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Prices, alcohol use initiation and heavy episodic drinking among Chilean youth

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ABSTRACT

Aims To examine the association between alcohol prices and age of initiation of alcohol use and the association between age of alcohol use initiation and heavy episodic drinking (HED) among adolescents in Chile. **Design** We estimated discrete-time hazard models using retrospective data and generalized ordered probit models with repeated cross-sectional data. **Setting** Chile. **Participants** A total of 248 336 urban youth who attended secondary school between 2003 and 2015 and self-reported ever having tried alcohol. **Measurements** We created drinking histories from self-reported responses of age, age of alcohol use initiation and year/month of survey. From two self-reported responses, we created a four-category ordinal variable of heavy episodic drinking: none, one to two, three to nine and more than 10 HED episodes in the past 30 days. We constructed a monthly measure of real alcohol prices using the all-items and alcohol component of the Consumer Price Index compiled by Chile's statistical agency, the Instituto Nacional de Estadísticas. **Findings** First, we found negative, statistically significant and policy-meaningful associations between alcohol prices and the age of alcohol use initiation. The estimated price elasticity of delay was −0.99 [95% confidence interval (CI) = −1.30, −0.69]. A 10% increase in real alcohol prices was associated with delayed alcohol use initiation of approximately 6.6 months. Secondly, we found that youth who had started drinking alcohol at a later age had statistically significant and substantially lower probabilities of having reported HED during the previous month. For example, youth who started drinking at 16 were 4.9 (95% CI = 4.2–5.6) percentage points more likely to have reported no HED in the previous month relative to youth who started drinking alcohol when aged 12 years or younger. **Conclusions** Increasing the price of alcohol products may delay alcohol initiation among young people in Chile. Chilean youth who start drinking alcohol later may engage in less harmful drinking practices.

Keywords Alcohol, Chile, duration analysis, initiation, Latin America, onset, price, survival analysis.

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INTRODUCTION

There is evidence that early initiation of alcohol consumption is associated with later harmful alcohol consumption, such as heavy episodic drinking (HED) [1–3], in particular in young adolescents [3–6]. HED, generally defined as five or more standard drinks (or 60 g of pure alcohol) for men and four or more standard drinks for women on at least one occasion in the past 30 days, can have serious health and safety consequences for youth. HED has been associated with short-term consequences such as impaired driving, injuries and violence and long-term consequences such as cognitive, structural and functional brain changes in youth and liver disease [7]. HED has also been found to increase the likelihood of developing later excessive consumption habits [8].

Given the potentially long-lasting consequences of early alcohol consumption, public health policies that can prevent or delay initiation are warranted. Price and tax policies have been shown to be effective at reducing tobacco and alcohol use in low-, middle- and high-income countries [9–15]. The evidence is, however, surprisingly scarce in the case of alcohol. In particular, recent systematic reviews have failed to identify a single study that assessed

the impact of prices or taxes on the onset of alcohol use [12–15].

Globally, marked differences in consumption levels and consumption patterns are related to socio-economic status (SES) [16,17] and sex [18,19]. The level of economic development also plays a role, as people in high-income countries tend to drink more, but suffer the harmful effects of alcohol less, than those in low- and middle-income countries [14,20]. In the Americas, alcohol use often begins before the age of 15 years and the prevalence of alcohol use among 15-year-old students generally ranges from 50 to 70% [21]. In Chile, alcohol consumption patterns are particularly concerning. For example, the 30-day prevalence of HED among males aged 15+ was approximately 35% in 2016 and exceeded 50% among 15–19-year-old male drinkers [21]. Alcohol consumption in the 13–17-year age group (high school teens) in Chile is also worrisome, as the alcohol month-prevalence has remained stable at approximately 35–43% from 2001 to 2015. In this group, teenage girls had the same month-prevalence as teenaged boys, although they were less likely to engage in HED [22]. Although selling alcohol to minors is illegal in Chile, enforcement is weak; in 2015, almost half of high school students reported that it was easy or very easy to buy alcohol, a proportion that has increased over time [22].

Our objectives were first, to examine the association between alcohol prices and age of initiation of alcohol use and explore if price responsiveness varied by SES or sex and secondly, to examine the association between alcohol use initiation and HED episodes among adolescents in Chile.

