We shall concentrate on the two most interesting of the conclusions to be drawn: the fact that levels of mortality vary with the parents' education and with the mother's ethnic origin.

Because of the strong correlation between the father's and the mother's education, and also between education and ethnic origin, it is tempting to identify families solely by the variable "mother's education," considering that the variation observed with the other two factors stems simply from the fact that they mediate its influence. Education varies, however, with ethnic origin. People from the Upper Zaire, Kasaï, and Shaba tribes have, on average, the most schooling (Appendix 8).

Variation in mortality according to mother's education and ethnic origin

Because the endogamy rate is high (75% for all tribes, except for those of the Central basin, Ubangi, Itimbiri, and Kivu, and for foreigners for whom the rate was 66%), we shall confine ourselves to maternal variables. According to the quotients obtained for ethnic origin (Table 12), three groups

Table 12. Variation in perinatal mortality by mother's education and ethnic origin.

Mother's tribe	Estimated deaths by mother's education					Quotient (‰)		σ of [1] (‰)	σ of [2] (‰)	[1] different from [2]
	Illiterate	Primary	Secondary school 1-3 years	Secondary school 4 years & over	Total	Standardized [1]	Observed [2]			
Lower Zaire	40 (834) [a]	109 (2 557)	149 (3'722)	53 (1 797)	351 (8 910)	39.4	45.3	2.1	2.2	No
Kwango	35 (727)	49 (1 151)	35 (883)	15 (505)	134 (3 266)	41.0	44.7	3.5	3.6	No
Kwilu	33 (668)	59 (1 377)	41 (1 025)	15 (520)	148 (3 610)	41.0	41.6	3.3	3.3	No
Central Basin	28 (580)	68 (1 586)	79 (1 963)	30 (999)	205 (5 128)	40.0	33.7	2.7	2.5	Yes
Kasaï-Shaba	9 (187)	38 (890)	59 (1 473)	29 (967)	135 (3 517)	38.4	27.3	3.2	2.7	Yes
Foreign	10 (210)	17 (399)	19 (472)	4 (148)	50 (1 229)	40.7	43.3	5.6	5.8	No
Total	155 (3,226)	340 (7 960)	382 (9 538)	146 (4 936)	1 023 (25 660)	39.9	39.9	-	-	No

[a] The values in parentheses represent the number of deaths plus the number of survivors.

of children should be distinguished: children whose mothers are foreign or belong to a Lower Zaire, Kwango or Kwilu tribe (these children have a high mortality rate of 40-45‰); children whose mothers belong to a Central basin, Ubangi, or Kivu tribe (these children have a fairly low mortality rate of 33.7‰); and those whose mothers belong to a Kasaï or Shaba tribe (these have a very low mortality rate of 27.3‰).

This breakdown corresponds closely to that of mothers by education and ethnic origin (Appendix 8). Let us see, therefore, whether this variation in levels of mortality does in fact stem from the variable of ethnic origin. We can verify its incidence by standardization and determine whether education alone yields identical results. (If numbers had been large enough, we would also have verified the influence of previous place of residence and length of stay in Kinshasa.) In other words, we shall see whether different results occur if, regardless of ethnic origin, we assign to infants the same mortality levels associated with their mothers' education in Table 11a,b,c.

Table 12 shows that the effect of education varies from one ethnic group to another. In the case of the Lower Zaire, Kwango, and Kwilu tribes, the standardized quotients are close to the observed quotients; for the Central basin, Kivu, Kasaï, and Shaba tribes, however, significant differences occur between these two sets of quotients. In other words, it is only in this second group of tribes that we can assume these to be a specific effect linked to ethnic origin. And these are precisely the tribes whose original territory is furthest from Kinshasa.

Should we conclude that people from tribes whose original territory is furthest from Kinshasa have a distinctly stronger tendency to preserve their cultural values? This is a hypothesis that deserves to be studied in other African cities. To do this, we must of course take into account each person's prior residence and how long he or she has lived in the city in question. We have insufficient data to decide this matter here.

Variation in mortality by parents' education

As in determining the specific influence of ethnic origin, let us see, by applying standardization, whether the influence of the mother's education alone yields the same variation as that observed with the father's education.

In Table 13, we see that children fall into three categories. Category 1 comprises those whose fathers did not complete 5 years of primary schooling. For these, the standardized quotient level is lower than the observed quotient. It appears, therefore, that an illiterate mother poses less risk than does an illiterate father. Category 2 comprises those whose fathers have completed at least 5 years of primary schooling but did not complete any postsecondary studies. In this group, no significant difference appears between the standardized and the observed quotients. We might conclude from this that the mother's education has the stronger

Table 13. Variation in mortality by father's and mother's education.

Father's education	Estimated deaths by mother's education					Quotient (‰)		σ of [1] (‰)	σ of [2] (‰)	[1] different from [2]
	Illiterate	Primary	Secondary school		Total	Standardized [1]	Observed [2]			
			1-3 years	4 years & over						
Illiterate and primary (1-4 years)	45 [a] (1 045)	36 (952)	8 (206)	1 (45)	90 (2 248)	40.0	49.0	3.9	4.4	Yes
Primary (5-6 years)	33 (756)	57 (1 492)	13 (353)	2 (65)	105 (2 666)	39.4	43.6	3.8	4.0	No
Secondary (1-3 years)	25 (584)	77 (2 003)	52 (1 377)	6 (214)	160 (4 178)	38.3	42.6	3.0	3.1	No
Secondary (4-6 years)	28 (659)	106 (2 781)	210 (5 514)	66 (2 381)	410 (11 335)	36.2	34.7	1.7	1.7	No
Postsecondary	1 (16)	11 (284)	37 (979)	49 (1 756)	98 (3 035)	32.3	21.0	3.2	2.6	Yes
Total	132 (3 060)	287 (7 512)	320 (8 429)	124 (4 461)	863 (23 462)	36.7				

[a] Values in parentheses show the number of deaths plus the number of survivors.

influence for these children. After repeating the operation and verifying the effect of the father's education, we find, however, that in this group, neither of the two variables predominates. Category 3, comprising children whose fathers have completed at least 1 year of postsecondary education, shows observed quotients that are lower than the standardized quotients. In other words, if their mortality levels were determined solely by the mothers' education, these children would show a distinctly higher risk.

There is a threshold above which the father's education predominates over that of the mother. Although levels of infant and juvenile mortality may vary significantly more with the latter variable (Caldwell 1979; Hobcraft et al. 1984), this is not necessarily the case with other categories, such as that of perinatal mortality. It would, therefore, be well to study the data available on this topic in other parts of Africa, and to attempt to determine the reasons for the preponderance, above a certain threshold, of the father's education. With the observation that, in any event, risk varies with the parents' socioeconomic characteristics, let us now proceed to identify those families at risk.

Determining families at risk

Some reminders

As with any multivariate analysis of child mortality, two orientations may be adopted when identifying families at risk. Either we begin by dividing children into four subpopulations (according to birth order and to marital status of the mothers), or we keep the children together and use only those variables that are relevant for each (Masuy-Stroobant 1985).

If, for example, we keep all the children together, we cannot include the variable "previous child's survival": this variable does not apply to firstborns. To analyze the data from the EMOKIN survey, both methods were adopted. Although similar results were obtained with each, it cannot be said that this will always be the case; the test must be extended to other populations. Because the first orientation is decidedly the easier to apply, it seems wiser, in the present state of research into families at risk, to choose this method.

The work tool: segmentation

From the items that indicate high mortality (Table 11a,b,c), we could attempt to define families at risk by placing the various characteristics "end to end." We could, for example, consider that all infants whose mothers are illiterate primiparas under 20 years of age constitute a group with high perinatal mortality. If we proceed in that way, however, we have no prospect of determining an optimum number of groups at risk. Moreover, we would not have any statistical indicators to demonstrate that the proposed groupings are based on optimum associations. It is therefore more appropriate to

use a method such as segmentation, that divides a population in the best manner according to a given dependent variable (Loriaux 1971; Rumeau-Rouquette 1979; Masuy-Stroobant 1985).

