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Density of alcohol-selling outlets and prices are associated with frequent binge drinking in Mexico

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ABSTRACT

Despite the increase in the prevalence of binge drinking in Mexico studies focus on sociodemographic factors and little attention is paid on contextual factors. We estimated the association between density of alcohol outlets, price of alcoholic beverages, and binge drinking in Mexico among the population aged 12 to 65 years old who consumed alcohol during the last 12 months. Data come from different sources for alcohol consumption; availability of bar, nightclubs, saloons and stores that sell alcohol and prices of alcoholic beverages. We estimated generalized linear models for binary outcomes for the relationship between density of alcohol outlets and prices of alcoholic beverages with binge drinking at least once per year, at least once per month, and at least once per week controlling for sex, age, religion, household income and municipality size. Living in areas with a high density of alcohol-selling outlets was associated with a higher risk of binge drinking, at least once a year (RR 1.0, 95% CI: 1.0,1.1) at least once a month (RR 1.3, 95% CI: 1.2, 1.4) and weekly (RR 1.9, 95% CI: 1.6, 2.2). Living in States with lower alcohol prices was marginally associated to binge drinking at least once a year (RR 1.0, 95% CI: 1.0, 1.1) but more strongly associated to monthly (RR 1.2, 95% CI: 1.2, 1.4) and weekly binge drinking (RR 1.4, 95% CI: 1.3, 1.6). Along with strong fiscal policies, the implementation of spatial restrictions to the number of alcohol-selling outlets could help decrease binge drinking.

1. Introduction

Alcohol use is a major risk factor for non-communicable diseases and an important cause of acute consequences, such as traffic accidents, violence and intoxication. In 2016, alcohol use accounted for 8.0% of total disability adjusted life years (DALYS) in the world (ranking 2 among 69 risk factors); and, in Mexico, alcohol use represented 6.7% of total DALYS (ranking 5), more than those associated with tobacco and diet high in sugar-sweetened beverages (4.3% and 0.9% of total DALYS, respectively) (Institute for Health Metrics and Evaluation, 2019). In the same year, more than 49,000 deaths were attributable to alcohol use in Mexico (Institute for Health Metrics and Evaluation, 2019).

Alcohol use is normalized and widely accepted, despite its negative consequences. Prolonged consumption is associated with chronic conditions such as alcoholic psychosis, dependence, or liver cirrhosis (Department of Mental Health and Substance Dependence, Noncommunicable Diseases and Mental Health Cluster, 2021). Additionally, binge drinking is associated with violence, accidents, and intoxication, among others (Department of Mental Health and Substance Dependence, Noncommunicable Diseases and Mental Health Cluster, 2021). In Mexico, the prevalence of binge drinking in the previous month increased from 12.3% in 2011 to 19.3% in 2016 in the population aged 12–65 years old; also, the gender gap has narrowed as women had larger increases in the prevalence of binge drinking (Instituto Nacional de Psiquiatría Ramón de la Fuente Muñíz, Instituto Nacional de Salud Pública, Comisión Nacional contra las Adicciones, 2017). Mexico presents a drinking pattern characterized by high frequencies of intense consumption; beer is the most frequently consumed alcoholic beverage (*Alcohol y salud publica en las Americas un Caso Para La Accion*, 2007).

Alcohol use and binge drinking are determined by individual and contextual factors (Daw et al., 2017). Individual factors such as education, income, risk-seeking behaviors, gender and mental health are well established risk factors (Blas et al., 2010; Tembo et al., 2017; Virtanen et al., 2015). Normative factors such as social or legal norms and

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contextual determinants such as advertising, availability and affordability, have a strong impact on alcohol use (Pérez-Núñez et al., 2014). Price is one of the most important drivers for alcohol use and abuse; given the elastic nature of alcohol use, taxes have been successfully used across the world to reduce consumption (Wagenaar et al., 2009; Patra et al., 2012). Alcohol availability, measured as the density of alcohol-selling outlets and liquor stores within neighborhoods, has received recent attention given the potential to intervene by limiting land use (Ashe et al., 2003). The density of alcohol-selling outlets has been associated with drinking (Scribner et al., 2000; Brenner et al., 2015a; Kavanagh et al., 2011; Chen et al., 2010) binge drinking (Ahern et al., 2016; Pereira et al., 2013; Gruenewald, 2011) accidents (Scribner et al., 2008; Lipton et al., 2018), and crime (Scribner et al., 2000; Roncek and Maier, 1991).

