Psychological discomfort and binge drinking in Mexican adults

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Abstract

Objective. To analyze the relationship between binge drinking and psychological discomfort in Mexican adults. **Materials and methods.** We used data from the 2011 National Survey on Addictions in Mexico. A two-stage bivariate probit model with instrumental variables was used to address the potential reverse causality in the association between binge drinking and psychological discomfort. **Results.** Individuals who had at least one episode of binge drinking in the last year and in the last month are more likely to experience psychological discomfort. **Conclusion.** This study shows the relevance of developing prevention and treatment programs for people who consume alcohol in excess due to its negative effects on mental health.

Keywords: depression; binge drinking; psychological discomfort; causality; Mexico

Resumen

Objetivo. Analizar la relación entre el consumo excesivo de alcohol y el malestar psicológico en adultos mexicanos. **Material y métodos.** Se utilizaron datos de la Encuesta Nacional de Adicciones en México 2011. Se estimó un modelo probit bivariado de dos etapas con variables instrumentales para abordar la posible causalidad inversa en la asociación entre el consumo excesivo de alcohol y el malestar psicológico. **Resultados.** Las personas que tuvieron al menos un episodio de consumo excesivo de alcohol en el último año y en el último mes tienen más probabilidades de experimentar malestar psicológico. **Conclusión.** Este estudio muestra la relevancia de desarrollar programas de prevención y tratamiento para las personas que consumen alcohol en exceso debido a sus efectos negativos sobre la salud mental.

Palabras clave: depresión; consumo excesivo de alcohol; malestar psicológico; causalidad; México

Alcohol consumption is a worldwide a public health problem. According to the World Health Organization (WHO), alcohol consumption ranks third among the world`s risk factors for different diseases and mental disorders, including depression.[1] It is estimated that 11.2% of depression cases in the world are associated with alcohol consumption.[2] The increased risk of depression among those who consume alcohol is associated to different factors such as the toxic effects of alcohol

consumption on the central nervous system as well as accidents and violence or other adverse consequences associated with alcohol consumption such as unemployment.[3,4]

According to the National Survey of Drugs, Alcohol and Tobacco Consumption (*Encuesta Nacional de Consumo de Drogas, Alcohol y Tabaco*, Encodat 2016), in Mexico, the prevalence of binge drinking in the population from 12 to 65 years increased from 12.3% in 2011 to

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19.8% in 2016, the increase was greater in men than in women.[5]

Several studies have shown an association between binge drinking and depression. People drinking alcohol in the previous year were more likely to have experienced depression than people who reported not drinking alcohol.[6,7] In Mexico, depressive symptoms are greater among people with alcohol dependence.[8,9]

On the other hand, binge drinking seems to be especially problematic. Excessive amounts of alcohol consumed per event was found to be associated with a higher risk of depression when compared with the consumption of lower amounts with lower frequency, and this association is stronger among women than men.[10,11] Moreover, individuals with binge drinking habits are more likely to have depressive symptoms when compared to individuals who do not drink.[12]

However, there is a potential reverse causality between binge drinking and depression. Binge drinking can lead to depression, but depression can also induce binge drinking when used to alleviate emotional distress.[13,14] The existence of either disorder (binge drinking or depression) has been found to increase more than double the probability of developing the other disorder.[15]

One limitation of the methods used in the literature to explore this association is that they do not address the potential reverse causality between alcohol consumption and psychological discomfort,[16] which can lead to biased estimations. The objective of this study was to analyze the relationship between binge drinking and psychological discomfort (symptoms of depression, nervousness, stress) in the population aged 18 to 65 in Mexico.

To address the potential reverse causality in the relationship between binge drinking and psychological discomfort, we estimated a two-stage bivariate model with the following instrumental variables (IV): average price per liter of beer and density of alcohol selling outlets, such as "minisupers" and convenience stores, and other economic units that sell alcoholic beverages. IV are used to address potential biases such as reverse causality. The inclusion of IV produces unbiased and consistent estimates of the causal effect of an explanatory variable (binge drinking) on the outcome variable (psychological distress). The first stage estimates binge drinking using the IV (that should not be correlated with psychological distress) and a vector of covariates. The second stage estimates psychological distress using predicted values for binge drinking (cleaned of endogeneity though the IV) and the vector of covariates.[17] The models were adjusted by variables that have been previously used in the literature when studying the relationship between binge drinking and depression: sex, education level, socioeconomic level, marital status, unemployment, place residence (rural or urban), religion and starting age of consumption.