This technique was proposed by Sonquist et al. (1973). It consists, in essence, of a step-by-step multiple regression analysis of variance with two criteria. It is conducted as follows: given a continuous or dichotomous dependent variable (in this instance, the death or survival of a surveyed child), we search through the independent variables for that which divides the population under study into two subpopulations whose "intra-group variance" is as low as possible and whose "inter-group variance" is as large as possible. As soon as this initial division is completed, the operation is repeated for each of the two subpopulations thus created until such time as the stopping criteria set by the user are reached. Each time a division is made, we have information on the characteristics, number of individuals, and risk levels of the subgroups formed. Because our aim is to identify those groups of children that are the most homogeneous as regards perinatal mortality and those that are the most heterogeneous, such a procedure meets our objective perfectly.

This method offers three further advantages (Loriaux 1971; Sonquist et al. 1973): it enables us to work with a large number of independent variables (a maximum of 63); apart from hypotheses relating to the analysis of variance, it does not require any other hypotheses, such as standard distributions, linear relations, or additive effects (a far from negligible asset, given that the relations that develop between a dependent variable and independent variables may not be the same from one variable to the next); it enables us to observe interactions between variables.

The main disadvantage to this method is that it proceeds sequentially. Loriaux (1971) concludes, therefore, that when several predictors are correlated, "the entire variation in the dependent factor they jointly account for is assigned to the first one selected, and no corrective measures are implemented later to offset this and allow the excluded predictors an opportunity to exert their influence." As far as possible, therefore, the results of segmentation should be tested against those of some other method of multivariate analysis.

An example

Let us suppose that we are seeking the high-mortality groups among the 18 905 children whose birth order is second or higher and who were born to married women surveyed by EMOKIN. Let us further suppose that, as our cut-off criterion, we decide on a minimum of 500 children in each subgroup; in other words, segmentation is to stop if the next division is liable to create a group of under 500 children. The dependent variable is the child's death or survival, and the independent variables are the father's and mother's age, education, ethnic origin, and type of housing (see Table 15).

By applying program AID3 (Automatic Interaction Detector) in OSIRIS software (Sonquist 1973), we obtain the divisions presented in Fig. 6. According to these, there are five groups of children or five types of families to be distinguished. As Table 14 shows, we have two groups with very low levels of mortality (Families E and F), one group with a close-to-average level of mortality (Family G), and two groups with high levels of mortality (Families H and I), constituting families at risk. Now that we have seen how the method works, let us turn to the results obtained by the EMOKIN study.

Families with high perinatal mortality in Kinshasa

The 25 670 single births were first divided into four subpopulations: first children born to unmarried parents (subpopulation 1, comprising 1 167 infants); first children born to married parents (subpopulation 2, comprising 4 555 infants); second and subsequent children born to unmarried parents (subpopulation 3, comprising 909 infants); and second and subsequent children born to married parents (subpopulation 4, comprising 18 905 infants).

Taking care that the independent variables applied to all the children considered (Table 15), four segmentations were then carried out, using the OSIRIS program AID3 (Sonquist 1973). Main findings are shown in Table 16. Nine families classifications arose. Three (Families I, II, and III) show a very low risk of perinatal death. One (Family IV) shows a perinatal mortality rate close to the average (39.9‰). The remaining five classifications, all showing significantly higher levels of mortality and thus constituting the group of

Table 14. Characteristics of groups of children identified.

Children of multiparous mothers	Family	Mortality (‰)	No.
Who has never lost a child and is neither from a Lower Zaire or a Kwango tribe	E	34.7	5372
Who is from a Lower Zaire or a Kwango tribe and whose education is			
4 years of secondary or over	F	27.2	913
less than 4 years of secondary	G	39.0	3923
Who has already lost a child and whose age is			
under 35	H	44.5	7767
35 or over	I	86.0	930

Table 15. Independent variables used for each of the four subpopulations identified.

	Independent variables used
Subpopulation 1: firstborns, unmarried mothers	Mother's age; mother's place of origin; mother's education; is mother a wage-earner? length of mother's stay in Kinshasa; mother's type of houseing; mother's ethnic origin.
Subpopulation 2: firstborns, married mothers	Mother's age; mother's place of origin; father's place of origin; mother's education; father's education; is mother a wage-earner? father's social status; length of mother's stay in Kinshasa; length of father's stay in Kinshasa; mother's type of housing; mother's ethnic origin; father's ethnic origin; marital status.
Subpopulation 3: second and subsequent children, unmarried mothers	Parity; mother's age; mother's place of origin; mother's education; is mother a wage-earner? length of mother's stay in Kinshasa; mother's type of housing; result of previous pregnancy; length of last interval between births; mother's ethnic origin; prior death of a child.
Subpopulation 4: second and subsequent children, married mothers	Parity; mother's age; mother's place of origin; father's place of origin; mother's education; father's education; is mother a wage-earner? father's social status; length of father's stay in Kinshasa; prior death of a child; result of previous pregnancy; length of last interval between births; father's ethnic origin; marital status.

families at risk, are those in which the mother is one of the following: a married multipara who has lost at least one child and is under 35 (Family V); a married primipara whose education is less than 4 years of secondary schooling (Family VI); an unmarried primipara (Family VII); an unmarried multipara (Family VIII); and a married multipara who has lost at least one child and is 35 or older (Family IX).

