

# Association of Tobacco Control Policies With Youth Smoking Onset in Chile

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**IMPORTANCE** Tobacco smoking is still responsible for more than 6 million preventable deaths annually, most of which occur in low- and middle-income countries. South American countries, Chile in particular, endure some of the highest cigarette smoking prevalence rates globally. Despite the lack of any meaningful increases in cigarette taxes (the most effective tobacco control measure) between 1999 and 2014, cigarette prices in Chile increased sharply almost entirely driven by British American Tobacco (BAT).

**OBJECTIVE** To examine the associations between cigarette prices and nonprice tobacco control policies targeted at youth introduced in 2006 (Law 20105) and smoking onset among Chilean youths.

**DESIGN, SETTING, AND PARTICIPANTS** This study used data from 8 waves of a large national school survey of urban communities in Chile conducted between October and December in 2001, 2003, 2015, 2007, 2009, 2011, 2013, and 2015 and discrete-time hazard models. Data analysis was performed from May 2017 to January 2019.

**EXPOSURES** Prices, advertising, and retail restrictions.

**MAIN OUTCOMES AND MEASURES** Smoking onset (the transition between never smoking and smoking) in youth.

**RESULTS** In this study of 181 624 survey respondents in 8751 Chilean secondary schools, higher prices (own-price elasticity [percentage change in quantity demanded in response to a 1% change in price],  $-0.40$ ; 95% CI,  $-0.45$  to  $-0.36$ ) and the tobacco control policies enacted in 2006 (hazard ratio, 0.83; 95% CI, 0.81-0.85) were associated with lower hazards of starting smoking. The study found that an increase in real prices of 58.6% and the introduction of Law 20105 were associated with similar lower hazards of starting smoking (hazard ratio, 0.83; 95% CI, 0.81-0.85); in comparison, between 1999 and 2017, inflation-adjusted cigarette prices increased by 206%.

**CONCLUSIONS AND RELEVANCE** The findings suggest that higher prices initiated by BAT and the tobacco control policies enacted by the Ministry of Health in 2006 were associated with lower hazards of starting smoking in Chilean youth. Large cigarette tax increases may be a strategy that can be used to help reduce smoking among youths in Chile.

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Despite decreases in high-income regions, the global burden of disease attributable to tobacco smoking has changed little between 1990 and 2010.<sup>1</sup> Tobacco smoking is still responsible for more than 6 million preventable deaths annually, most of which now occur in low- and middle-income countries (LMICs).<sup>1</sup> South American countries, Chile in particular, endure some of the highest cigarette smoking prevalence rates globally. In 2014, 35% of Chilean adults were current tobacco smokers.<sup>2,3</sup> An array of tobacco control measures, such as taxes, advertising bans, and smoke-free policies, have been shown to be effective in reducing tobacco use.<sup>4-9</sup> Tobacco taxes that raise the price of tobacco products have at times been lauded as the most effective way to reduce tobacco use and the single best health policy in the world.<sup>10,11</sup>

After years of inaction, Chile ratified the Framework Convention on Tobacco Control in 2005 and passed legislation (Law 20105) in 2006 aiming to decrease its high smoking rates (in 2004, a total of 44% of Chilean adults were current tobacco smokers and 31% were daily tobacco smokers).<sup>2</sup> Law 20105 strengthened existing advertising and smoking restrictions. It banned all tobacco advertising with the exception of point-of-sale and banned smoking in enclosed workplaces and public spaces. Some aspects of the law focused specifically on youth: point-of-sale advertising was prohibited within 300 m of primary and secondary schools, the sale of tobacco products was prohibited within 100 m of primary and secondary schools, and the minimum legal age to purchase cigarettes was increased from 16 to 18 years. Health warnings were also increased to 50% of principal display areas. Missing from this comprehensive package of tobacco control policies were tobacco taxes, which, although relatively high, remained unchanged until 2010.