Materials and methods

Data sources

We used data from the National Survey of Additions (*Encuesta Nacional de Adicciones,* ENA 2011), a cross-sectional survey representative at the national, regional, and rural/urban strata in Mexico.[18,19] The aim of ENA 2011 is to estimate prevalence and trends in the use of alcohol, tobacco, medical and non-medical drugs in Mexican adults and adolescents.[20] We had to use the ENA 2011, as the Encodat 2016 did not include the Kessler Psychological Scale.

For the instrumental variable average beer prices per liter, we used mean prices from the National Institute of Statistics and Geography *(Instituto Nacional de Estadística y Greografía*, INEGI). INEGI collects weekly prices directly from sale points in 45 different cities in the country. These mean prices are reported by beer package size, brand, and unit of measure.[21] Prices from June to August 2011 (data collection period of the ENA 2011) were utilized.

The density of alcohol selling outlets (the second IV) was estimated using data from the National Statistical Directory of Economic Units (*Directorio Estadístico Nacional de Unidades Económicas,* DENUE), which reports the number of units by economic activity according to the North American Industrial Classification System (SCIAN).[22] The DENUE is obtained through economic censuses and regular updates through surveys, administrative records and demographic studies of establishments. Data collected ranged from 2015 and 2019.

Variables

Dependent variable

Psychological discomfort includes symptoms of the mental health issues with the highest prevalence in the population, such as nervousness, anxiety, depression, and stress.[23] For the ENA 2011 a shortened version (six questions) of the Kessler Psychological Discomfort Scale (K-10) was applied, an instrument used to measure symptoms of anxiety and depression in primary care in the last 30 days.[24] The Kessler Psychological Discomfort Scale has been validated in the Mexican population attending the first level of care and used in different studies to detect psychological distress.[25-27]

Questions are used to measure how often people feel: 1) nervous, 2) hopeless, 3) restless and uneasy, 4) depressed, 5) that everything takes too much effort, and 6) that nothing is worth it. Each question has 5 possible answers, 1 being "never" and 5 "always". The sum of the scoring scale ranges from 6 to 30 points, where 6 represents no psychological discomfort and 30 the maximum.

The distribution of the score from the ENA data shows that 37% of the population had a score of 6 so we created a binary variable for psychological discomfort taking the value of 1 if the total score was greater than 6 (having some psychological discomfort), and 0 if the score was 6 points (no psychological discomfort).

Independent variable

For this study, the independent variable is binge drinking. Binge drinking is defined as 0.08% blood alcohol concentration, which corresponds to five drinks or more for men and four drinks or more for women on a single occasion.[28] Two binary variables were created: binge drinking in the last year and binge drinking in the last month. The value for these binary variables is: 1 if the person ever consumed four or more drinks (women) or five or more drinks (men) on a single event during the reference period, and 0 otherwise.

Covariates

A set of variables associated with psychological discomfort and / or binge drinking were included: sex (men = 1, women = 0) (7), place of residence (urban = 1, rural = 0) (3), marital status (married = 1, unmarried = 0),[29] employment status (employed = 1, unemployed= 0).[30] We included health insurance (yes = 1, no = 0),[31] religion (catholic = 1, other = 0),[32] age at drinking onset (< 20 years old = 1, > 20 years old= 0).[33] For educational level three binary variable were created: elementary, middle school and high school education or higher, where the variables were: 1 if it was related to the last study level of the participant and 0 if not.[34] We created an index for socioeconomic level based on the number of rooms, bedrooms, and lightbulbs in the participants' home. We used principal components to create the index and divided it in tertiles to distinguish low, middle, and high socioeconomic level.[35]

Instrumental variables (IV)

Instrumental variables are used when the explanatory variable (binge drinking) is correlated with the error terms in a regression (with psychological discomfort as the dependent variable). The instrumental variables allow obtaining unbiased and consistent estimate of the causal effect of an explanatory variable over the outcome variable. An IV ought to meet two characteristics: 1) be associated with the variable of exposure, and 2) be unrelated to the outcome variable other than through the exposure variable.[17]

For this study we used two IV: price per liter of beer and the density of alcohol selling outlets per 100 000 inhabitants. These two variables explain binge drinking but they are not directly related to psychological discomfort. As described above, we retrieved prices per liter of beer data collected in 45 cities in all states in Mexico from June to August 2011 (the period of fieldwork of the ENA 2011). We then aggregated mean prices at the state level. This state-level mean price data was then merged to the ENA 2011 dataset at the state level.