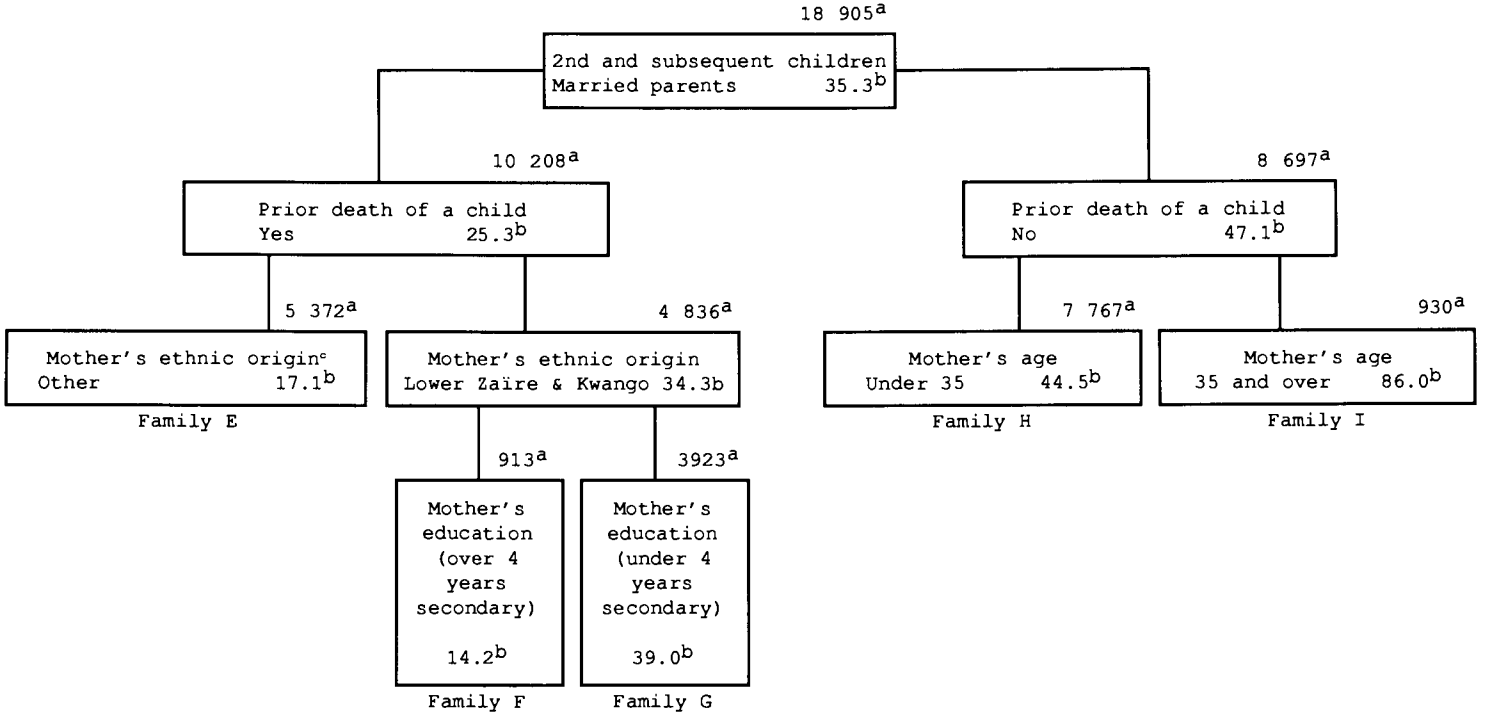


Fig. 6. Chart of divisions ([a]Number of children in group identified; [b]Risk per thousand (‰); [c]Variable on which division was based).

Table 16. Families at risk and families with low perinatal mortality.

Mother's characteristics	Family classification	Risk (%)	Births		Recorded deaths	
			No.	(%)	No.	(%)
Married primiparas with at least 4 years of secondary education	Family I	12.7	1 185	4.6	15	1.5
Married multiparas never having lost a child and belonging to a Lower Zaire or Kwango tribe and having at least 4 years of secondary education	Family II	14.2	913	3.6	13	1.3
Married multiparas never having lost a child and belonging to a tribe other than a Lower Zaire or Kwango tribe	Family III	17.1	5 372	21.0	92	9.1
Married multiparas never having lost a child and belonging to a Lower Zaire or Kwango tribe and having less than 4 years of secondary education	Family IV	39.0	3 923	15.4	153	15.1
Married multiparas having lost at least one child and under 35 years of age	Family V[a]	44.5	7 767	30.4	326	32.1
Married primiparas with less than 4 years of secondary education	Family VI[a]	53.4	3 370	13.2	180	17.7
Unmarried primiparas	Family VII[a]	74.6	1 167	4.6	87	6.6
Unmarried multiparas	Family VIII[a]	75.9	909	3.6	69	6.8
Married multiparas having lost at least one child and age 35 years or over	Family IX[a]	86.0	930	3.6	80	7.9
Total		40.6	25 536	100.0	1 015	100.0

[a] Families at risk.

When we examine these characteristics, three main observations emerge. Of the children surveyed, one in two belongs to a family at risk. In our opinion, such a high proportion not only demonstrates the importance of the present research, but also suggests the advisability of drawing up action programs. Second, when we examine the breakdown of deaths, we find that 73% of them occurred in families at risk. Analyses aimed at identifying these families have enabled us to isolate the characteristics of most of the families in which perinatal deaths occur. Finally, when we decided on a minimum of 500 children for each subgroup, no divisions were made among the children of unmarried women. All such children were therefore considered to be children at risk; it is possible, however, at least a priori, that some may have low levels of mortality.

By setting the cut-off criterion at 500 children per subgroup and rerunning the segmentation program, we verified that the groups identified were actually at risk. We then found that all the subgroups consisting of children of unmarried mothers showed high levels of mortality (Nzita Kikhela 1986). There is therefore no reason to believe that this problem distorts the results.

Explanatory analysis of families at risk

Several hypotheses may serve to account for these differences (Table 2). Avoiding those discussed elsewhere (Nzita Kikhela 1986), we shall consider only one hypothesis -- that families at risk have higher levels of mortality because they have a higher proportion of children of low weight or, in other words, of high-risk weight.

To examine this hypothesis, we must first determine what constitutes high-risk weight, and then study whether, in families at risk, there is a higher percentage of children of such weight. Families were classified into four categories. Category I comprises Families I-III; these are families with very low levels of mortality (average of 15.9‰). Category II corresponds to Family IV, whose mortality is slightly below average (38.6‰). Category III corresponds to Family V, whose mortality is slightly higher than average (44.5‰). Category IV includes Families VI-IX, characterized by very high levels of mortality (65.5‰).

Determining a critical weight

Many studies have demonstrated that mortality is somewhat high among children whose birthweight is 4.0 kg and over and very high among children with low birthweight (Susser et al. 1972; WHO 1978). Low birthweight is defined variously as under 2.50 kg, under 2.25 kg, and under 2.0 kg (Vincent and Hugon 1962; Indira Bai 1971). Although for many years much was written about the setting of a universal criterion for low birthweight, it is now agreed that we should base our criterion

on the way in which mortality varies with the weight of the children under consideration.

In the case of our Kinshasa children, we find the same mortality profile as is described above: the risk of death for children weighing 2.0 kg is 514.3‰; for those weighing 3.2-3.4 kg, the risk is 7.4‰; and for those weighing 3.4 kg and over, the risk is 14.1‰ (Table 17 and Fig. 7). The main point to note, however, is that the critical weight is 2.5 kg. Below this level, we find significantly higher-than-average mortality rates and, above it, much lower rates. We shall therefore consider that a high-risk birthweight for children is anything under 2.5 kg.

Low birthweight: a factor affecting levels of mortality

Because we have no data on each child's gestational age, we have been unable to identify the level of mortality attributable to prematurity or that attributable to dysmaturity. By the same token, in the absence of data on causes of death, it is impossible to determine which children died because of low birthweight per se and which because their resistance was weakened by the low birthweight. This type of problem must be addressed by further medical studies. Let us simply posit that infants weighing less than 2.5 kg are infants at risk. To test this hypothesis, we shall consider whether the families with the highest levels of mortality also prove to be those with the highest proportion of children weighing less than 2.5 kg.

According to Table 18, the answer is yes. In category I, in which only 8.1% of children weigh under 2.5 kg, mortality is 10.1‰; in category IV, in which these children constitute 17.9% of the total, we find the significantly higher risk of 49.2‰. Similarly, in categories II and III, with an intermediate proportion of low-birthweight children, we find levels of mortality between the two extremes, namely 32-35‰. This substantiates our hypothesis.

We also note from Table 18 that the risk associated with low birthweight varies with type of family. Mortality is very high (153.6‰) for children in category IV, and less than half the figure (61.4‰) in category I. What causes this difference? Might it be related to the quality of care given in premature infants' wards? These questions require further study.

Conclusion

We begin by choosing between the two orientations that exist for identifying families at risk. We might then apply program A1D3 to the four subpopulations obtained by classifying children according to birth order and mother's marital status.

Table 17. Variation in mortality by birthweight.

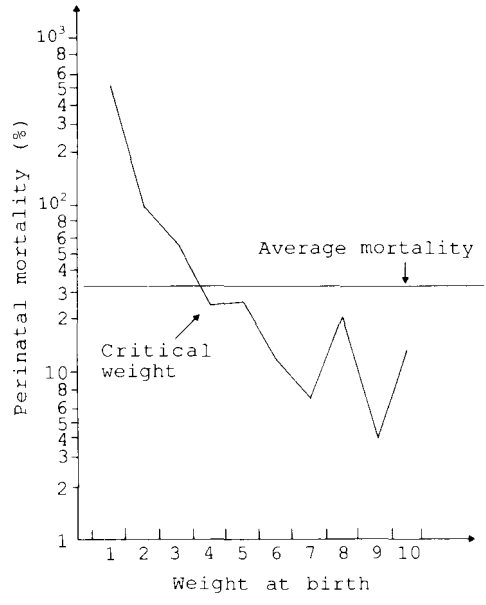
Birthweight (g)	Perinatal mortality[a] (‰)	Births[b] No.	Births[b] (%)	Confidence interval $\chi - 1.96$ (‰)	Confidence interval $\chi + 1.96$ (‰)
Under 2 000[c]	514.4	453	1.9	468.3	560.4
2 000 - 2 249	95.4	713	3.0	93.8	96.9
2 250 - 2 499	55.4	1 498	6.2	52.9	57.9
2 500 - 2 749	25.6	3 787	15.8	24.2	27.0
2 750 - 2 999	26.8	4 667	19.4	25.5	28.1
3 000 - 3 249	12.0	6 012	25.0	11.2	12.8
3 250 - 3 499	7.4	3 365	14.0	6.5	8.3
3 500 - 3 749	22.2	2 342	9.7	20.5	23.9
3 750 - 3 999	3.9	763	3.2	2.6	5.3
4 000 and over[c]	14.0	426	1.8	10.8	17.4
Not known	100.0	5	–	–	–
Total	32.0	24 031	100.0		

[a] $\chi^2 = 4\ 363.66$ significant for df = 10 and $\alpha = 0.05$.
[b] Includes only children born without complications.
[c] Given for information, because of the small number of children in question.