Most of these studies have been conducted in high income countries where prices and availability of alcohol may be different from lower income countries. In Mexico, studies on alcohol consumption focus on sociodemographic factors, implicitly assuming that the context has not a significant role and little attention has been paid to the association between prices and availability with binge drinking. Given the pattern of intense binge drinking in Mexico, we analyzed the association between binge drinking and the density of alcohol-selling outlets at the municipality level and prices of alcoholic beverages at the state level among the population who consumed alcohol at least once during the last 12 months using a nationally representative survey. Given the few public policies to reduce the consumption of alcohol in the country, evidence on the association between density of alcohol-selling outlets with binge drinking could lead to policy recommendations such as zoning laws or licensing policies to reduce the number of liquor stores that have been implemented in other settings (Hippensteel et al., 2021; de Vocht et al., 2016).

2. Methods

2.1. Data

2.1.1. Binge drinking

We used the National Drugs, Alcohol and Tobacco Consumption Survey 2016 (ENCODAT, for its acronym in Spanish) collected between June and October of 2016 (Instituto Nacional de Salud Pública, 2018). The ENCODAT 2016 is a national survey, representative of the population aged 12 to 65 years old, that collects information on drug use, alcohol and tobacco, while exploring potential risk factors from one adult (18 years and older) and one adolescent (12–17 years old) selected at random from each household. The household response rate was 85% and the individual response rate was 87% (complete interviews).

We defined binge drinking as consuming five or more drinks in a single occasion for men and four drinks or more for women (Daw et al., 2017). A standard drink was defined as a beverage containing 10 g of pure alcohol (*Alcohol y salud publica en las Americas un Caso Para La Accion*, 2007). We created three binary variables for binge drinking at least once per year, at least once per month, and at least once per week. Binge drinking at least once a week includes the following options: 1 to 2 times per week, 3 to 4 times, 5 to 6 times and daily. For once a month, it includes in addition to the options for at least once per week, 2 to 3 times and once a month. Binge drinking at least once a year includes, in addition to the options for at least once a month, once, 2 times, 3 to 6 times and 7 to 11 times in the last 12 months.

The study uses the ENCODAT whose data are publicly available (https://encuestas.insp.mx/ena/encodat2017.php) with no access to any variable that could identify individuals or their households.

2.1.2. Density of alcohol establishments

To estimate the municipal density of alcohol-selling outlets we obtained the counts of stores, nightclubs, bars and others at each municipality, using retailer data from the 2016 National Statistical Directory of Economic Units (DENUE for its acronym in Spanish) (Instituto Nacional de Estadística y Geografía, 2018). The DENUE registers all economic units that operate in Mexico. For our analyses, we included the following economic classes that sell alcoholic beverages according to the North American Industry Classification System: 461,211–461,213 (retailers of wines and liquors, beer and non-alcoholic beverages and ice), 462,111–462,112 (supermarket and convenience stores), and 722,411–722,412 (nightclubs, discotheques, bars and saloons). We then divided the total number of alcohol-selling outlets at each municipality by its population and multiply it by 100,000, obtaining the ratio of venues per 100,000 inhabitants as a proxy for alcohol availability. National estimates for population were obtained from the National Institute of Statistics and Geography Census for 2015 (Instituto Nacional de Estadística y Geografía, 2021). To project the population in 2016 for each municipality, we used the growth rates at the State level from the projected populations of 2015 and 2016 published by the National Population Council (Consejo Nacional de Población, 2017). We then used the survey sample weights to create tertiles of density of alcohol-selling outlets: in low-density municipalities, the average number of establishments that sell alcohol was 42.9 per 100,000 inhabitants; 98.1 in the middle-density areas and in the municipalities with higher density, the average density of alcohol outlets was 186 per 100,000 inhabitants.

We merged the density variable created from DENUE to the municipality where the ENCODAT survey participant lives. Municipalities are the smallest geo-political territories in Mexico. Municipalities are not always homogeneous; however, they do share structural characteristics. Regarding size, they could be as large as a city, there are 2456 municipalities in the country. The population of a municipality ranges from 93 to 2 million people, 11 have more than one million people and 128 less than 1000 inhabitants.