METHODS

We used seven waves of the Estudio Nacional de Drogas en Población Esclar, a national and regionally representative bi-annual urban survey of 8th–12th grade students (typically, ages 13–17) conducted between 2003 and 2015 [22]. A common sampling strategy and similar questionnaires were used in all survey waves. A two-stage cluster sample design was used. At the first stage, the probability of grades being selected was proportional to the number of students enrolled in each grade, within each administrative region. At the second sampling stage, students within the selected grades were randomly selected. We used data only for teens who had reported ever having tried an alcoholic beverage (between approximately 70 and 80% of all respondents, depending on survey waves) and excluded missing and nonsensical data (approximately 4% of the sample). Our pooled sample included observations from 248 336 Chilean youth. Research Ethics Board approval was not required for analyses of secondary data sets that had been de-identified [23]. Data from the Estudio Nacional de Drogas en Población Escolar are available from the Servicio Nacional para la Prevención y Rehabilitación del Consumo de Drogas y Alcohol (SENDA): https://www.senda.gob.cl/observatorio/areas-de-estudio/poblacion-escolar/. Price data are available from the Instituto Nacional de Estadística de Chile (INE): https://www.ine.cl/estadisticas/economia/indices-de-precio-e-inflacion. Stata do and log files are available at: doi: 10.17605/OSF.IO/B9CYJ (https://osf.io/b9cyj/).

As outcome variables, we first created a measure of the age of alcohol onset from the self-reported response to the question: 'Qué edad tenías cuando probaste por primera vez alguna bebida alcohólica? No consideres si tu padre, madre o una persona adulta te dieron a probar siendo niño/niña' ['How old were you when you first tried an alcoholic beverage of any type? Do not consider times when your father, your mother or an adult may have given you some to try as a child']. Using responses from the above question and month of interview we randomly selected, using a uniform distribution, the year and month of alcohol onset within each interval for each ever alcohol user. As a sensitivity check, we also used the mid-point of the interval. We also estimated models using annual data instead of monthly data. We assumed that individuals were first exposed to the risk of starting to drink alcohol at age 8 (very few respondents reported having started drinking alcohol before 8 years of age, and some who did may have reported such a low age of initiation in error). As a sensitivity check, we also assumed that individuals were first exposed to the risk of starting to drink alcohol at age 5, the lowest age for alcohol onset reported. Secondly, we created a measure of heavy episodic drinking (HED) from two questions: (1) we used responses to the question 'Cuántos días te ha pasado tomar más de la cuenta y te has emborrachado durante los últimos 30 días? ['On how many days did you drink too much and get drunk over the past 30 days?'], with a continuous response scale (0–30 days); and (2) we used responses to the question 'Cuántas veces te has emborrachado o intoxicado tomando alcohol, por ejemplo tambalearse al caminar, no ser capaz de hablar bien, vomitar o no recordar qué ocurrió?' ['How many times did you get drunk or intoxicated with alcohol, for example tottering while walking, not being able to speak clearly, vomiting or not remembering what happened?'], with response categories in the last month: never, one to two, three to five, six to nine, 10–19, 20–39 and 40 or more times. The first question was used up to 2009; the second from 2011. We combined responses to both questions and created a common four-category ordinal variable: none, one to two, three to nine and more than 10 HED episodes in the past 30 days.

We constructed a monthly measure of real alcohol prices using the all-items and alcohol component of the Consumer Price Index (CPI) compiled by the Instituto Nacional de Estadísticas (INE). The alcohol CPI basket is

composed of beer (approximately 50%), wine (approximately 33%) and distilled beverages.

We used two measures of SES. First, we used a measure of mother's education levels (three binary indicators: primary or less, secondary or less, more than secondary). Secondly, we used the type of schools attended by Chilean youth: public (pública municipal), subsidized (privada subvencionada) and private (privada pagada). Public schools are free and attract students from mainly low- and lower-middle income families. Subsidized schools are private institutions but supported by government vouchers to families. Subsidized schools are mainly attended by children of middle-income families. Private schools receive no government funding and are mainly attended by students from high-income families. Data from the 2015 Chilean household survey (Encuesta de Caracterización Socioeconómica Nacional, CASEN) indicated that approximately 40% of those who attended public schools belonged to the lowest income quintile, while 88% belonged to the lowest three quintiles. For publicly subsidized schools those figures were 26 and 75%. Of those attending private schools, 56% came from the top quintile and 73% from the top two quintiles [24]. Finally, we included, as additional covariates, dichotomous indicators for sex and administrative regions. Two regions were split in 2007, increasing the number of regions from 13 to 15; we used the original 13 administrative regions. Unlike US states or Canadian provinces, administrative regions in Chile have limited regulatory powers. There are, however, substantial socio-economic differences between regions.

First, we used time-to-event analysis to examine the association between alcohol prices and age of alcohol use initiation. Specifically, we used discrete-time hazard models with a complementary log-log (clog-log) specification [25,26]. Unlike probit or logit, for which the response curve is symmetrical, the clog-log model has a response curve that is asymmetrical [25]. We log-transformed the price variable (using the natural logarithm) so that estimated price coefficients represent the own-price elasticity of delay. An own-price elasticity is a measure of the responsiveness of the demand for a good to a change in its own price. In our case, the price elasticities can be interpreted as measuring the proportionate change in months before starting, given a proportionate change in the real price of alcohol; a negative coefficient indicating that the hazard rate or risk of event is delayed for higher values of prices. We modelled the baseline hazard using a cubic polynomial specification for time at risk, measured in months. As a sensitivity check, we used a more flexible approach, a dummy specification for time at risk, measured in years. We first estimated a model without any measures of SES. Secondly, we included two measures of SES (mother's education and type of school). Thirdly, we included interactions to explore differences between sex and SES.