Table 18. Perinatal mortality levels by birthweight and type of family.

Family category	Birthweight (kg)	Perinatal mortality Quotient	Perinatal mortality 1.96	Births considered[a] No.	Births considered[a] (%)
I	Under 2.5	61.4	0.0199	554	8.1
	2.5 and over	5.6	0.0018	6275	91.9
	Total	10.1	0.0024	6829	100.0
II	Under 2.5	–	–	318	8.8
	2.5 and over	21.7	0.0050	3276	91.2
	Total	35.9	0.0061	3594	100.0
III	Under 2.5	155.4	0.0140	592	8.4
	2.5 and over	21.5	0.0035	6425	91.6
	Total	32.8	0.0042	7017	100.0
IV	Under 2.5	153.6	0.0221	1022	17.9
	2.5 and over	26.5	0.0046	4684	82.1
	Total	49.2	0.0056	5706	100.0

[a] Includes only births without complications.



Weight (g)

1.	<2000	6.	3000-3249
2.	2000-2249	7.	3250-3499
3.	2250-2499	8.	3500-3749
4.	2500-2749	9.	3750-3999
5.	2750-2999	10.	≥4000

Fig. 7. Perinatal mortality levels by birthweight.

Alternatively, we might begin segmentation by keeping all children in the same group and using only those independent variables that are relevant for all (in most cases, maternal variables). To these we add either variables relating to the father or those relating to the mother's prior pregnancies, depending on whether we obtain a subgroup comprising only children of married women or a subgroup containing only second and subsequent children. Although, in the EMOKIN study, these two options led to similar results, we feel that the first method is easier to implement and is therefore preferable.

Working with the EMOKIN survey data, we found that the phenomenon under study was not widespread and that not many children had been surveyed; the segmentation process had therefore stopped relatively early. To achieve more stable results, it would be preferable either to survey a larger number of children or to work with a variable other than death, such as birthweight under 2.50 kg. In any case, it would be advisable to select a variable with a higher frequency of occurrence.

GENERAL CONCLUSION

In Zaire, as in most sub-Saharan African countries, underreporting of births and deaths in the literature is a thorny problem, not only for research into child mortality, but also for the development of a sound social and health policy. In view of this difficulty, a few suggestions are offered here to improve the gathering of data: particular recommendations include the drawing up of a conceptual framework, the selection of survey staff, and the organization of fieldwork.

The data-gathering system that we used offers undeniable advantages. As noted earlier, however, it does not extend to home births (Table 4). Before attempting, therefore, to apply this system to the entire phenomenon of mortality in a given region, we ought to have some indication of the number of home births in that region. One way to do this would be to survey a sample of properties that have been selected to cover at least one neighbourhood of low socioeconomic standing.

To analyze our data, we used a technique that enabled us to identify those people most affected by a given phenomenon (in the case of the EMOKIN study, perinatal mortality). Although it remains little used, segmentation is no novelty, especially in demographic research. Because it is cumbersome, however, we feel that research would benefit greatly from software that was easier to use. We would like, therefore, to conclude with a plea both for a wider use of the procedure and for simplified computer programs to implement it. Let specialists take note. As for further research into child mortality, we feel that the points listed below should be considered.

Data gathering In carrying out this survey, we found that obstetric units have considerable data that remain unused. Rather than assuming, a priori, that these data are useful only for administrative reports, researchers should attempt to analyze and upgrade them.

Home births and those in small obstetric units In Zaire, and no doubt in several African countries, very little information is available on these two groups -- groups that are probably at risk. A concerted effort should, therefore, be made to determine the characteristics of the women in question and to reduce their numbers. In any case, it is high time that the activities of small obstetric units were monitored: the present neglect opens the door to all forms of abuse.

Low birthweight In analyses conducted elsewhere of the data from this survey (Nzita Kikhela 1986), it emerged that low birthweight is the factor that most effects the level of

perinatal mortality in Kinshasa. It therefore seems worthwhile to look for the factors that determine this low birthweight. Special attention might be given to the relations between the filiation system, distribution of resources within the household, and dietary taboos for pregnant women.

Finally, as has no doubt been observed, some methodological problems were resolved, but many others remain. More attention must therefore be given to all questions raised by the study of mortality among young children.

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APPENDIX 2. DEATHS IN SOME SUB-SAHARAN AFRICAN CITIES, BROKEN DOWN BY CAUSE (%)

Cause of death	Deaths (%)
Addis-Ababa (Ethiopia 1975, 1979)[a]	
• Amniotic fluid infection syndrome	33
• Obstructed labour	15
• Abruptio placentae	8
• Congenital syphilis	7
• Umbilical cord compression	7
• Congenital abnormalities	4
• Placenta previa	3
• Massive placental infarction	3
• Premature rupture of membranes	2
• Toxemia of pregnancy	2
• Other disorders	16
Total	100
Nairobi (Kenya 1976)[b]	
• Premature labour	49
• Antepartum hemorrhage	12
• Labour-related death	12
• Toxemia	6
• Maternal disease	5
• Congenital abnormalities	5
• Unexplained causes	11
Total	100
Mackakos District (Kenya 1977)[c]	
• Labour complications	38
• Undernourished child and antepartum hemorrhage	25
• Congenital abnormalities	8
• Infection	7
• Unknown and accidental	22
Total	100
Kampala (Uganda 1960)[d]	
• Trauma during labour	35
• Newborn pulmonary syndrome	22
• Prematurity (no other cause determined)	12
• Anoxia (abruptio placentae, placenta previa and placental inadequacy)	8
• rupture of the uterus	3
• other	3

Cause of death	Deaths (%)
Kampala (Uganda 1960) (cont'd)	
• Antepartum death and maceration	5
• Congenital malformations	2
• No obvious cause	10
Total	100
Kampala (Uganda 1964)[e]	
• Trauma-asphyxia	36
• Miscellaneous	26
• Newborn distress syndrome group	16
• Infection	14
• Congenital malformations	7
• Isoimmunization	1
Total	100
Lagos (Nigeria 1979)[f]	
• Trauma	30
• Undernourishment	24
• Hemorrhage	14
• Toxemia gravidae	10
• Unknown	10
• Other	12
Total	100

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APPENDIX 3. OBSTETRIC UNIT QUESTIONNAIRE

Interviewer's name: _____

1. General

1.1 Name of obstetric unit: _____

1.2 Street: _____ No.: _____

1.3 Neighbourhood: _____ Zone: _____

1.4 Does this obstetric unit belong to a hospital? _____
(1. yes; 2. no; 9. not known)
If yes, which? _____

1.5 Total number of beds:
Total number of private beds: _____
Total number of standard beds: _____

1.6 Obstetric unit staff:
Number of physicians: _____
Number of nurses: _____
Number of midwives: _____
Number of paramedics: _____
Other: _____