2.1.3. Prices of alcoholic beverages

Price data for alcoholic beverages were gathered from the National Institute of Statistics and Geography (INEGI in Spanish) (Instituto Nacional de Estadística y Geografía, 2017). We considered prices for the period of June - October, 2016, when ENCODAT was collected. INEGI collects prices for a large set of commodities—to estimate the consumer price index—in 46 cities across all the States, so there is at least one price for each of the 32 States in the country. We calculated prices of alcoholic beverage as the average price for three categories of alcoholic beverages: beer, wine and spirits (tequila, rum, vodka, whisky, brandy), by State. We weighted prices by the proportion of household purchases at the State level for every category using the 2016 National Income and Expenditure Survey (ENIGH in Spanish). ENIGH is a nationally representative survey that collects information on household income and expenditures (Instituto Nacional Estadística y Geografía, 2021). Average prices (in pesos per liter) were estimated and then merged to the ENCODAT 2016 at the State level. We calculated a binary variable that indicated municipalities with high (above the median price) and low (below the median) prices of alcoholic beverages.

2.1.4. Covariates

We adjusted the models for socioeconomic factors. We created four groups of age to reflect the heterogeneity of binge drinking among alcohol drinkers: 12–17 years old, 18 to 34, 35 to 49 and more than 50" by "50-65. We included tobacco use, defined as daily or occasional consumption based on ENCODAT's definition, as the literature has shown that tobacco and alcohol consumption share common determinants (Dani and Harris, 2005). We created a binary variable for religion (1 if the individual stated to have a religion, 0 otherwise), to test if individuals with a religion have a lower likelihood of consuming an excessive amount of alcohol in a single occasion. We created three binary variables for educational attainment: secondary or lower, high school, and college or more. Household income in the ENCODAT was reported in ranges of monthly minimum salary ($2190 Mexican pesos,

about 112 USD). We created binary variables for the following categories: low (up to 1 minimum salary: less than $2291 Mexican pesos), middle (1 to 4 minimum salaries: between $2191 to $8764 Mexican pesos), and high (4 or more minimum salaries: more than $8765 Mexican pesos). Municipalities were considered urban if they had 2500 inhabitants or more and rural otherwise.

2.2. Statistical analysis

We first described the sample with respect to the outcomes and covariates of interest. We then estimated generalized linear models for binomial dependent variables (Hardin, 2014) for the three defined outcomes: binge drinking at least once a year, at least once a month and at least once a week. We specified the models to get adjusted risk ratios and clustering at the household level to test whether the results changed when addressing the potential clustering at the household level as there is one adolescent and one adult selected from the same household (Stata manual, 2021). We fitted the models by density of alcohol-selling outlets, weighted average price of alcoholic beverages at the state level, tobacco consumption, sex, age group, urban/rural, religion and household income. In all models, we included an interaction between density of alcohol-selling outlets and alcoholic beverages price to assess the potential modifying effect of prices over density.

In the ENCODAT binge drinking is asked only to individuals that consumed alcohol at least once in the last 12 months. Thus, from a sample of 56,877 individuals, 32,652 are excluded because they had never consumed alcohol (19,410) or did not consumed in the last 12 months (13,242). A high proportion of the excluded sample corresponds to the population aged 12 to 17 that has never consumed alcohol (n = 7658) or that did not consume in the last 12 months (n = 3038). The analytical sample for this study is 21,809 with information on binge drinking and data for the full set of covariates (1977 without information on household income, 411 on education and 28 in other variables were excluded). We tested if individuals in the analytical sample were statistically different to those with missing values in the following variables: age, sex, tobacco use, religion, place of residence and the three binge drinking variables.

Given that the outcomes for binge drinking are nested as binge drinking at least once a month includes weekly excess consumption and binge drinking at least once a year includes weekly and monthly binge drinking, we estimated a multinomial probit model for a categorical variable for mutually exclusive groups. We created a categorical variable for four mutually exclusive groups: no binge drinking (reference category), binge drinking weekly, binge drinking monthly (it does not include those who binge drank in a week) and annual binge drinking (it does not include those who binge drank in a week or a month.

All statistical analyses were performed with Stata IC V15.1.