We then used ordered probit models to examine the association between early alcohol initiation and later HED among adolescents in Chile. Implicit in ordinal regression models is the parallel-lines assumption, which requires that separate equations for each category differ only in their intercepts (i.e. the slopes are assumed to be the same when going from one category to the next) [27]. We used a likelihood-ratio test to assess the parallel-lines assumption and found that it was violated [28]. We proceeded to use generalized ordered probit models that relax the parallel-lines assumption [29]. In addition to age of alcohol use initiation, we included as covariates sex, SES and regions. Because the questions used to construct our measure of HED differed slightly between 2003 and 2009 and 2011 and 2015, we re-examined the association between age of alcohol initiation and HED by splitting our pooled sample.

All estimations were conducted using Stata version 15.1/MP with standard errors (SE) clustered at school level. We did not use sampling weights, as they were missing in the 2005 and 2009 data files. The primary research questions and analysis plan were not pre-registered on a publicly available platform. Consequently, results should be considered exploratory.

RESULTS

Table 1 shows descriptive statistics for respondents who had started drinking, by survey year. On average, age of alcohol initiation was approximately 13.5 years, approximately 20–25% reported at least one HED in the past month, 50% were female, and more (between 34 and 47%) resided in the Santiago Metropolitan Region at interview. Time trends in SES differed by measures. The proportion of respondents for each type of school remained relatively constant (approximately 33–39% attended public schools, 42–54% attended subsidized schools and 8–17% attended private school), while the proportion of respondents whose mothers had completed secondary school increased from 34 to 44%.

Figure 1 presents inflation-adjusted alcohol prices and a measure of alcohol affordability (the ratio of wages in the formal sectors of the economy to the CPI alcohol component). From the early 1990s, alcohol prices have been fairly stable, fluctuating by less than 10%. By 2015, real alcohol prices were approximately 5% lower than they were in 2000. Affordability, however, rose sharply. By 2015, alcohol products were approximately 85% more affordable than they were in 2000; on average, Chileans needed to work substantially less to buy an average basket of alcoholic beverages.

Table 1 Descriptive statistics.

	2003	*2005*	*2007*	*2009*	*2011*	*2013*	*2015*
Age of onset, mean	13.4	13.4	13.4	13.4	13.5	13.5	13.5
Standard deviation	2.1	2.1	2.0	2.2	2.1	2.1	2.2
Age at interview, mean	15.7	15.2	15.4	15.5	15.5	15.6	15.6
Standard deviation	1.6	1.5	1.5	1.5	1.5	1.5	1.5
	%	%	%	%	%	%	%
Life-prevalence alcohol	78.6%	71.2%	75.0%	73.8%	78.8%	79.5%	78.2%
Past-month heavy episodic drinking (HED)	24.8%	21.1%	22.7%	22.4%	20.0%	21.2%	20.9%
Past-month HED							
No HED	75.2%	78.9%	77.3%	77.6%	80.0%	78.8%	79.1%
1–2 HED episodes	16.0%	14.0%	14.6%	13.6%	13.9%	15.2%	14.3%
3–9 HED episodes	6.5%	5.2%	5.7%	5.6%	4.8%	4.8%	5.0%
10 or more HED episodes	2.3%	1.9%	2.4%	3.2%	1.3%	1.2%	1.6%
Sex: female	50.6%	51.4%	51.3%	51.7%	50.7%	50.7%	50.4%
School type							
Public municipal	37.9%	38.9%	38.3%	34.2%	33.5%	37.6%	38.3%
Private subsidized	45.0%	45.2%	53.5%	50.0%	41.6%	44.8%	44.8%
Private not subsidized	17.1%	15.9%	8.2%	15.8%	24.9%	17.6%	16.9%
Education, mother							
Primary	23.4%	23.2%	20.6%	21.5%	17.6%	19.3%	17.9%
Secondary	42.3%	42.5%	44.2%	41.8%	36.7%	38.7%	38.5%
> Secondary	34.3%	34.3%	35.2%	36.7%	45.7%	42.0%	43.6%
Region							
Arica, Parinacota y Tarapaca	2.8%	2.7%	3.1%	3.3%	2.8%	3.1%	3.3%
Antofagasta	2.8%	2.9%	3.3%	4.0%	3.0%	2.3%	1.9%
Atacama	2.0%	2.1%	1.6%	1.9%	2.5%	2.3%	2.3%
Coquimbo	3.6%	3.8%	3.7%	4.3%	3.5%	2.6%	2.9%
Valparaíso	12.3%	11.1%	10.9%	10.8%	14.1%	11.0%	12.0%
O'Higgins	3.4%	2.5%	3.5%	3.8%	6.3%	7.6%	6.8%
Maule	4.9%	6.4%	4.9%	5.8%	6.9%	7.0%	6.9%
Biobio	11.7%	10.9%	10.6%	11.5%	12.4%	11.0%	11.7%
Araucanía	2.9%	2.5%	3.7%	4.4%	5.7%	6.1%	5.7%
Los Lagos	4.4%	4.9%	4.4%	5.4%	5.9%	9.3%	8.0%
Aysén	0.7%	0.7%	0.7%	1.1%	1.5%	1.4%	1.2%
Magallanes	1.1%	1.3%	0.8%	1.1%	1.4%	1.8%	1.7%
Metropolitana de Santiago	47.4%	48.2%	49.0%	42.7%	34.1%	34.6%	35.6%
No. of observations	38764	39610	33832	31273	23388	42507	38962