1.7 Fee for a normal delivery:
Private: _____
Standard: _____

1.8 Is there a system of supervision and of encouragement of initiatives ? _____

Is there a continuing education or retraining system for:
Physicians? _____
Nurses? _____
Midwives? _____

1.9 Are information sessions organized for mothers on
Hygiene? _____
Nutrition? _____
The need for prenatal consultations? _____
The need for postnatal consultations? _____
Contraception? _____

2. Who owns the obstetric unit? _____
   Government _____
   Religious organization _____
   Private company _____
   Government, but managed by a religious organization ____
   Other (specify) _____

2.1 Does the obstetric unit regularly receive assistance from a foreign agency? _____
   (1. yes; 2. no; 9. not known)

2.2 Period from 15 October to 15 March

	81-82	80-81	78-79	77-78	76-77
Number of deliveries	_____	_____	_____	_____	_____
Number of stillbirths	_____	_____	_____	_____	_____
Number of live births	_____	_____	_____	_____	_____

2.3 Distance from the zone house (km)

Gombe	_____	Ngaliema	_____	Barumbu	_____
Kinshasa	_____	Lingwala	_____	Kalamu	_____
Kasa-Vubu	_____	Ngiri-Ngiri	_____	Bandalungwa	_____
Kintambo	_____	Limete	_____	Lemba	_____
Matete	_____	Kisenso	_____	Ngaba	_____
Makala	_____	Bumbu	_____	Selembao	_____
Ndjili	_____	Kimbanseke	_____	Masina	_____
Ngafula	_____	Moule	_____	Maluku	_____

3. Delivery room

	Service	
	Private	Standard
3.1 Number of resuscitation tables for newborns	_____	_____
Number of tables with heating ramp	_____	_____
Number of tables with succion	_____	_____
Number of tables with oxigen	_____	_____
3.2 Number of units with expiration pressure valves	_____	_____
Number of laryngoloocopea for newborns - premature	_____	_____
- full-term	_____	_____
3.3 Number of endrotracheal intubation probes	_____	_____
Number of umbilical catheters	_____	_____
Number of isolation units	_____	_____
Number of infant incubators	_____	_____
Number of newborn scales	_____	_____
4.1 Number of incubators	_____	_____
Number of hood bells (for intensive O_2)	_____	_____
Number of oxygen mixers and humidifiers	_____	_____
Number of oxygen analyzers	_____	_____
Number of electrical pumps for perfusion and gavage	_____	_____
4.2 Is there micromeasurement equipment for pH, bilirubin, and ionogram?	_____	_____

4.3 Number (per "operating" team)

of specialists	_____	_____
of general practitioners	_____	_____
of nurses or graduate nurses	_____	_____
of nursing assistants	_____	_____

APPENDIX 4. INDIVIDUAL QUESTIONNAIRE

DEPARTMENT OF DEMOGRAPHY
B.P. 176 UNIV. of KINSHASA
REPUBLIC OF ZAIRE

1 = M.N, 2 = DCD, 3 = VV ⌊_⌋ 1.1.

QUESTIONNAIRE NO ⌊_____⌋ 1.7.

STUDY OF INFANT MORTALITY

IN KINSHASA OBSTETRIC UNITS

STRICTLY CONFIDENTIAL INDIVIDUAL QUESTIONNAIRE

OBSTETRIC UNIT:..... ZONE:..... ⌊___⌋ 1.10

INTERVIEWER'S NAME:.....

DATE QUESTIONNAIRE COMPLETED: ⌊__/__/__⌋ 1.16
D M Y

DATE CHECKED: ⌊__/__/__⌋ BY:.....
D M Y

DATE CODED: ⌊__/__/__⌋ BY:.....
D M Y

Mother's name:..... Quest No. ⌊_⌋ ⌊_____⌋

1. Demographic characteristics of the child's parents

1.1 Questions relating to the mother and father:

	MOTHER	FATHER	Computer	
1.1.1 Place of birth (Zone):.....		.....	M ⌊___⌋	1.19
Region (country, if not Zaire):.....		.....	F ⌊___⌋	1.22
			M ⌊_____⌋	1.28
Date of birth:	⌊_____⌋ D M Y	⌊_____⌋ D M Y	F ⌊_____⌋	1.34
Date of death (if applicable):	⌊_____⌋ D M Y	⌊_____⌋ D M Y	M ⌊_____⌋	1.40
			F ⌊_____⌋	1.46
1.1.2 Current marital status:				
1 = Single 2 = Legally married 3 = Married in common law 4 = Divorced or separated 5 = Widowed 9 = Not known	⌊_⌋	⌊_⌋	M ⌊_⌋ F ⌊_⌋	1.47 1.48
If legally married, ask what type of marriage: 1 = Monogamous 2 = Polygamous with 2 wives 3 = Polygamous with 3 wives 4 = Polygamous with 4 or more wives 9 = Not known	⌊_⌋	⌊_⌋	M ⌊_⌋ F ⌊_⌋	1.49 1.50
1.1.3 Year of last move to Kinshasa:	⌊__⌋		M ⌊__⌋	1.52
1.1.4 Previous place of residence:	⌊__⌋		F ⌊__⌋	1.54
Name of zone or city:.....		.....	M ⌊__⌋	1.57
Region (country if not Zaire):.....		.....	F ⌊__⌋	1.60

1.2 Questions relating to mother only:

1.2.1 Place of residence in Kinshasa ⌊___⌋ 1.63
Street:..... No:.....
Location or neighbourhood:.....
Zone:.....
Region (country if not Zaire):.....

Quest. No. ⌊_⌋ ⌊_____⌋

Computer

1.2.2 Do you plan to change residence after leaving the obstetric unit? ⌊_⌋ ⌊_⌋ 1.64

If answer is 2 or 9, go to question 1.2.3

(1 = yes, 2 = no, 9 = not known)

If answer is 1 (yes), ask the following question:

Do you know where you are moving to? ⌊_⌋ ⌊_⌋ 1.65

If answer is 1 (yes), say where, if answer is 2 or 9, give a reference address

Street:..... No:..... ⌊___⌋ 1.68

Location or neighbourhood:.....

Zone:.....

Region (country if not Zaïre):.....

1.2.3 How many times have you been pregnant, including this time? ⌊__⌋ ⌊__⌋ 1.70

1.2.4 Questions on successive pregnancies (including the most recent)

No. of pregnancy	Result of pregnancy 1=LB, 2=SB, 3=AB, 9=NK	Obstetrical history (see 5.6)	Name of child	Date of birth (month, year; 99.99=NK)	Sex of child: 1=M, 2=F, 9=NK	Survival of child: 1=living, 2=dead, 9=NK	Date of death (month, year; 99.99=NK)	Age at death (months)	
1	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	2.21
2	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	2.35
3	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	2.49
4	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	2.63
5	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	3.21
6	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	3.35
7	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	3.49
8	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	3.63
9	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	4.21
10	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	4.35
11	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	4.49
12	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	4.63
13	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	5.21
14	⌊_⌋	⌊_⌋	.....	⌊____⌋	⌊_⌋	⌊_⌋	⌊____⌋	⌊__⌋	5.35

Note: NK, not known; LB, live birth; SB, still birth; AB, aborted; M, male; F, female.