3. Results

Table 1 shows the descriptive analysis of the population aged 12–65 years old in Mexico that used alcohol over the past year according to the ENCODAT 2016. Binge drinking at least once a year was experienced by 36% of participants, once a month by 20%, and once a week by 6.6%. A higher prevalence of binge drinking of any frequency was observed in areas with higher density of alcohol outlets, compared to areas with lower availability. Also, individuals living in areas with low prices of alcoholic beverages had a higher prevalence of binge drinking once a year, month and week. The prevalence of binge drinking was higher among males and those who consume tobacco. By age group, participants aged 18 to 34 year old had a higher prevalence of binge drinking. Urban dwellers had a higher prevalence of binge drinking in contrast to rural. Individuals that reported having a religion displayed a lower prevalence of binge drinking. The prevalence of binge drinking was higher for participants with college or more education compared to lower education levels. Low income drinkers drank less compared to

Table 1
Unadjusted prevalence of binge drinking by characteristic, n = 21,809.

Variable	% of n = 21,809	Binge drinking at least once a year (%)	Binge drinking at least once a month (%)	Binge drinking at least once a week (%)
All	100%	36.0 [34.8,37.3]	20.0 [18.7, 20.7]	6.6 [6.1,7.1]
Density of establishments				
Low	19%	33.6 [30.9,36.5]	14.9 [12.9,17.1]	3.0 [2.3,3.8]
Middle	38.2%	34.8 [33.1,36.5]	18.8 [17.4,20.3]	7.4 [6.6,8.3]
High	42.8%	39.5 [37.7,41.4]	25.0 [23.2,27.0]	9.1 [8.2,10.2]
Price of alcoholic beverages				
High	46.2%	34.1 [32.3,35.9]	16.3 [14.8,17.9]	4.3 [3.8,5.0]
Low	53.8%	39.1 [37.7,40.4]	25.0 [23.4,26.3]	10.1 [9.3,11.0]
Tobacco use				
No	74.9%	28.2 [26.8,19.6]	14.0 [12.9,15.1]	4.1 [3.6,4.6]
Yes	25.1%	55.7 [53.3,58.1]	34.1 [31.8,36.4]	12.9 [11.6,14.2]
Sex				
Female	53.1%	10.2 [52.3,55.6]	4.2 [3.6,4.8]	1.2 [0.9,1.5]
Male	46.9%	53.9 [9.2,11.2]	30.4 [28.9,32.0]	10.3 [9.5,11.2]
Age group				
12–17	12.8%	18.1 [15.7,20.6]	8.9 [7.6,10.4]	4.1 [3.2,5.1]
18–34	40.1%	40.1 [38.3,41.9]	21.9 [20.5,23.5]	7.6 [6.3,8.5]
35–49	30.1%	34.8 [32.7,36.9]	18.9 [17.4,20.4]	5.8 [6.8,8.5]
50–65	17.0%	35.1 [31.8,38,6]	19.7 [16.6,23.3]	5.9 [4.7,7.2]
Area of residence				
Rural	23.2%	35.1 [32.9,37.2]	18.4 [16.9,20.1]	6.0 [5.2,7.0]
Urban	76.8%	36.2 [34.8,37.3]	20.0 [18.8,21.2]	6.7 [6.1,7.3]
Religion				
No	9.9%	49.2 [45.3,53.2]	25.0 [21.7,28.5]	9.5 [7.7,11.7]
Yes	90.1%	33.5 [33.2,35.8]	19.1 [18.0,20.2]	6.3 [5.7,6.8]
Education				
Secondary or lower	57.5%	36.7 [35.1,38.4]	21.0 [19.6,22.5]	7.7 [7.0,8.5]
Highschool	31.7%	36.7 [34.6,38.8]	19.3 [17.6,21.1]	6.1 [5.3,7.1]
College or more	10.8%	31.0 [28,2,34.0]	15.3 [13.2,17.8]	3.4 [2.5,4.5]
Household income				
Low	27.2%	32.5 [30.4,34.7]	18.2 [16.6,20.0]	6.2 [5.3,7.2]
Middle	61.1%	37.2 [35.5,38.8]	20.2 [18.8,21.6]	6.7 [6.1,7.4]
High	11.7%	37.1 [34.0,40.3]	20.0 [17.6,22.8]	6.7 [5.3,8.4]

higher income individuals.