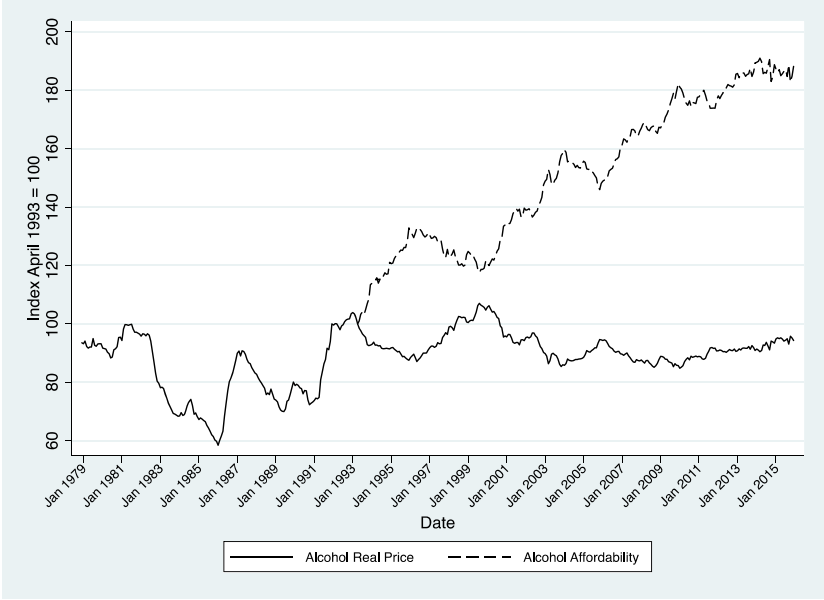
The association between alcohol prices and age of onset of alcohol use

Table 2 and Fig. 2 present the complementary log-log regression results. We found, irrespective of the specifications, negative and statistically significant associations between alcohol prices and the age of alcohol use onset. The estimated price elasticities of delay fell in a narrow range of approximately −1.0. Our preferred estimates (Table 2, models 2 and 3) indicate that a 1% increase in real alcohol prices was associated with a 1% [95% confidence interval (CI) = −1.31 to −0.70] and 0.99% (95% CI = −1.30 to −0.69) delay in the hazard of starting drinking alcohol. Put differently, we found that a 10% increase in real prices was associated with delayed alcohol use initiation of approximately 6.6 months. We found that teenage girls were more responsive to price than teenage boys ($\chi^2_{(1)} = 5.2$, $P = 0.02$). We also found that that lower SES teens were, if anything, more responsive to price (mother's education, $\chi^2_{(2)} = 31.9$, $P = 0.00$; type of school, $\chi^2_{(2)} = 3.6$, $P = 0.17$).

We found that teenage girls started drinking alcohol later than boys, that lower-SES teens started earlier than higher-SES teens and that teens who resided in the Santiago Metropolitan Region started earlier. In general, we found no appreciable differences between our main price elasticity results and alternative specifications (see Supporting information, Table S1).

The association between age of alcohol initiation and HED

Table 3 and Fig. 3 present the results of the generalized ordered probit models that examined the association between early alcohol initiation and subsequent HED among



Source: Instituto Nacional de Estadísticas (INE)

Figure 1 Real price and affordability of alcohol in Chile. April 1993 = 100. Source: Instituto Nacional de Estadísticas (INE) [Colour figure can be viewed at wileyonlinelibrary.com]

adolescents. We present marginal effects (i.e. the difference in the adjusted predictions between groups, e.g. male and female). For example, for a categorical variable, column 1 shows the difference in the predicted probabilities (in percentage points) of not having reported any HED versus at least one HED during the previous month for cases in one category relative to the reference category. Similarly, column 2 shows the difference in the predicted probabilities (in percentage points) of having reported one to two HED versus no HED or three or more HED during the previous month for cases in one category relative to the reference category.