Before 2014, Chile relied almost exclusively on *ad valorem* cigarette taxes (ie, levied as a percentage of the value of a product) to tax manufactured tobacco products (cigarettes represent nearly 100% of the manufactured tobacco market [eAppendix in the Supplement describes tax changes since 1982]). Despite the lack of any meaningful increases in taxes between 1999 and 2014, cigarette prices in Chile increased sharply. For example, real cigarette prices increased by approximately 6% in 1999, 3% in 2000, 11% in 2001, and 5% in 2003. From 2009 to 2014, real cigarette prices increased between 7% and 19% annually. Countries such as France, the United Kingdom, and South Africa, which are often portrayed as tobacco tax success stories, have not experienced cigarette price increases to an extent similar to that of Chile.<sup>12-15</sup> Unlike France and the United Kingdom, where higher prices were mostly the result of concerted government efforts, all price increases in Chile were initiated by tobacco manufacturers and, in particular, British American Tobacco (BAT), whose brands made up 92% to 98% of the Chilean cigarette market in the 2000s and early 2010s.<sup>16</sup>

A recent systematic review<sup>7</sup> examined the association of tobacco prices or taxes with tobacco use in Latin American and Caribbean countries and concluded that prices had a negative and statistically significant association with cigarette consumption. This review, however, did not identify a single study

## Key Points

**Question** Were British American Tobacco's large and sustained price increases and nonprice tobacco control policies targeted at youth introduced by the government in 2006 associated with lower smoking onset among youths in Chile?

**Findings** In this study of data from a total of 181 624 survey respondents in 8751 Chilean secondary schools, both higher prices and the nonprice tobacco control policies were associated with lower hazards of starting smoking.

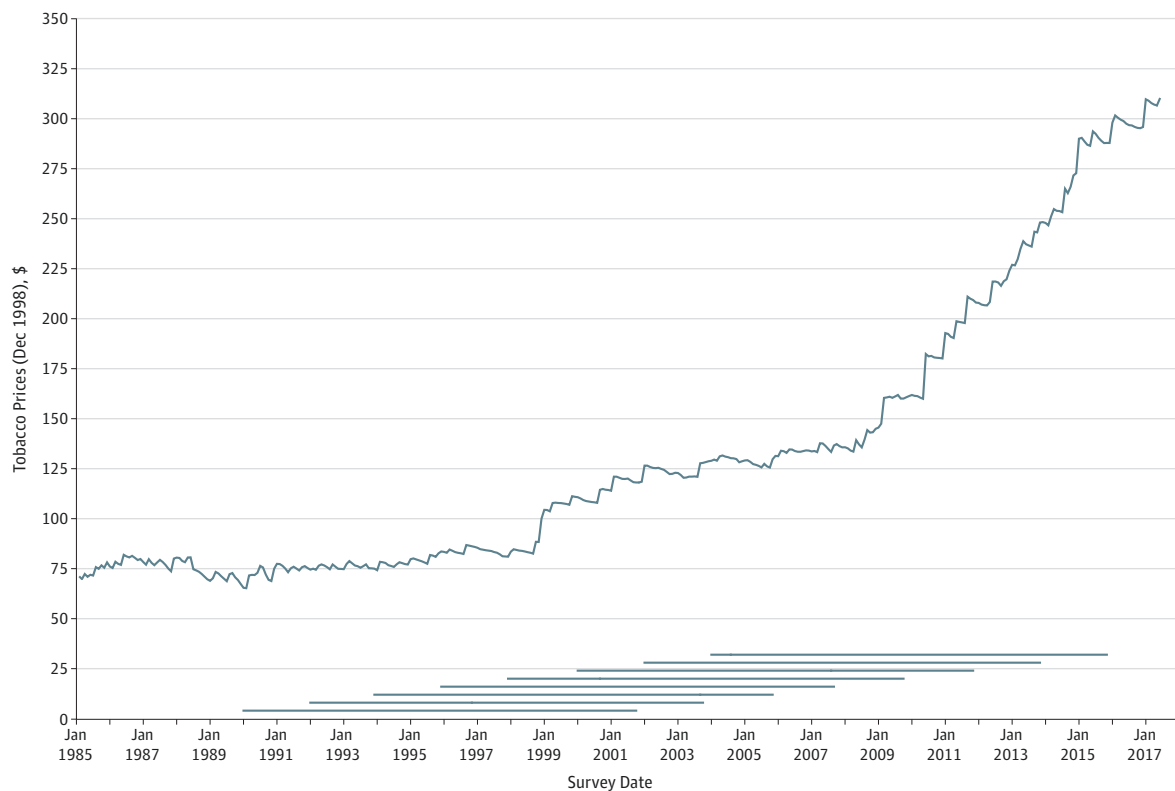
**Meaning** Large cigarette tax increases may be a strategy that can be used to help reduce smoking among youths in Chile.