3.1.1. Confidence intervals in brackets

Table 2 shows the adjusted risk ratios for binge drinking, density of alcohol-selling outlets and alcohol price. We found that a higher density of alcohol-selling outlets was associated with a higher risk of binge drinking, at least once a year (RR 1.0, 95% CI: 1.0,1.1) at least once a month (RR 1.3, 95% CI: 1.2, 1.4) and at least once a week (RR 1.9, 95% CI: 1.6, 2.2). For weekly binge drinking, the RR for the middle density of alcohol-selling outlets was also significant (1.5, 95% CI: 1.3, 1.8). Living in States with lower alcohol prices was marginally associated to binge drinking at least once a year (RR 1.0, 95% CI: 1.0, 1.1) but more strongly associated to monthly (RR 1.2, 95% CI: 1.2, 1.4) and weekly binge drinking (RR 1.4, 95% CI: 1.3, 1.6). The interaction between the density of alcohol-selling outlets and alcohol prices was not significant and was dropped from the final model.

When we compared the analytical sample with the sample with missing values on age, sex, tobacco use, religion, place of residence and binge drinking, we only found differences in age (the analytical sample is three years younger) and tobacco use (25% used tobacco in the analytical sample compared to 22% in the sample with missing values.

Results from the multinomial probit model shows that a middle and a high density of alcohol selling outlets as well as lower prices were associated with a higher probability of binge drinking weekly (supplemental material Table 1). For binge drinking monthly but less than weekly, we found associations with high density of alcohol selling outlets and lower prices. No statistically significant associations were found for binge drinking annually but less than monthly.

Table 2
Generalized lineal models for binary outcomes for binge drinking at least once a year, at least once a month and at least once a week, $n = 21{,}809$.

Variable	Binge drinking at least once a year	Binge drinking at least once a month	Binge drinking at least once a week
	Risk ratio [95% confidence interval]		
Density of establishments			
Low (ref)			
Middle	0.9 [0.9,1.0]	1.1 [1.0,1.2]	1.5 [1.3,1.8]
High	1.06 [1.0,1.1]	1.3 [1.2,1.4]	1.9 [1.6,2.2]
Price of alcoholic beverages			
High (ref)			
Low	1.0 [1.0,1.1]	1.2 [1.1,1.3]	1.4 [1.3.1.6]
Tobacco use	1.4 [1.3,1.4]	1.6 [1.6,1.7]	2.1 [1.9,2.3]
Sex			
Female (ref)			
Male	4.9 [4.7,5.3]	6.8 [6.1,7.5]	7.1 [5.9,8.5]
Age group			
12–17	0.6 [0.6,0.7]	0.7 [0.6,0.8]	0.9 [0.8,1.2]
18–34	1.2 [1.2,1.3]	1.3 [1.2,1.4]	1.4 [1.3,1.7]
35–49	1.2 [1.1,1.2]	1.2 [1.1,1.3]	1.2 [1.0,1.4]
50–65 (ref)			
Area of residence			
Rural (reference)	1.1 [0.9,1.1]	1.1 [0.9,1,3]	1.1 [1.0,1.3]
Urban			
Religion	0.9 [0.9,0.9]	0.9 [0.9,1.0]	0.9 [0.8,1.0]
Education			
Secondary or lower (ref)			
Highschool	0.9 [0.9,1.0]	0.9 [0.8,1.0]	0.8 [0.7,0.9]
College or more	0.9 [0.8,0.9]	0.7 [0.6,0.8]	0.5 [0.4,0.6]
Household income			
Low (ref)	1.1 [1.0.1.2]	1.1 [0.9,1.1]	1.1 [0.9,1.2]
Middle	1.1 [1.1,1.2]	1.2 [1.1,1.3]	1.2 [1.0,1.4]
High			
Constant	0.08 [0.07,0.09]	0.03 [0.02,0.03]	0.003 [0.003,0.006]

4. Discussion

We assessed factors associated with the prevalence of binge drinking at least once a year, once month, and once a week among the population who consumed alcohol at least once during the last 12 months. We found that people living in areas with high density of alcohol- selling outlets had a higher risk of binge drinking at least once a week, once a month and once a year. Lower prices were associated with higher binge drinking once a year, once a month and once a week. The risk of binge drinking depended both on the density of alcohol-selling outlets and prices, suggesting that both variables could be important to reduce binge drinking.