The density of alcohol selling outlets per 100 000 inhabitants was calculated based on the DENUE data. We included convenience stores and minisupers. Because last DENUE update was for 2015, a linear growth rate was assumed to obtain the number of alcohol selling outlets in 2011. The linear growth rate between 2015 and 2019 was calculated by state. That linear growth rate was then used to calculate the number of alcohol selling outlets available in 2011. The formula to estimate the density is as follows:

$$\text{Alcohol selling outlets} = \left(\frac{1 - \left(\frac{UE2019 - UE2015}{UE2015} \right) * UE2015}{2011 \text{ population}} \right) * 100\ 000$$

Where UE2015 is the number of alcohol selling outlets in 2015 and UE2019 is the number of alcohol selling outlets in 2019. These state level data were merged in the database of the analytical sample.

Statistical analysis

To address the potential reverse causality in the association between binge drinking and psychological discomfort, a two-stage bivariate probit model was used. In the first stage, we estimated factors associated with the probability of binge drinking:

$$C = \Phi(\beta_0 + \beta_1 X + B_2 z + e)$$

Where C is binge drinking, X is the vector of covariates, and z is the vector of instrumental variables.

In the second stage, we estimated factors associated with the probability of presenting psychological discomfort:

$$P=\Phi(\Upsilon 0+\Upsilon 1\hat{C}+\Upsilon X+e)$$

where P is the probability of having psychological discomfort, Y1 is the predicted values of binge drinking in the first phase, and YX the vector of covariates.

To evaluate the over-identification and strength of the instruments, linear probability models were calculated which is valid when the probability of the event ranges between 0.2 and 0.8.[36]

These models allow to estimate the sub-identification test and the F statistic, the strength of the instruments as predictors of binge drinking. An instrument is considered strong if the F statistic is >10. Furthermore, we proved that the instruments were not related to the dependent variable of psychological discomfort through the overidentification test that tests that the instrumental variables should not be correlated with the error term.

For this analysis, we included participants from 18 to 65 years old that had consumed alcohol at least once in their life, with no missing values in all variables.

All analyzes were performed considering the ENA 2011 sample design in Stata version 15 software.

Results

Figure 1 shows the diagram of the analytical sample. From the total sample of the ENA 2011 (16 249 participants), individuals between 18 and 65 years old who responded to the questionnaire of psychological discomfort and who reported having consumed alcohol at least once in their life were chosen. Of these, all responded to the alcohol consumption questions in the past year and in the past month (9 351 individuals met these eligibility criteria). The analytical sample was 8 654 individuals, who did not present missing values for the covariates included in the study. Statistical tests were performed to test whether the individuals excluded for missing values in the covariates were different from those in the analytical sample. No significant differences were found.

Table I shows the descriptive characteristics of the analytical sample. 63.2% of the population reported having experienced psychological discomfort in the 30 days prior to the interview, 42.2% had at least one episode of binge drinking in the last year and 18.1% in the last month. Of those who presented psychological discomfort, 43.3% reported at least one episode of binge drinking in the last year and 18.6% in the last month. 54.6% were men, 61.6% had a job, 48.9% were married, 43.9% had high school as their highest degree of studies, 70.8% had social security, and 81.4% lived in an urban area.

Figure 2 shows that the proportion of individuals who presented psychological discomfort (unadjusted) was higher in the population among binge drinkers in the last year and in the last month when compared to those who did not have binge drinking.