that used individual-level data. This limitation is important because studies that use aggregate time series data cannot examine the association of tax or price changes with smoking initiation (the transition between never smoking and smoking), between groups such as men and women, or between individuals of low and high socioeconomic status (SES). Another recent review<sup>17</sup> examined the association of prices or taxes with smoking initiation and identified only 3 studies that used data from LMICs, none of which were from Latin America. Subsequent to the above reviews, 2 studies<sup>18,19</sup> examined the association of prices with smoking onset or cessation in Argentina. In addition, one study<sup>20</sup> evaluated the association of Law 20105 with smoking behavior among Chilean students. The lack of consensus on the association of prices and taxes with smoking initiation, the scarcity of studies that use individual-level data from LMICs, and the extent of industry-initiated price increases calls for an examination of the Chilean experience. Moreover, price responsiveness may differ among contexts for a number of reasons: smokers in less affluent countries may be more price responsive than those in more affluent countries because they have relatively fewer resources and generally lower levels of education; poorer individuals may behave differently when it comes to choices involving intertemporal tradeoffs; and the availability and prices of substitutes and complements may differ.<sup>21-23</sup> There is also a need to examine the association of Law 20105 enacted in 2006 with smoking initiation because several of its components specifically targeted youth. Thus, we examine the associations between cigarette prices and nonprice tobacco control policies targeted at youth introduced in 2006 and smoking onset among Chilean youths.

## Methods

For this study, we used data from the Encuesta de Población Escolar de Chile (Chilean School Population Survey), a nationally and regionally representative urban school-based survey (grades 8-12) conducted biannually. We used 8 waves conducted between October and December in 2001, 2003, 2015, 2007, 2009, 2011, 2013, and 2015. Data analysis was performed from May 2017 to January 2019. Research ethics board approval and patient consent were not required according to the Canadian Institutes of Health Research, Natural Sciences

Figure 1. Inflation-Adjusted Cigarette Prices, 1985 to 2017



Horizontal lines represent the periods at which youths were at risk of starting smoking for each survey cycle. Data are from the Instituto Nacional de Estadísticas.

and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada, Tri-Council Policy Statement.<sup>24</sup>

We created a measure of age at smoking onset from the self-reported response to the question, “How old were you when you smoked for the first time?” Because the month of the interview (October, November, or December) and the month of birthday were not reported, we randomly selected, using a uniform distribution, a month of interview and birth for each individual (instead of selecting the midpoint as is usually done). We then randomly selected, using a uniform distribution, the year and month of smoking onset within each interval for each current and former smoker.<sup>25,26</sup> This approach (compared with the selected midpoint) yielded similar coefficients but wider CIs. We assumed that individuals were first exposed to the risk of starting to smoke at 8 years of age. Consequently, we follow up individuals from December 1990 (ie, individuals who were 19 years of age when surveyed in 2001) to December 2015 (ie, individuals surveyed in December 2015).

As a measure of cigarette prices, we used the cigarette component of the Consumer Price Index compiled by the Instituto Nacional de Estadísticas. Before 2009, prices were only collected in the metropolitan region of Chile’s capital city Santiago. Although more than half of Chileans do not live in Santiago, this is not problematic because the price of cigarettes does not vary across regions in Chile. As is the case in a number of countries, such as Argentina and France, cigarette

brand prices are uniform across the country (ie, prices vary among brands, but the prices of individual brands do not vary among neighborhoods or regions). **Figure 1** presents inflation-adjusted cigarette prices along with the periods at which youths were at risk of starting smoking for each survey cycle.

In addition to our measure of cigarette prices, we included a dichotomous indicator to capture the implementation of Law 20105 in August 2006. We used 2 measures to capture SES. First, we included a measure of the mother’s educational level with 3 binary indicators: primary or less, secondary or less, or more than secondary. Second, we included indicators of the types of schools surveyed: public (pública municipal), subsidized (privada subvencionada), and private (privada pagada). Public schools are completely free and are mostly attended by students from low- and lower- to middle-income households. Subsidized schools are private schools supported by government funding through the provision of vouchers to families; such vouchers are mostly used by middle-income households. Private schools receive no government funding and are largely attended by students from high-income families. The 2013 Chilean household survey indicated that 39% of students who attended public schools belonged to the lowest-income quintile and 87% belonged to the lowest 3 quintiles. For the publicly subsidized schools, 24% belonged to the lowest-income quintile and 73% belonged to the lowest 3 quintiles. Of those attending private schools, 60% came from the top quintile and 77% from the top 2 quintiles.<sup>27</sup>

In addition, we included a measure of real alcohol prices as an additional covariate and sex and administrative regions as dichotomous indicators. Two regions were split in 2007, increasing the number of regions from 13 to 15; we used the original 13 administrative regions. We excluded from our sample individuals who were older than 19 years at interview and those with missing or nonsensical data.