Our results on the association between density of alcohol-selling outlets and higher consumption are in line with recent literature published in high-income contexts (Brenner et al., 2015a; Chen et al., 2010; Ahern et al., 2016; Pereira et al., 2013; Gruenewald, 2011; Chaloupka and Wechsler, 1996; Mori-Gamarra et al., 2018; Foster et al., 2017; Lo et al., 2013; Astudillo et al., 2014; Halonen et al., 2013; Halonen et al., 2014; Kypri et al., 2008; Shimotsu et al., 2013; Brenner et al., 2015b). As of our knowledge, similar studies have not been conducted in Latin American countries. We also found, as expected, that higher prices of alcoholic beverages were associated with lower prevalence of binge drinking (Wagenaar et al., 2009; Patra et al., 2012). We also included an interaction between the density of outlets and prices, to test the hypothesis that binge drinking would be lower in areas with lower outlet density and higher prices. However, the interaction was not statistically significant in any of the outcomes, suggesting that the effects of price and density are independent. If that is the case, public policies could use both approaches to produce substantive reductions to reduce binge drinking. While price increases through taxation is already being used as an effective measure to reduce alcohol use, restrictions to the number of alcohol outlets are less frequent. In our study, municipalities with a high density of alcohol outlets had more than twice the prevalence of binge drinking once a week than municipalities with low density; this suggest that restrictions to density could be included in the next generation of alcohol policies in Mexico, but also in countries with similar characteristics, where binge drinking, rather than frequent drinking is a problem.

We decided to use the number of alcohol outlets per 100,000 inhabitants as our density measure, yet, we tested other definitions of density, such as restricting the density to stores that sell alcohol, to nightclubs, or to supermarkets and found the same patterns (results not shown). Therefore, we decided to use a variable that classified together these three types of outlets. Our density variable does not consider proximity of stores to households, as the ENCODAT 2016 does not provide geographical location of households for confidentiality reasons. Previous literature on alcohol outlets density has also used a measure of road length to capture proximity to establishments that sell alcohol (Romley et al., 2007). However, we did not have information on road length at the municipality level, but only at State level. Nevertheless, we assume that higher density of establishments that sell alcohol imply smaller distances and this measure of density has been widely used in alcohol literature, as reported elsewhere (Shimotsu et al., 2013). The relationship between density of alcohol-selling outlets and the probability of binge drinking was robust for binge drinking at least once a month and once a week. Another usual way to define the density or availability of alcohol outlets is using the area of the geographic units. We decided not to use this definition since area does not necessarily reflect population density. Still, we recognize that there can be variability of density of alcohol outlets within municipalities, *i.e.* areas with presence of many stores that we cannot account for.

We were able to capture variations in prices across states, but we lacked information from smaller geographic areas. However, aggregated prices compared to self-reported prices attenuate the random error from

quality and measurement error. Despite this limitation, we found a statistically negative relationship between price and weekly and monthly binge drinking. For prices, we acknowledge that since our information is limited to State level, our estimates do not allow us to derive price elasticities. Rather, we adjusted the probability of binge drinking by price and other covariates. We used the National Income and Expenditure Survey to estimate weighted prices. The survey lacks specific details to get price per standard drinks or data from bar or nightclubs. However, in Mexico, among all alcoholic beverages, beer represents more than 90% of sales.

We tested if density of outlets was associated with binge drinking but we acknowledge that more places that sell liquor can likely be a response to local demand or heavy drinkers might choose to live in areas with higher density of alcohol outlets. As we did not find an association of density of outlets and binge drinking once a year, we think that this may not the case but recognize that our results are not causal.

We also acknowledge that some of our explanatory variables could be better measured. In the ENCODAT, household income is aggregated in categories at the household level and therefore does not allow to better study the relationship between income measured continuously and the probability of binge drinking. Also, the effect of household income could be vague since alcoholic beverages are not homogenous and there is a large variability of alcoholic types and prices of these, leading to substitution for cheaper options among household with lower income. In addition, important explanatory variables such as advertisement of alcoholic beverages and promotions were not available.

5. Conclusions

Alcohol consumption causes considerable harm to health in Mexico and excessive alcohol intake has increased in the last decade. Environmental factors such as prices and density of alcohol-selling outlets could be important determinants of binge drinking in Mexico. Our results suggest that public policies to discourage binge drinking could be strengthened by increasing existing taxes to alcoholic beverages and decreasing the density of places that sell alcohol. These policies must be accompanied by other options, such as regulating the distance between outlets that sell alcohol and schools or public facilities, regulating hours of alcohol sales (Hahn et al., 2010), zoning laws to reduce the number of liquor stores in cities, monitoring alcohol in blood levels, and eliminating special offers such as open bars and all-inclusive promotions. Our study also suggests that reducing the availability of alcohol selling-outlets and increasing prices of alcoholic beverages are independent, and could be implemented at the same time to produce more effective reductions in binge drinking.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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