Our results clearly show that youth who started drinking alcohol at a later age had lower probabilities of having reported more HED during the previous month. For example, youth who started drinking at ages 15, 16 and 17 + were 1.9 (95% CI = 1.3–2.4), 4.9 (95% CI = 4.2–5.6) and 7.2 (95% CI = 6.2–8.2) percentage points more likely to have reported no HED in the previous month; and 1.6 (95% CI = −1.8 to −1.4), 2.1 (95% CI = −2.3 to −1.8) and 1.6 (95% CI = −1.9 to −1.3) percentage points less likely to have reported 10 or more HED in the previous month, relative to youth who had started drinking alcohol when 12 years old or less.

We found that teenage girls were more likely to have reported no HED (by 4.7%, 95% CI = 4.3–5.1 percentage points) and less likely to have reported 10 or more HED in the previous month (by 1.5 percentage points: 95% CI = −1.6 to −1.3) relative to teenage boys. Lastly, we found that higher SES youth tended to have higher probabilities of reporting no HED in the previous month relative to lower SES youth and lower probabilities of reporting 10 or more HED. These differences were, however, fairly small.

Figure 3 presents predicted probabilities (predicted probabilities calculated by setting each of the other covariates to their respective sample observed relative frequencies); the top panel shows the predicted probabilities of reporting no HED in the previous month by age of alcohol onset; the bottom panel shows the predicted probabilities of reporting one to two, three to nine and 10+ HED in the previous month by age of alcohol onset. Youth who reported having started drinking alcohol before age 15 were significantly less likely to have reported no HED in the previous month relative to youth who started drinking at 15, 16 and 17 (approximately 0.76–0.78 versus. 0.79, 0.82 and 0.84). Similarly, in general, youth who started drinking alcohol later reported fewer multiple HED in the previous month.

We found no appreciable differences in estimated marginal effects and predicted probabilities when we split our pooled sample into two (i.e. using data from 2003 to 2009 and 2011 to 2015 instead of pooled sample, from 2003 to 2015) (Supporting information, Figs S1 and S2).

DISCUSSION

Main findings

First, we found negative, statistically significant and policy-meaningful associations between alcohol prices and the age of alcohol use initiation. We found that a 10% increase in real prices was associated with delayed

Table 2 Discrete-time complementary log-log duration models of alcohol use initiation.

	(1) *HR*	*(2)* *HR*	*(3)* *HR*
Real alcohol prices (in ln)	0.34 (0.25; 0.47)	0.36 (0.27; 0.49)	0.30 (0.20; 0.45)
Sex (ref. male)	0.98 (0.97; 1.00)	0.99 (0.98; 1.00)	6.22 (1.27; 30.34)
School type (ref, public)			
Subsidized		1.05 (1.03; 1.07)	2.98 (0.23; 37.49)
Private		1.04 (1.01; 1.06)	0.13 (0.01; 4.40)
Education, mother (ref, primary)			
Secondary		1.05 (1.03; 1.06)	0.36 (0.06; 2.10)
> Secondary		1.13 (1.11; 1.14)	0.01 (0.00; 0.85)
Region (ref, Santiago)			
Arica, Parinacota y Tarapaca	0.89 (0.85; 0.93)	0.88 (0.84; 0.93)	0.88 (0.84; 0.93)
Antofagasta	0.86 (0.82; 0.90)	0.86 (0.82; 0.90)	0.86 (0.82; 0.91)
Atacama	0.90 (0.85; 0.95)	0.90 (0.85; 0.95)	0.90 (0.85; 0.95)
Coquimbo	0.92 (0.88; 0.96)	0.93 (0.89; 0.97)	0.93 (0.89; 0.97)
Valparaíso	0.94 (0.91; 0.97)	0.94 (0.91; 0.97)	0.94 (0.91; 0.97)
O'Higgins	0.90 (0.86; 0.93)	0.91 (0.87; 0.94)	0.91 (0.87; 0.94)
Maule	0.90 (0.86; 0.93)	0.91 (0.87; 0.94)	0.91 (0.87; 0.94)
Biobio	0.94 (0.91; 0.97)	0.95 (0.92; 0.98)	0.95 (0.92; 0.98)
Araucanía	0.99 (0.94; 1.03)	1.00 (0.96; 1.04)	1.00 (0.96; 1.04)
Los Lagos	0.94 (0.90; 0.97)	0.94 (0.91; 0.98)	0.94 (0.91; 0.98)
Aysén	0.84 (0.77; 0.91)	0.85 (0.78; 0.92)	0.85 (0.78; 0.92)
Magallanes	0.90 (0.84; 0.97)	0.90 (0.84; 0.96)	0.90 (0.84; 0.96)
Duration dependency			
t	1.03 (1.02; 1.03)	1.03 (1.03; 1.03)	1.03 (1.03; 1.03)
t^2	1.00 (1.00; 1.00)	1.00 (1.00; 1.00)	1.00 (1.00; 1.00)
t^3	1.00 (1.00; 1.00)	1.00 (1.00; 1.00)	1.00 (1.00; 1.00)
Interactions			
Price × sex			0.76 (0.58; 0.96)
Price × subsidized			0.85 (0.58; 1.25)
Price × private			1.37 (0.80; 2.34)
Price × secondary			1.18 (0.90; 1.53)
Price × > secondary			2.26 (1.62; 3.15)
Constant	0.99 (0.13; 7.68)	0.64 (0.08; 4.87)	2.50 (0.17; 37.31)
Own-price elasticity			
All	−1.06 (−1.36; −0.75)	−1.01 (−1.31; −0.70)	−0.99 (−1.30; −0.69)
Female			−1.13 (−1.48; −0.78)
Male			-0.84 (−1.13; −0.55)
School: public			−1.09 (−1.47; −0.71)
School: subsidized			−1.14 (−1.47; −0.81)
School: private			−0.38 (−0.90; 0.15)
Mother's education: primary			−1.41 (−1.75; −1.07)
Mother's education: secondary			−1.24 (−1.55; −0.94)
Mother's education: > secondary			−0.50 (−0.88; −0.12)