Table II shows the results of the first stage of the bivariate probit model and the linear model that predicted binge drinking in the last year and in the last month based on a vector of covariates and the instrumental variables. Both, the price per liter of beer and the density of alcohol selling outlets were statistically significant ($p<0.01$). An increase in the price per liter of beer reduced the probability of binge drinking in the last
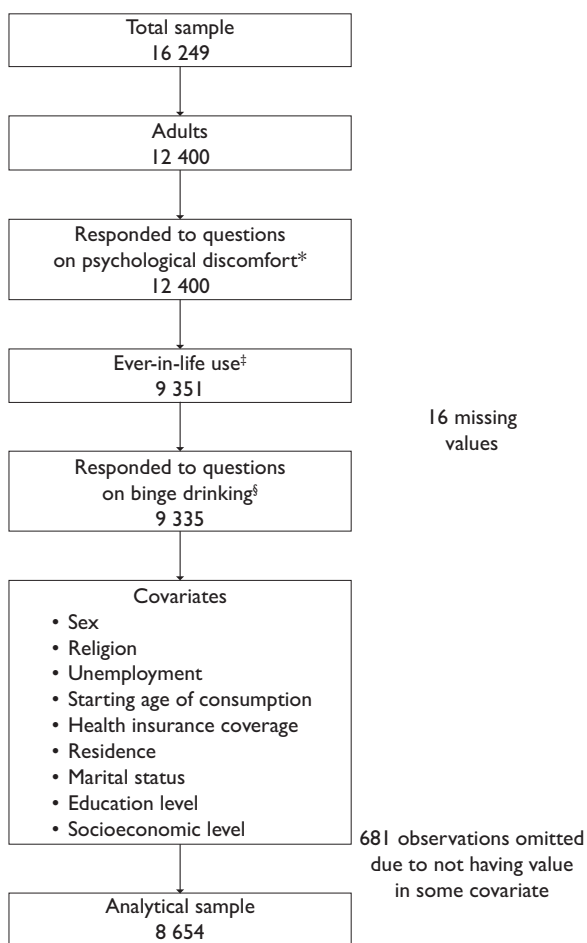
Own estimations using the Mexican National Survey of Addictions (ENA, 2011).

* Psychological discomfort: People who answered the 6 questions related to psychological discomfort in the last 30 days

‡ Ever-in-life use: People who reported ever-in-life alcohol use

§ Binge drinking: Consuming 5 or more drinks in men or 4 or more drinks in women on a single occasion

FIGURE 1. ANALYTICAL SAMPLE

Table I
Descriptive characteristics for the analytical sample (n=8 654)

Dependent variable	Total sample %	With psychological discomfort %	No psychological discomfort %	P-value Difference χ^{2*}
Psychological discomfort	63.2			
Consumption types				
Binge drinking in the last year	42.2	43.3	40.3	0.00
Binge drinking in the last month	18.1	18.6	17.3	0.18
Covariables				
Men	54.6	49.1	63.9	0.00
Married	48.9	48.8	49.0	0.86
Employed	61.6	63.9	72.1	0.00
Age when started consumption (>20 years)	19.6	20.0	19.0	0.28
Catholic religion	83.1	84.6	82.4	0.01
Urban	81.4	81.5	81.3	0.87
Health insurance	70.8	70.2	71.9	0.08
Highest education level				
Elementary	25.3	25.1	25.6	0.62
Middle school	30.7	31.3	29.8	0.01
Highschool	43.9	43.5	44.7	0.13
Socioeconomic level (index mean)				
Low	-1.2	-1.1	-1.2	0.63
Middle	-0.1	-0.1	-0.1	0.77
High	1.4	1.3	1.3	0.57
Instrumental variables				
Price of beer per liter (mean)	27.7	27.7	27.8	0.01
Alcohol selling outlets density per 100 000 habitants (mean)	74.4	74.4	74.3	0.00

Own estimations using the Mexican National Survey of Addictions (ENA, 2011).
* Chi test-squared for group difference
Estimates made with the sample design of the ENA 2011

year and in the last month. An increase in the density of alcohol selling outlets increased the probability of binge drinking in the last year and in the last month.

For binge drinking in the last year, the F score (2, 8 640) of 10.52 rejects the null hypothesis of instrument weakness. The overidentification test with a score of 2.88 (*p*> 0.05) shows that the instruments are not related to psychological discomfort. For binge drinking in the last month the F score (2, 8 640) of 25.79 rejects the null hypothesis of weakness of the instruments; the overidentification test score of 3.61 (*p*> 0.05) shows that the instruments are not related to psychological discomfort.

Being a man, not being married, having a job, consuming alcohol for the first time before 20 years old, being catholic, having social security, having only primary education completed, and having a low socioeconomic level increase the probability of binge drinking in the last year and month.

Table III shows the results of the second stage of the bivariate probit model that estimates the probability of psychological discomfort based on the predicted values of binge drinking estimated in the first stage and a vector of covariates; the two-stage linear model and the probit model without instrumental variables for comparison. The two-stage models with instrumental variables show that the relationship between binge drinking and psychological discomfort was positive and statistically significant (*p*<0.05). In the model without instruments, the magnitude is smaller when compared to the other models.