### Statistical Analysis

We used survival analysis to examine the associations between cigarette prices and tobacco control policies targeted at youth that were introduced in 2006 with smoking onset among Chilean youths. Specifically, we used discrete-time hazard models and a complementary loglog specification (unlike logit or probit, cloglog has a response curve that is asymmetric).<sup>28-30</sup> As a functional form for the baseline hazard function, we used a cubic polynomial specification (theory and data indicate that the hazard rate first increases and then decreases). A key assumption of hazard models is noninformative censoring (ie, the mechanism that causes censoring of individuals ought not to be related to the probability of an event occurring). Because younger individuals at interview are less likely to have initiated smoking and more likely to be censored, we focused our analysis on individuals who were 16 to 19 years of age at interview. To explore potential differences between sex and SES, we included a series of interactions. Our preferred specification included interactions between price and sex, price and SES (mother's educational level and school type), Law 20105 and sex, Law 20105 and SES, and price and Law 20105. This specification imposes fewer functional form assumptions and is preferable to conducting tests to compare coefficients estimated from independent regressions.<sup>31</sup>

To ensure that our results were robust to alternative specifications, we conducted a number of sensitivity checks. First, as a functional form for the baseline hazard function, in addition to using a cubic polynomial, we used a dummy specification for time at risk, measured in years. Second, we estimated discrete-time split population models because standard survival models assume that the probability of eventual failure is greater than zero for all individuals.<sup>32-34</sup> Third, we estimated all models with and without sampling weights. The use of weights in survival analysis is complex and sometimes controversial.<sup>35-37</sup> In our case, using survey weights allowed us to weight the individual responses so that they better represented the population; in retrospectively identifying the date of smoking onset, we assumed that the collection of individuals represented by each person represented a collection of individuals at the time that they were at risk of starting. The results were obtained without sampling weights because sampling weights were missing from 2 survey cycles. Fourth, variation in prices are correlated by construction with calendar time, which raises an identification problem.<sup>38</sup> Although it is generally not recommended to include a measure of calendar time in duration models, we followed Forster and Jones<sup>38</sup> and used a fourth-order polynomial (measured in years) to identify price effects by variations around this trend. We also estimated models that controlled for differing birth cohorts.<sup>39</sup> All models were estimated using Stata/MP, version 15.1 statis-

tical software (StataCorp). Split population models were estimated using *spsurv* developed by Stephen Jenkins.<sup>40</sup>

## Results

Data from a total of 181 624 survey respondents in 8751 Chilean secondary schools were included in the study. We present key descriptive statistics in **Table 1**. In the early 2000s, 82.5% of teens (16-19 years) in 2001 and 81.2% of teens (16-19 years) in 2003 (mean age, 13.5 years in both years) had initiated smoking. By the early 2010s, the proportion of teens who had started smoking had decreased substantially to 63.6% in 2011, 64.7% in 2013, and 65.4% in 2015, whereas the mean age of starters had increased to 14.2 years. In 2001, 41.4% attended public schools, 36.3% attended subsidized schools, and 22.3% attended private school. Throughout the decade, more teens attended subsidized schools than public and private schools. In 2001, a total of 50.1% of respondents were teenage boys, and 45.4% resided in the Santiago Metropolitan Region at interview. In 2015, a total of 50.3% of respondents were teenage boys, and 34.4% resided in the Santiago Metropolitan Region at interview.