HR = hazard ratio; 95% confidence intervals in parentheses; number of individuals, 248 336; model 1: no adjustments for socio-economic status (SES); model 2: adjusted for SES (mother's education, school type); model 3: adjusted for SES and interactions (sex × price, SES × price).

alcohol use onset of approximately 6.6 months or that a 50% increase in real alcohol prices would delay onset by approximately 33 months, thereby raising the average age of onset from 13.5 to 16.2 years. These findings add to the extensive literature that suggests strong associations between alcohol taxes and prices and alcohol use [12–15]. Our results also suggest that girls and low-SES youth were probably more responsive to price changes than boys and youth of higher SES. To our knowledge, this is the first study to examine the association between prices and the age at which youth first drink alcohol. Secondly, having shown the policy relevance of price at delaying the onset of alcohol use, we studied the association between age of alcohol initiation and HED. We found that youth who started drinking alcohol at a later age had statistically significant lower probabilities of having reported HED during the

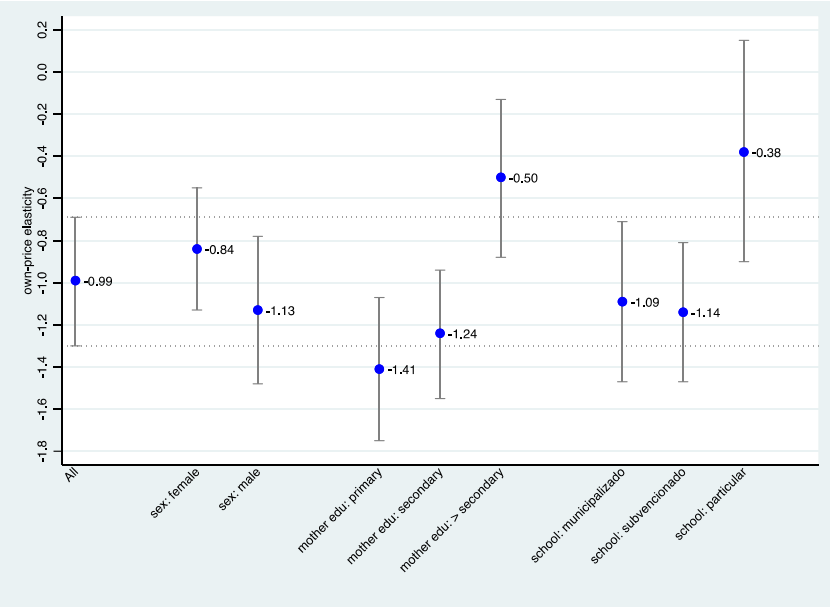


Figure 2 Own-price elasticity of delay, alcohol initiation in Chile [Colour figure can be viewed at wileyonlinelibrary.com]

previous month. We consider these associations large enough to be meaningful.