Quest. No. ⌊_⌋ ⌊_____⌋

2. Cultural and socio-economic characteristics of child's parents

2.1 Questions relating to mother and father	MOTHER	FATHER	Computer	
2.1.1 Education				
Attended school? (1 = Yes 2 = No 9 = Not known)	⌊_⌋	⌊_⌋	M ⌊_⌋	5.36
			F ⌊_⌋	5.37
If yes, ask highest grade completed: Primary (21 to 26) Secondary (31 to 36) Postsecondary (41 to 46)	⌊__⌋	⌊__⌋	M ⌊__⌋	5.39
			F ⌊__⌋	5.41
At what age did you leave school?	⌊__⌋	⌊__⌋	M ⌊__⌋	5.43
			F ⌊__⌋	5.45
If no, go on to question 2.1.2				
2.1.2 Tribe (nationality if not from Zaire).....		.....	M ⌊___⌋	5.48
			F ⌊___⌋	5.51
2.1.3 Activity				
Degree of activity: 1 = Student 2 = Homemaker 3 = Employed 4 = Not working because ill 5 = Unemployed 6 = Free woman 7 = Pensioner	⌊_⌋	⌊_⌋	M ⌊_⌋	5.52
			F ⌊_⌋	5.53
Main occupation (bringing in greatest income).....		.....	M ⌊__⌋	5.55
			F ⌊__⌋	5.57
Field of economic activity:.....		.....	M ⌊___⌋	5.60
			F ⌊___⌋	5.63
Social status: 1 = Manager 2 = Office worker 3 = Independent with employees 4 = Independent without employees 5 = Skilled or semi-skilled worker 6 = Unskilled labourer 9 = Not known	⌊_⌋	⌊_⌋		
			M ⌊_⌋	5.64
			F ⌊_⌋	5.65

Quest. No. ⌊_⌋ ⌊_____⌋

	MOTHER	FATHER	Computer		
2.1.4 Religion					
1 = Atheist 2 = Catholic 3 = Protestant 4 = Kimbanguist 5 = Moslem 9 = Not known	⌊_⌋	⌊_⌋	M F	⌊_⌋ ⌊_⌋	5.66 5.67
2.2 Questions relating to mother only					
2.2.1 Who is the person in your place of residence on whom you are primarily dependent? 1 = your spouse 2 = yourself 3 = your son 4 = a member of your family 5 = a member of your spouse's family 6 = a friend 9 = not known	⌊_⌋			⌊_⌋	5.68
If the answer is 1 or 2, go on to question 2.2.2 If the answer is 3, 4, 5, 6, 7, 8, or 9: What is this person's degree of activity? 1 = Student 2 = Homemaker 3 = Ill 4 = Working 5 = Unemployed 6 = Free woman 7 = Pensioner 9 = Not known	⌊_⌋			⌊_⌋	5.69
What is this person's occupation?.....				⌊_⌋	5.71
What is his or her field of economic activity?.....				⌊_⌋	5.74
What is his or her status? 1 = Manager 2 = Office worker 3 = Independent without employees 4 = Independent with employees 5 = Skilled or semiskilled worker 6 = Unskilled labourer 9 = Not known	⌊_⌋			⌊_⌋	5.75
2.2.2 What is the mother's weight?	⌊_⌋ kg ⌊_⌋ g			⌊_⌋ kg ⌊_⌋ g	6.12
What is the mother's height?	⌊_⌋ cm			⌊_⌋ cm	6.15
What is the mother's haemoglobin count?	⌊_⌋			⌊_⌋	6.18

Quest. No. ⌊_⌋ ⌊_____⌋

		Computer	
3. Mother's dwelling			
3.1 What are the walls of the house you live in made of? 1 = Brick or stone 2 = Wood 3 = Clay 9 = Not known	⌊_⌋	⌊_⌋	6.19
3.2 What is the roof made of? 1 = Sheet metal or tile 2 = Thatch or raffia 3 = Other 9 = Not known	⌊_⌋	⌊_⌋	6.20
3.3 Apart from the kitchen, bathroom, and toilet, how many rooms does your dwelling have?	⌊_⌋	⌊_⌋	6.22
3.4 How many people live in the same house as you (including you)?	⌊_⌋	⌊_⌋	6.24
3.5 How do you get drinking water? 1 = Tap 2 = Well 3 = Stream 9 = Not known	⌊_⌋	⌊_⌋	6.25
Where is it? 1 = In the house 2 = On the property 3 = Off the property 9 = Not known	⌊_⌋	⌊_⌋	6.26
3.6 Is there a garbage dump in your neighbourhood? 1 = Yes 2 = No 9 = Not known	⌊_⌋	⌊_⌋	6.27
How many times was garbage removed in the past 6 months? 9 = Not known	⌊_⌋	⌊_⌋	6.28
3.7 Is there a drain beside your property? 1 = Yes 2 = No 9 = Not known	⌊_⌋	⌊_⌋	6.29
Is it blocked? 1 = Yes 2 = No 9 = Not known	⌊_⌋	⌊_⌋	6.30
4. Characteristics of latest pregnancy			
4.1 Did you have prenatal consultations with a practitioner? 1 = Yes 2 = No 9 = Not known	⌊_⌋	⌊_⌋	6.31

Quest. No. ⌊_⌋ ⌊_____⌋

Computer

If yes (see prenatal consultations chart, if any) ⌊_⌋

Why?..... ⌊_⌋ 6.32
.....

How many months pregnant were you when you began? ⌊_⌋ ⌊_⌋ 6.33

How many prenatal visits did you make? ⌊__⌋ ⌊__⌋ 6.35

Where did all (or most of) your prenatal consultations take place? ⌊_⌋ ⌊_⌋ 6.36

1 = In a private physician's office
2 = In an obstetric unit, hospital or clinic
9 = Not known

Did all (or most of) your prenatal consultations take place in a medical centre or office ⌊_⌋ ⌊_⌋ 6.37

1 = In the zone where you live
2 = Outside the zone where you live
9 = Not known

Why did you choose this medical centre or office? ⌊__⌋ ⌊__⌋ 6.39

01 = Because it is close to where you live
02 = Because its services are cheaper
03 = Because your friends go there
04 = Because the physician working there has a good reputation
05 = Because the physician working there is a family friend
06 = No reason
11 to 19 = Other, to be specified
99 = Not known

If no, what was the main reason why you did not have any prenatal consultations? ⌊_⌋ ⌊_⌋ 6.40

1 = Did not know I should
2 = Could not afford them
3 = I felt all right
4 = Other (specify).....
9 = Not known

4.2 Were you ill during pregnancy?

1 = Yes 2 = No 9 = Not known ⌊_⌋ ⌊_⌋ 6.49

Quest. No. ⌊_⌋ ⌊_____⌋

Computer

If yes, did you have the following diseases during pregnancy? ⌊_____⌋ 7.47

(See medical chart or prenatal consultations record)

1 = High blood pressure and toxaemia gravidae ☐
2 = Diabetes ☐
3 = Fever ☐
4 = Pyelonephritis ☐
5 = Anaemia ☐
6 = Toxoplasmosis ☐
7 = Syphilis ☐
8 = Other (specify).....
.....
9 = Not known ☐

Did this illness require ⌊_⌋ ⌊_⌋ 7.48

1 = Hospitalization
2 = Ambulatory treatment in a medical centre
3 = Treatment by a lay practitioner
4 = Treatment by a physician (or nurse) and a lay practitioner
5 = No treatment
9 = Not known

4.3 Did you have haemorrhages or threatened abortion or labour during pregnancy? ⌊_⌋ ⌊_⌋ 6.49
1 = Yes 2 = No 9 = Not known

4.4 Are you aware of means or methods of preventing or delaying pregnancy? ⌊_⌋ ⌊_⌋ 6.50
1 = Yes 2 = No 9 = Not known

If yes, did you use any before this latest pregnancy? ⌊_⌋ ⌊_⌋ 6.51
1 = Yes 2 = No 9 = Not known

What method did you use? ⌊_⌋ 6.53

1 = Pill ☐
2 = IUD ☐
3 = Rhythm (calendar) ☐
4 = Depo Provera ☐
5 = Coitus interruptus ☐
6 = Other (specify).....
.....
9 = Not known ☐

Did you plan to abort when you found you were pregnant? ⌊_⌋ ⌊_⌋ 6.54
1 = Yes 2 = No 9 = Not known

5. Birth

5.1 Date of birth (day, month) ⌊_____⌋ (D M) ⌊_____⌋ 6.58

5.2 Time of birth (hour) ⌊_⌋ (H) ⌊_⌋ 6.60

Quest. No. ⌊_⌋⌊_____⌋

Computer

5.3 Where did you give birth?

1 = In an obstetric unit ⌊_⌋ ⌊_⌋ 6.61
2 = At home
3 = On the road
4 = Other (specify).....
.....
9 = Not known

If in an obstetric unit, what service did you use? ⌊_⌋ ⌊_⌋ 6.62

1 = Private 2 = Standard 9 = Not known

Why did you decide to give birth in this unit?