**Table 2**, **Figure 2**, and eTables 1-3 in the **Supplement** present the regression results. Because the models estimated are nonlinear, the comparison of price elasticities and hazard ratios (HRs) between models with different sets of covariates should be made with caution.<sup>41,42</sup> Irrespective of the specifications, negative and statistically significant associations were found between cigarette prices and the hazard of smoking onset. Our preferred specification (model 5) suggested an own-price elasticity (a measure of the responsiveness of the demand for a good to a change in its own price) of  $-0.40$  (95% CI,  $-0.45$  to  $-0.36$ ) (ie, a 1% increase in cigarette prices was associated with 0.4% lower hazard of smoking onset) (**Table 2**). We found that teenage boys were more responsive to price than teenage girls ( $-0.50$  [95% CI,  $-0.56$  to  $-0.45$ ] vs  $-0.3$  [95% CI,  $-0.36$  to  $-0.25$ ]). Youths with higher SES were no more or less responsive to price than youths with lower SES (own-price elasticities for youths whose mother had an educational level of primary or less,  $-0.41$ ; 95% CI,  $-0.48$  to  $-0.34$ ; secondary or less,  $-0.44$ ; 95% CI,  $-0.49$  to  $-0.38$ ; more than secondary,  $-0.36$ ; 95% CI,  $-0.42$  to  $-0.30$ ; own-price elasticities for youths who attended a public school,  $-0.41$ ; 95% CI,  $-0.47$  to  $-0.35$ ; a subsidized school,  $-0.44$ ; 95% CI,  $-0.50$  to  $-0.38$ ; and a private school,  $-0.30$ ; 95% CI,  $-0.39$  to  $-0.20$ ). Irrespective of the specifications, youths had a lower hazard of smoking onset after the introduction Law 20105 in 2006 (HR, 0.83; 95% CI, 0.81-0.85). Teenage girls (HR, 0.78; 95% CI, 0.76-0.81) were more responsive to the policies introduced in Law 20105 than teenage boys (HR, 0.88; 95% CI, 0.85-0.91), but teens with lower SES were less responsive to these policies than teens with higher SES (HR for youths whose mother had an educational level of primary or less, 0.86; 95% CI, 0.83-0.91; more than secondary, 0.79; 95% CI, 0.76-0.82). In addition, we found a stronger association between prices and smoking onset before than after the introduction of Law 20105 ( $-0.45$  [95% CI,  $-0.51$  to  $-0.40$ ] vs  $-0.30$  [95% CI,  $-0.35$  to  $-0.25$ ]).

Table 1. Characteristics of the Individuals Aged 16 to 19 Years at Interview<sup>a</sup>

Characteristic	Year							
	2001	2003	2005	2007	2009	2011	2013	2015
Age when starting smoking, mean (SD), y	13.5 (1.8)	13.5 (1.9)	13.6 (1.9)	13.7 (1.9)	13.8 (1.8)	14.0 (1.7)	14.1 (1.8)	14.2 (1.8)
Smoking onset	82.5	81.2	77.9	79.4	76.5	63.6	64.7	65.4
Male	50.1	48.9	49.7	48.9	48.7	49.7	49.7	50.3
Age, y								
16	37.9	38.0	43.8	43.1	42.2	42.0	40.7	40.3
17	37.6	38.0	38.6	38.3	39.1	37.8	36.7	37.3
18	19.8	20.3	15.1	16.1	16.0	17.5	18.9	18.8
19	4.7	3.8	2.5	2.4	2.6	2.7	3.8	3.6
Mother's educational level								
Primary or less	29.1	25.5	25.1	23.0	23.2	19.4	21.4	19.5
Secondary or less	44.4	42.3	42.6	44.0	43.2	39.1	40.2	40.1
More than secondary	26.5	32.3	32.4	33.0	33.6	41.5	38.4	40.4
School type								
Public	41.4	39.2	39.7	40.5	36.2	35.3	40.5	41.6
Subsidized	36.3	44.5	44.3	51.8	48.4	42.5	43.7	43.6
Private	22.3	16.3	16.1	7.6	15.4	22.2	15.8	14.8
Region								
Arica, Parinacota, Tarapacá	3.2	3.0	3.0	3.4	3.4	2.7	3.2	3.2
Antofagasta	3.0	3.0	2.9	3.5	4.1	3.0	2.4	2.0
Atacama	2.3	2.1	2.2	1.6	1.8	2.3	2.3	2.2
Coquimbo	4.0	3.6	3.9	3.7	4.1	4.0	2.9	3.0
Valparaíso	11.5	12.3	11.0	10.6	11.3	15.0	10.5	12.6
O'Higgins	3.5	3.6	2.5	3.6	3.5	6.6	7.8	6.5
Maule	5.7	5.0	6.7	5.3	6.3	7.5	7.5	7.5
Biobío	11.8	12.0	10.7	11.4	12.6	11.7	11.2	12.0
Araucanía	2.6	2.9	2.9	3.9	4.4	5.9	6.1	5.9
Los Lagos	4.9	4.5	5.0	4.6	5.3	5.5	9.6	8.1
Aysén	0.8	0.8	0.9	0.8	1.2	1.7	1.6	1.2
Magallanes	1.4	1.2	1.5	0.7	1.1	1.2	1.9	1.5
Metropolitana de Santiago	45.4	46.3	46.8	47.1	41.0	33.0	33.0	34.4
No. of individuals	26 167	26 039	21 896	21 964	20 401	13 926	25 966	25 265
No. of schools	1011	1046	1079	1119	1137	738	1326	1295
No. of observations	2 058 414	2 039 797	1 760 556	1 774 302	1 691 441	1 240 360	2 334 393	2 278 573