Limitations

First, using cross-sectional self-reported data to construct personal histories of alcohol initiation may introduce measurement error in the dependent variable [30]. The young age of respondents, however, probably reduced the possibility of such recall bias. Secondly, the price index used to construct our measure of alcohol prices was, until 2008, calculated using prices for the Metropolitan Santiago area only. The INE only recently began collecting prices in other major Chilean cities. Given that Chile's territory extends latitudinally over 4270 km, it is conceivable that alcohol products cost more in areas that are further away from the capital region. However, what matters is not price differences between regions but changes in relative prices (i.e. between alcohol and other goods and services) across time within regions. Additionally, we used a composite index of alcohol prices and consequently were unable to examine the association between specific types of alcohol beverages such as beer, wine and distilled alcohol and age of alcohol use initiation. Thirdly, although SES is inherently time-varying, we used time-invariant measures of SES in our duration analyses. Given the age of respondents, substantial changes in educational attainment of their mothers are unlikely. Changes between public, subsidized and private schools may have been more frequent, and these results should be interpreted with caution. Fourthly, we only examined youth who had reported ever having used alcohol. Consequently, our results are not generalizable to youth who have never tried alcohol. Chile's socio-economic and cultural characteristics also limit the generalizability of our findings.

Implications for policy

Our study suggests that increasing the price of alcohol products may delay alcohol initiation and that youth who start drinking alcohol later may engage in less harmful drinking practices. Given the health consequences associated with both early alcohol initiation and HED, price and tax policies that increase the price of alcohol products may have additional benefits to the well-documented benefits of price and tax policies, such as reduced alcohol-related mortality, traffic crash deaths and sexually transmitted disease [31].

Currently, a 19% value added tax (VAT) is applied on all alcohol products. An additional 20.5% tax is applied on beer and wine and an additional 31.5% is applied on distilled alcoholic beverages [32]. Excise alcohol taxes represent only approximately 15% of retail prices for beers and wines and 21% for distilled alcoholic beverages. These rates are substantially lower than those applied to tobacco products. During the first months of 2019, the best-selling brand of cigarettes in Chile (Pall Mall Blue Soft Cup) had an excise tobacco tax burden of 71% of its price. [33]

Assuming that alcohol producers fully pass on tax increases to consumers, to increase the retail price of alcoholic beverages by 50% the alcohol tax would need to increase more than fourfold for beer and wine and more than threefold for distilled alcoholic beverages. Such tax increases would bring the alcohol tax burden to only approximately 43–47% of the retail price, still significantly below cigarette's tax burden. Non-tax strategies to increase prices

Table 3 Association between early alcohol initiation and later heavy episodic drinking (HED): marginal effects.

	No HED versus ≥ 1 HED	*1–2 HED versus 0 HED, ≥ 3 HED*	*3–9 HED versus 0–2 HED, ≥ 10 HED*	*10 HEDversus < 10 HED*
Age of onset (ref, ≤ 12 years)				
13	0.008 (0.00; 0.01)	0.010 (0.00; 0.01)	−0.007 (−0.01; −0.00)	−0.011 (−0.01; −0.01)
14	0.002 (−0.00; 0.01)	0.020 (0.01; 0.02)	−0.009 (−0.01; −0.00)	−0.013 (−0.02; −0.01)
15	0.019 (0.01; 0.02)	0.016 (0.01; 0.02)	−0.019 (−0.02; −0.01)	−0.016 (−0.02; −0.01)
16	0.049 (0.04; 0.06)	0.004 (−0.00; 0.01)	−0.032 (−0.04; −0.03)	−0.021 (−0.02; −0.02)
≥ 17	0.072	−0.016 (−0.02; −0.01)	−0.040 (−0.05; −0.03)	−0.016 (−0.02; −0.01)
(0.06; 0.08)				
Sex (ref, male)	0.047 (0.04; 0.05)	−0.011 (−0.01; −0.00)	−0.022 (−0.02; −0.02)	−0.015 (−0.02; −0.01)
School type (ref, public)				
Subsidized	0.019 (0.01; 0.02)	−0.006 (−0.01; −0.00)	−0.007 (−0.01; −0.00)	−0.006 (−0.01; −0.00)
Private	−0.006 (−0.01; 0.00)	0.018 (0.01; 0.02)	−0.004 (−0.01; −0.00)	−0.008 (−0.01; −0.01)
Education, mother (ref, primary)				
Secondary	0.011 (0.01; 0.01)	−0.001 (−0.00; 0.00)	−0.005 (−0.01; −0.00)	−0.005 (−0.01; −0.00)
> Secondary	0.014 (0.01; 0.02)	−0.004 (−0.01; 0.00)	−0.006 (−0.01; −0.00)	−0.004 (−0.01; −0.00)
Region (ref, Santiago)				
Arica, Parinacota y Tarapaca	0.019 (0.00; 0.03)	−0.012 (−0.02; −0.00)	−0.006 (−0.01; 0.00)	−0.001 (−0.01; 0.00)
Antofagasta	0.024 (0.00; 0.03)	−0.020 (−0.03; −0.01)	−0.003 (−0.01; 0.00)	0.000 (−0.00; 0.00)
Atacama	−0.008 (−0.01; 0.01)	0.001 (−0.01; 0.01)	0.010 (0.00; 0.02)	−0.002 (−0.01; 0.00)
Coquimbo	−0.011 (−0.02; 0.00)	0.003 (−0.01; 0.01)	0.008 (0.00; 0.01)	0.000 (−0.00; 0.00)
Valparaíso	−0.007 (−0.01; 0.00)	0.001 (−0.00; 0.01)	0.007 (0.00; 0.01)	−0.001 (−0.00; 0.00)
O'Higgins	−0.001 (−0.01; 0.01)	0.005 (−0.00; 0.01)	−0.003 (−0.01; 0.00)	−0.002 (−0.00; 0.00)
Maule	0.010 (0.00; 0.02)	−0.005 (−0.01; 0.00)	−0.005 (−0.01; −0.00)	−0.001 (−0.00; 0.00)
Biobio	0.015 (0.00; 0.02)	−0.009 (−0.01; −0.00)	−0.005 (−0.01; −0.00)	−0.002 (−0.00; 0.00)
Araucanía	0.013 (0.00; 0.02)	−0.009 (−0.02; −0.00)	−0.001 (−0.01; 0.01)	−0.004 (−0.01; −0.00)
Los Lagos	0.006 (−0.00; 0.02)	0.000 (−0.01; 0.01)	−0.004 (−0.01; 0.00)	−0.003 (−0.01; −0.00)
Aysén	−0.019 (−0.04; 0.00)	0.017 (0.00; 0.03)	0.002 (−0.00; 0.01)	−0.002 (−0.01; −0.00)
Magallanes	−0.006 (−0.02; 0.01)	0.000 (−0.01; 0.01)	0.006 (−0.00; 0.01)	−0.000 (−0.01; 0.00)