1 = It is closest to my home ☐
2 = It was cheap ☐ ⌊___⌋ 6.66
3 = Emergency birth ☐
4 = No reason ☐
5 = Because my friends gave birth there ☐
6 = Other (specify).....
.....
9 = Not known ☐

Does the physician you saw prenatally work in this obstetric unit?

1 = Yes 2 = No 9 = Not known ⌊_⌋ ⌊_⌋ 6.67

If outside an obstetric unit, why?

1 = No money ☐
2 = Labour too fast ☐
3 = Did not need an obstetric unit ☐ 6.71
4 = No transport ☐
5 = No reason ☐
6 = Other (specify).....
.....

5.4 Who conducted the delivery?

1 = Physician
2 = Nurse
3 = Midwife ⌊_⌋ ⌊_⌋ 6.72
4 = Other helper
9 = Not known

Name of person who conducted the delivery:.....
.....

Name of person who assisted the above:.....
.....

Quest. No. ⌊_⌋⌊_____⌋

Computer

5.5 Complications of birth (see obstetrical nurse and mother's medical record) ⌊____⌋ 7.12

1 = None ☐
2 = Placenta praevia ☐
3 = Membranes broke over 24 h before birth ☐
4 = Dyskinesia ☐
5 = Eclampsia ☐
6 = Disproportion between fetus and pelvis ☐
7 = DPPNI ☐
8 = Other (specify).....
.....
.....
7 = Not known ☐

5.6 How did the birth go? ⌊___⌋ 7.16

1 = Spontaneous birth ☐
2 = Caesarean ☐
3 = Oxytoxins administered ☐
4 = Vacuum ☐
5 = Forceps ☐
6 = Tear ☐
7 = Episiotomy ☐
8 = Other (specify).....
.....
.....
9 = Not known ☐

5.7 How did the child present? ⌊_⌋ ⌊_⌋ 7.17

1 = Head
2 = Breech
9 = Not known

5.8 Are you suffering from an illness now? ⌊_⌋ 7.18

1 = Haemorrhage ☐
2 = Fever ☐
3 = Other (specify).....
.....
.....
9 = Not known ☐

5.9 To how many children did you give birth? ⌊_⌋ 7.19

1 = One ⌊_⌋
2 = Two
3 = Three
9 = Not known

Quest. No. ⌊_⌋ ⌊_____⌋

6. Newborn's characteristics	First child (single)	Second child (twins)	Third child (triplets)
6.1 How is the child? 1 = Well 2 = Ill 3 = Dead 4 = Not known If well, go to question 6.2	⌊_⌋ 7.20	⌊_⌋ 7.21	⌊_⌋ 7.22
If ill, what is the illness? 1 = Respiratory problems 2 = Icterus 3 = Fever 4 = Anaemia 5 = Congenital malformations 6 = Other (specify) 9 = Not known	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.26	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.30	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.34 .....
If dead, did the child die 1 = Before birth 2 = During delivery 3 = After birth 9 = Not known	⌊_⌋ 7.35	⌊_⌋ 7.36	⌊_⌋ 7.37
If dead before birth, what did the child die of? 1 = Obstetrical trauma 2 = Mother's death 3 = Cord circulation 4 = Placental disease 5 = Membrane rupture 6 = Other (specify) 9 = Not known	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.41	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.45	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.43 .....

Quest. No. ⌊_⌋⌊_____⌋

6. Newborn's characteristics	First child (single)	Second child (twins)	Third child (triplets)
<u>If died during delivery,</u> what did the child die of? 1 = Mother's death 2 = Cord prolapse 3 = Surgical and instrumental intervention 4 = Membrane rupture 5 = Other (specify) 9 = Not known	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.53	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.57	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.60 ....
<u>If died after delivery,</u> what did the child die of? 1 = Respiratory problems 2 = Trauma (fall) 3 = Prematurity or dysmaturity 4 = Congenital malformations 5 = Fever 6 = Anaemia 7 = Icterus 8 = Other (specify) 9 = Not known	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.65	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.69	Computer ⌊_⌋⌊_⌋⌊_⌋ 7.73 ....
<u>COMMENTS</u>			

Quest. No. ⌊_⌋⌊_____⌋

6.	Newborn's characteristics	First child (single)	Second child (twins)	Third child (triplets)
	<u>If died after delivery,</u>			
	On what date did the child die?	⌊_⌋⌊_⌋⌊_⌋ 8.11	⌊_⌋⌊_⌋⌊_⌋ 8.15	⌊_⌋⌊_⌋⌊_⌋ 8.19
	At what time did the child die?	⌊_⌋⌊_⌋ 8.21	⌊_⌋⌊_⌋ 8.23	⌊_⌋⌊_⌋ 8.25
6.2	What did the child weigh at birth?	⌊_⌋⌊_⌋⌊_⌋ 8.29 kg g	⌊_⌋⌊_⌋⌊_⌋ 8.33 kg g	⌊_⌋⌊_⌋⌊_⌋ 8.35 kg g
	What was the child's length (cm)?	⌊_⌋⌊_⌋ 8.39 cm	⌊_⌋⌊_⌋ 8.41 cm	⌊_⌋⌊_⌋ 8.43 cm
	What was the child's cranial perimeter (cm)?	⌊_⌋⌊_⌋ 8.45 cm	⌊_⌋⌊_⌋ 8.47 cm	⌊_⌋⌊_⌋ 8.49 cm
	What was the child's Apgar score (at 1', 5' and 10')?	⌊_⌋⌊_⌋⌊_⌋ 8.52	⌊_⌋⌊_⌋⌊_⌋ 8.55	⌊_⌋⌊_⌋⌊_⌋ 8.57
6.3	What is the child's sex? 1 = Male 2 = Female 9 = Not known	⌊_⌋ 8.59	⌊_⌋ 8.60	⌊_⌋ 8.61
6.4	What anomalies did the child show at birth?	⌊_⌋⌊_⌋ 8.63	⌊_⌋⌊_⌋ 8.65	⌊_⌋⌊_⌋ 8.67
		.....	.....	.....
		.....	.....	.....
		.....	.....	.....
		.....	.....	.....

Investigator: ..... Quest. No. ⌊_⌋⌊_____⌋ 9.7

7. Home visit on 7th day	First child (single)	Second child (twins)	Third child (triplets)
7.1 Has the child had the following vaccinations? 1 = BCG (tuberculosis) 2 = Tetanus 3 = Smallpox 4 = Other vaccination 9 = Not known	⌊___⌋ 9.10	⌊___⌋ 9.13	⌊___⌋ 9.16
7.2 How is the child? 1 = Well 2 = Ill 3 = Dead 9 = Not known	⌊_⌋ 9.17	⌊_⌋ 9.18	⌊_⌋ 9.19
<u>If well,</u> has he been ill? 1 = Yes 2 = No 9 = Not known	⌊_⌋ 9.20	⌊_⌋ 9.21	⌊_⌋ 9.22
<u>If yes,</u> was he cared for by 1 = A physician or nurse 2 = A lay practitioner 3 = A physician or nurse and a lay practitioner 4 = The mother 5 = No treatment 9 = Not known	⌊_⌋ 9.23	⌊_⌋ 9.24	⌊_⌋ 9.25