<sup>a</sup> Data are presented as percentage of survey respondents unless otherwise indicated.

Results presented in eTable 2 and eTable 3 in the Supplement suggest the importance of not examining policy changes in isolation. Inclusion of variables to capture the association of prices and Law 20105 yielded an own-price elasticity and an HR for Law 20105 that were statistically significantly different than when policy changes were examined in isolation.

Overall, our price results were robust to alternative specifications. Our estimates of the association between Law 20105 and smoking onset were, however, sensitive to the inclusion of a calendar time trend and a measure that captures differing birth cohorts. These specifications yielded estimates that were not statistically significantly different from zero.

## Discussion

The findings suggest that higher prices and the tobacco control policies enacted in 2006 were associated with lower hazards of starting smoking. Our results add to the increasing evidence that higher cigarette prices are associated with reduced hazard of starting smoking in LMICs.<sup>18,19,43-49</sup>

Studies<sup>4,50,51</sup> that examine the regressivity of tobacco taxation typically assume, based mostly on evidence from high-income countries, that individuals with low SES are more responsive to price changes. Evidence from LMICs is, however, mixed, and estimates vary widely among studies.<sup>4</sup> Our re-

**Table 2. Discrete-Time Complementary loglog (cloglog) Duration Models of Smoking Initiation Among Individuals Aged 16 to 19 Years at Interview<sup>a</sup>**

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
<b>Own-price elasticities, estimate (95% CI)<sup>b</sup></b>					
All	-0.36 (-0.40 to -0.32)	-0.37 (-0.41 to -0.33)	-0.36 (-0.40 to -0.32)	-0.40 (-0.44 to -0.35)	-0.40 (-0.45 to -0.36)
<b>Sex</b>					
Female	NA	-0.27 (-0.32 to -0.22)	NA	NA	-0.30 (-0.36 to -0.25)
Male	NA	-0.47 (-0.52 to -0.42)	NA	NA	-0.50 (-0.56 to -0.45)
<b>Mother's educational level</b>					
Primary or less	NA	NA	-0.37 (-0.44 to -0.30)	NA	-0.41 (-0.48 to -0.34)
Secondary or less	NA	NA	-0.40 (-0.45 to -0.35)	NA	-0.44 (-0.49 to -0.38)
More than secondary	NA	NA	-0.32 (-0.38 to -0.26)	NA	-0.36 (-0.42 to -0.30)
<b>School</b>					
Public	NA	NA	-0.37 (-0.42 to -0.31)	NA	-0.41 (-0.47 to -0.35)
Subsidized	NA	NA	-0.40 (-0.45 to -0.34)	NA	-0.44 (-0.50 to -0.38)
Private	NA	NA	-0.26 (-0.36 to -0.17)	NA	-0.30 (-0.39 to -0.20)
<b>Law 20105</b>					
Before	NA	NA	NA	-0.44 (-0.50 to -0.38)	-0.45 (-0.51 to -0.40)
After	NA	NA	NA	-0.30 (-0.35 to -0.25)	-0.30 (-0.35 to -0.25)
<b>Law 20105 (August 2006), HR (95% CI)</b>					
All	0.85 (0.83 to 0.87)	0.85 (0.83 to 0.87)	0.85 (0.83 to 0.87)	0.83 (0.81 to 0.85)	0.83 (0.81 to 0.85)
<b>Sex</b>					
Female	NA	0.80 (0.78 to 0.83)	NA	NA	0.78 (0.76 to 0.81)
Male	NA	0.90 (0.88 to 0.93)	NA	NA	0.88 (0.85 to 0.91)
<b>Mother's educational level</b>					
Primary or less	NA	NA	0.90 (0.85 to 0.93)	NA	0.86 (0.83 to 0.91)
Secondary or less	NA	NA	0.87 (0.84 to 0.90)	NA	0.84 (0.82 to 0.88)
More than secondary	NA	NA	0.80 (0.77 to 0.83)	NA	0.79 (0.76 to 0.82)
<b>School</b>					
Public	NA	NA	0.88 (0.85 to 0.92)	NA	0.86 (0.83 to 0.90)
Subsidized	NA	NA	0.85 (0.82 to 0.88)	NA	0.83 (0.80 to 0.86)
Private	NA	NA	0.78 (0.73 to 0.83)	NA	0.76 (0.71 to 0.81)