95% confidence intervals in parentheses; number of observations, 248 336; marginal effects represent the difference in the adjusted predictions between groups.

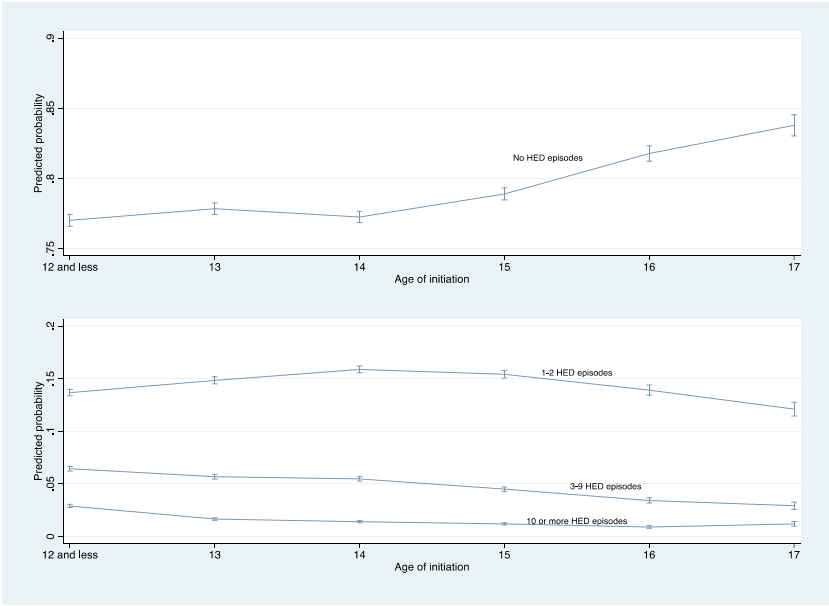


Figure 3 Predicted probabilities of heavy episodic drinking (HED) [Colour figure can be viewed at wileyonlinelibrary.com]

such as minimum pricing have also been shown to be associated with lower alcohol consumption and reduced harm [15], while alcohol-content-based taxation has been proposed to reduce harmful drinking [34]. It seems probable that minimum pricing and alcohol-content-based taxation be associated with delaying alcohol use initiation and lowering the prevalence of HED.

Declaration of interests

None.

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Author contributions

Guillermo Paraje: Conceptualization; data curation; formal analysis; funding acquisition; methodology; project administration; software; supervision; writing - original draft; visualization. **G Emmanuel Guindon:** Conceptualization; formal analysis; funding acquisition; methodology; software; writing - original draft; visualization. **Frank Chaloupka:** Conceptualization; funding acquisition; writing - reveiew & editing.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1 Predicted probabilities of Heavy Episodic Drinking (HED), 2003 to 2009.

Figure S2 Predicted probabilities of Heavy Episodic Drinking (HED), 2011 to 2015.

Table S1 Discrete-Time Complementary loglog Duration Models of Alcohol Use Initiation: sensitivity checks.