Quest. No. ⌊_⌋⌊_____⌋

7. Home visit on 7th day	First child (single)	Second child (twins)	Third child (triplets)
<u>If ill,</u> what is his illness? 1 = Respiratory problems 2 = Conjunctivitis 3 = Icterus 4 = Fever 5 = Noncardiac congenital malformations 6 = Skin rashes 7 = Other (specify)	⌊_⌋⌊_⌋⌊_⌋ 9.29	⌊_⌋⌊_⌋⌊_⌋ 9.33	⌊_⌋⌊_⌋⌊_⌋ 9.37
<u>If dead,</u> On what date did he die?	⌊_⌋⌊_⌋⌊_⌋⌊_⌋ 9.43	⌊_⌋⌊_⌋⌊_⌋⌊_⌋ 9.49	⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋⌊_⌋ 9.55
Of what did he die? 1 = Respiratory problems 2 = Prematurity or dysmaturity 3 = Erythroblastosis 4 = Tetanus 5 = Noncardiac congenital malformations 6 = Other (specify) 9 = Not known	⌊_⌋⌊_⌋⌊_⌋ 9.59	⌊_⌋⌊_⌋⌊_⌋ 9.63	⌊_⌋⌊_⌋⌊_⌋ 9.67
7.3 Mother's survival 1 = Mother alive 2 = Mother dead 3 = Mother ill 9 = Not known	⌊_⌋ 9.68	⌊_⌋⌊_⌋ 9.70	

APPENDIX 5. STILLBIRTH AND EARLY NEONATAL MORTALITY RATES IN SUB-SAHARAN AFRICA

Region	Year of publication	Year data collected	Stillbirths (‰)	Early neonatal mortality (%)	Perinatal mortality (‰)	References[a]
West Africa						
Ghana[b]	1982	-	-	-	-	2
Côte d'Ivoire (rural region near Abidjan)	1978	1966-1971	32.9	15.6	48.6	3
Nigeria						
Vom	1970	1963-1967	66.4	47.8	107.2	11
Ibadan	1971	1961-1964	-	-	54.0	12
Ibadan	1971	1967-1968	-	-	60.7	13
Benin City	1977	1974-1975	-	-	80.9	14
Rural region	1978	1977	95.0	-	-	15
Zaroa	1979	1976-1977	86.4	-	-	16
Ondo	1979	1973	-	-	52.3	17
Ibadan[c]	1982	1977-1978	86.9	-	-	19
Senegal						
Dakar	1971	1964-1965	40.0	19.0	59.0	37
Khombole	1971	1964-1965	27.0	16.0	33.0	37
Sine, Niakhar	1971	1964-1965	40.0	33.0	77.0	37
Sierra Leone						
Freetown[d]	1980	1969-1974	24.9	73.8	96.8	38
Togo						
Lomé	1983	1980-1981	47.0	-	-	29
Central Africa						
Zaire						
Equatorial	1966	1950-1965	42.0	-	-	33
Kinshasa	1968	1962-1966	35.0	-	-	34
Kinshasa	1974	1971-1972	30.0	-	-	35
Kinshasa[d]	1985	1969	18.3	30.2	48.2	36

(continued)

(cont'd)

Region	Year of publi-cation	Year data collected	Still-births (‰)	Early neonatal mortality (%)	Perinatal mortality (‰)	Refer-ences[a]
East Africa						
Ethiopia						
Addis Ababa	1977	1974-1975	47.6	17.7	65.3	1
Kenya						
(Kenya)[b]	1964	-	-	-	-	4
Nairobi[b]	1968	-	-	-	-	5
Rural region (Mackakos Project)	1979	1977-1978	29.8	-	-	6
Nairobi	1980	1976-1977	-	-	97.0	8
Rural region	1983	1975-1978	29.6	16.8	46.4	10
Uganda						
Kampala	1964	1960	68.1	-	-	22
Kampala	1966	1963-1964	54.4	-	-	23
Kampala	1967	1962-1965	32.8	-	-	24
Tanzania						
Dar-es-Salam	1975	1969	37.0	-	-	28
Kibara	1980	1973	32.0	-	-	29
Zambia						
Lusaka	1978	1976	25.2	28.1	53.3	30
Lusaka	1978	1971-1976	27.0	28.0	53.0	31
Mulamfashi	1978	1971-1974	95.0	-	-	-
Lusaka	1982	1979-1980	26.0	-	-	32

[a]See Appendix 1.
[b]Study listed but unavailable.
[c]This study dealt only with problem deliveries.
[d]These are quotients; the others are rates.

APPENDIX 6. SAMPLING ERROR ESTIMATION

Formula used[a]: $V_o(t) = (1 - f) \frac{t(1-t)}{n-1}$

where $V_o(t)$ = variance sought

f = sampling rate

t = rate observed in sample

m = sample size

In the case of this survey

$f = 0.2$

$m = 5\ 195$

$t = \frac{76}{5149} = 0.0148$

Thus $V_o(t) = (1 - 0.2) \frac{0.0148 \times 0.9852}{5.149}$

$\sigma(t) = \sqrt{V_o(t)} = 0.0015$

Hence $t \pm \sigma(t) = 0.0148 \pm 0.0015$

Number of deaths estimated by sample

- upper limit = 0.0163 x 25 745 = 420
- lower limit = 0.0133 x 25 745 = 342

Perinatal mortality quotient

- upper limit = (607 + 177 + 420) : (26 759 - 230) = 45.4‰
- lower limit = (607 + 177 + 342) : (26 759 - 230) = 42.4‰

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[a] Clairin, R. 1983. L'estimation de la précision de certains paramètres démographiques obtenus à partir d'une enquête par sondage. Études et documents (11) Groupe de démographie africaine, novembre 1983, p. 14.

APPENDIX 7. VARIATION IN PERINATAL MORTALITY BY PARENTS' PLACE OF ORIGIN AND LENGTH OF STAY IN KINSHASA

Parent	Place of origin	Length of stay in Kinshasa	Perinatal mortality (%)	No. of births
Mother	Urban[a]	Under 10 years	38.1	4 719
		Over 10 years	41.1	5 475
		Total	40.5	10 194
	Rural[b]	Under 10 years	40.6	2 882
		Over 10 years	34.6	3 610
		Total	37.3	6 492
	Kinshasa		41.0	8 984
Father	Urban[c]	Under 10 years	34.8	3 477
		Over 10 years	36.3	7 705
		Total	35.7	11 182
	Rural[d]	Under 10 years	61.8	1 796
		Over 10 years	26.8	5 570
		Total	35.3	7 366
	Kinshasa		41.3	4 944

[a]
[b] $\chi^2 = 0.07$ (not significant).
[c] $\chi^2 = 1.4$ (not significant).
[d] $\chi^2 = 0.9$ (not significant).
$\chi^2 = 49.0$ (significant).

APPENDIX 8. BREAKDOWN OF MOTHERS BY EDUCATION AND TRIBE

Mother's nationality and tribe	Illiterate	Primary school		1-3 years secondary	4 and more years secondary	Total
		1-4 years	5-6 years			
Lower Zaire	874 (9.6)[a]	983 (10.7)	1 645 (18.0)	3 379 (41.4)	1 853 (20.3)	9 134 (100.0)
Kwango	766 (22.8)	579 (17.3)	612 (18.2)	895 (26.7)	505 (15.0)	3 357 (100.0)
Kwilu	715 (19.4)	687 (18.6)	716 (19.4)	1 051 (28.4)	525 (14.2)	3 694 (100.0)
Central basin Ubangi, Itimbiri, and Kivu	601 (11.4)	500 (9.5)	1 119 (21.3)	2 017 (38.4)	1 021 (19.4)	5 258 (100.0)
Kasaï-Shaba	207 (5.8)	228 (6.3)	677 (18.9)	1 500 (41.8)	977 (27.2)	3 589 (100.0)
Foreign	230 (17.9)	111 (8.6)	303 (23.5)	490 (38.1)	153 (11.9)	1 287 (100.0)
Total	3 393 (12.9)	3 088 (11.7)	5 072 (19.3)	9 732 (37.0)	5 034 (19.1)	26 329 (100.0)

[a] Values in parentheses are percentages.

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