Abbreviations: HR, hazard ratio; NA, not applicable.

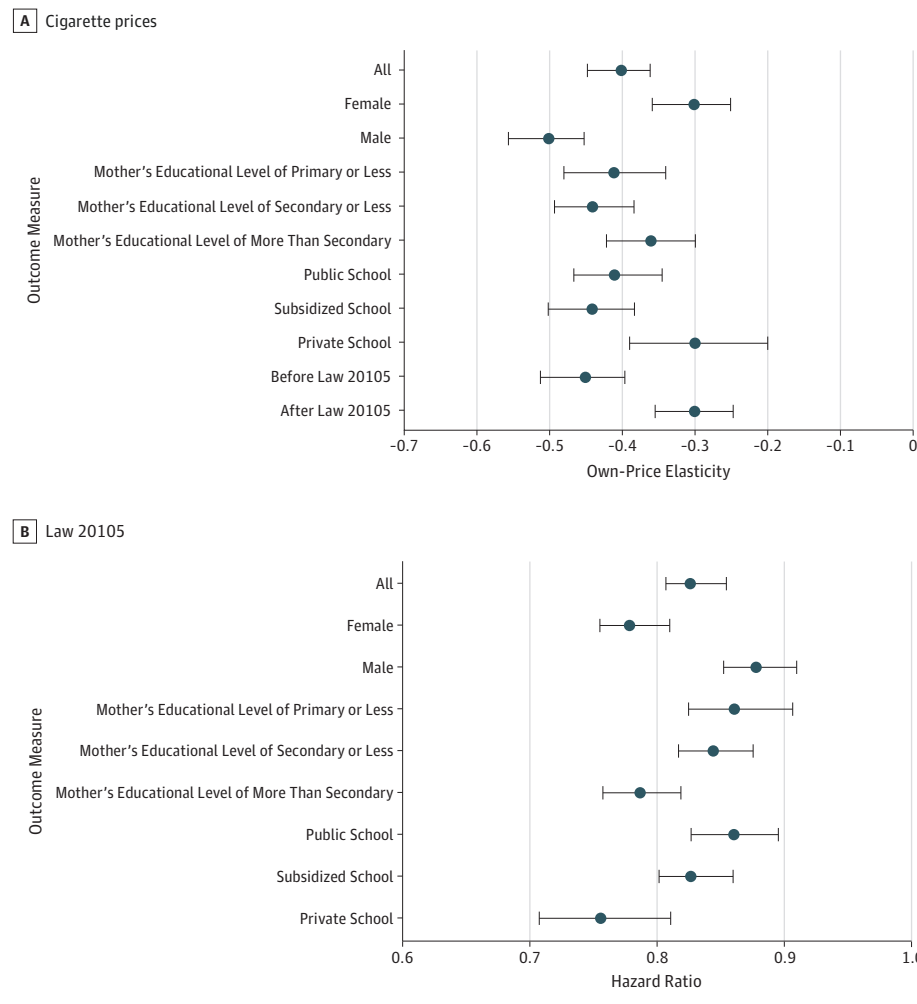
<sup>a</sup> All models adjusted for regions; time dependence modeled using a cubic polynomial; SEs clustered at the school level; number of observations, 15 177 836; number of individuals, 181 624; and number of failures, 135 019.

<sup>b</sup> Own-price elasticity is a measure of the responsiveness of the demand for a good to a change in its own price; more precisely, it represents the percentage change in quantity demanded in response to a 1% change in price.

sults do not suggest that teens with low SES were more responsive to price increases. A recent Argentine study<sup>19</sup> that used a similar approach found comparable results. Given the importance of the assumption that price responsiveness differs among groups with differing SES, more research is warranted. Our results support the importance of not examining tobacco control policies in isolation. A previous study,<sup>20</sup> which used an interrupted time-series approach, examined the association of Law 20105 with smoking prevalence and found a greater decrease in smoking prevalence among individuals aged 12 to 18 years than among those aged 19 to 24 years. This study, however, failed to account for increasing cigarette prices. These results are only valid if price responsiveness does not vary with age, although current evidence suggests that price responsiveness decreases with age.<sup>4,9</sup>

Despite finding that both higher prices and nonprice measures, such as advertising and sale restrictions (most of which are targeted at youth), enacted in 2006 were associated with decreased hazards of starting smoking, our results suggest that the price increases initiated by BAT outweighed the association of nonprice measures. We found that an increase in real prices of 58.6% and the introduction of Law 20105 were associated with similar lower hazards of starting smoking; in comparison, between 1999 and 2017, inflation-adjusted cigarette prices increased by 206%. The addictive nature of cigarettes presents manufacturers with a tradeoff between short- and long-run profits. On one hand, cigarette manufacturers may raise prices to obtain higher profit from current, addicted smokers. On the other hand, manufacturers may forgo short-run profits to hook users for the purposes of increasing long-run profits (by increasing future

**Figure 2. Differences in the Associations of Cigarette Prices and Tobacco Control Policies According to Sex, Socioeconomic Status, and Period Before vs After Law 20105**



A, Differences in the association between cigarette prices and smoking onset. Own-price elasticity is a measure of the responsiveness of the demand for a good to a change in its own price; more precisely, it represents the percentage change in quantity demanded in response to a 1% change in price. B, Differences in the association between Law 20105 and smoking onset.

demand).<sup>52</sup> In the 2000s and early 2010s, BAT's large and sustained price increases suggest that BAT aimed to maximize short-run profits even if they came at the expense of fewer new young users becoming addicted. Three characteristics of the Chilean market have made BAT's pricing strategy possible and ultimately successful at increasing short-term profits: (1) 92% to 98% control of the cigarette market by BAT, (2) high smoking prevalence and consumption, and (3) inelastic demand for cigarettes (ie, an increase in price leads to an increase in revenue because the association with price is proportionally larger than the association with quantity). The Chilean operating revenues of BAT more than doubled between 2003 and 2013.<sup>53,54</sup>

The tobacco industry in general and BAT in particular ceaselessly argue that higher cigarette taxes inevitably lead to increased contraband.<sup>55</sup> The pricing strategies of BAT in the past 2 decades cast doubt on the truthfulness of that argument. It is disingenuous to submit that higher prices via higher taxes inescapably lead to increased contraband but not higher prices driven by manufacturers. If anything, BAT's pricing strategy inadvertently provides support for large cigarette tax increases.

**Limitations**

First, our own-price elasticity estimates are robust across specifications and fairly precisely estimated. However, our estimates of the association of Law 20105 with smoking onset are sensitive to some specifications. Second, because the assumption of noninformative censoring is invalid for the youngest respondents, we only included those who were at least 16 years of age at interview. Our approach, however, may not fully address this issue. As a sensitivity check, we estimated models with individuals who were 17 to 19 years of age and 18 to 19 years of age at interview and obtained estimates that suggested even larger associations for cigarette prices and similar associations for Law 20105. Third, our measure of cigarette prices represent mean cigarette price changes over time. However, price changes may have differed among brands in the 1990s, 2000s, and early 2010s. In addition, Chile's socioeconomic and cultural characteristics as well as the industrial organization of its tobacco industry may limit the generalizability of our findings.

## Conclusions

The findings suggest that higher prices and the tobacco control policies enacted in 2006 were associated with lower haz-

ards of starting smoking in Chile. Large cigarette tax increases may be a strategy that can be used to help reduce smoking among youths in Chile.

## ARTICLE INFORMATION

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