In the bivariate probit model, individuals who had binge drinking in the last year had a 38.7 higher probability to have psychological discomfort than those who did not have binge drinking in the past year. Binge drinking in the last month is associated with a 38.1 probability of having psychological discomfort.
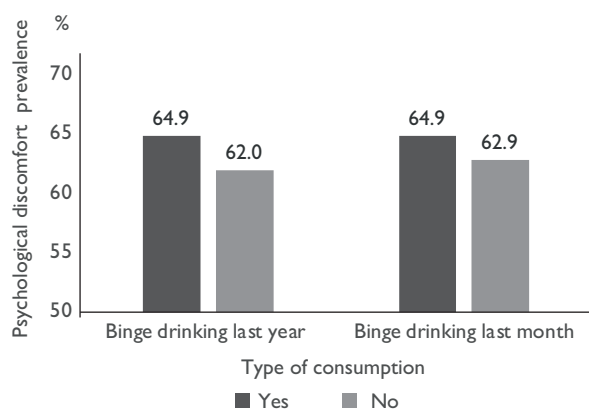
Own estimations using the Mexican National Survey of Addictions (ENA, 2011).

Psychological discomfort: It is constructed from six questions referring to symptoms of psychological discomfort in the last 30 days, each question has a score from 1 (never) to 5 (always). For the dichotomous variable: 0 (score of 6), 1 (score> 6).

Binge drinking last year: Consumed at least once in the last year 4 or 5 drinks or more on a single occasion.

Binge drinking last month: Consumed at least once in the last month 4 or 5 drinks or more on a single occasion.

FIGURE 2. PREVALENCE OF PSYCHOLOGICAL DIS-COMFORT BY BINGE DRINKING CONSUMPTION

Some factors such as being a woman, not having a job, not having social security, and having a higher degree of education increase the probability of presenting psychological distress.

Discussion

We estimated the association between binge drinking and psychological discomfort using data from the ENA 2011. We used a two-stage bivariate model with instrumental variables to address the potential reverse causality between alcohol consumption and psychological discomfort. We found that individuals who had at least one episode of binge drinking in the last year or month are more likely to experience psychological discomfort when compared to those who did not binge drink.

The results of this study are consistent with previous studies that show that the intensity of consumption is related to depression.[10,11] In Mexico, depressive symptoms are greater in individuals who reported alcohol dependence or abuse.[8]

One limitation of the study is that we could not establish causality due to the cross-sectional nature of

Table II

FIRST STAGE: FACTORS ASSOCIATED WITH THE LIKELIHOOD OF BINGE DRINKING. ANALYTICAL SAMPLE (18 TO 65 YEARS OLD). MEXICO, JUNE TO AUGUST 2011

	Binge drinking in the last year*		Binge drinking in the last month‡	
	Linear model§	Probit bivariate model§	Lineal model§	Probit bivariate model§
Beer price#	-0.012 (0.00)&	-0.013 (0.00)&	-0.014 (0.00)&	-0.014 (0.00)&
Alcohol selling outlets≠	0.0003 (0.00)&	0.0002 (0.02)&	0.0005 (0.00)&	0.0004 (0.00)&
Men	0.267 (0.00)&	0.251 (0.00)&	0.210 (0.00)&	0.210 (0.00)&
Married	-0.079 (0.00)&	-0.079 (0.00)&	-0.060 (0.00)&	-0.063 (0.00)&
Employed	0.054 (0.00)&	0.057 (0.00)&	0.031 (0.00)&	0.042 (0.00)&
Age when started consumption (>20 years)	-0.090 (0.00)&	-0.096 (0.00)&	-0.043 (0.00)&	-0.061 (0.00)&
Catholic religion	0.097 (0.00)&	0.095 (0.00)&	0.040 (0.00)&	0.036 (0.00)&
Urban	-0.012 (0.32)	-0.012 (0.32)	0.0002 (0.98)	0.005 (0.57)
Health entitlement	-0.020 (0.08)∞	-0.020 (0.07)∞	-0.016 (0.07)∞	-0.017 (0.04)∅
Highest education level				
Elementary	-0.080 (0.00)&	-0.083 (0.00)&	-0.042 (0.00)&	-0.051 (0.00)&
Middle School	-0.010 (0.40)	-0.011 (0.34)	-0.0006 (0.94)	-0.002 (0.79)
Socioeconomic level				
Low	0.034 (0.00)&	0.033 (0.01)&	0.006 (0.54)	0.002 (0.78)
Middle	0.041 (0.00)&	0.042 (0.00)&	0.020 (0.04)∅	0.019 (0.04)∅

Own estimations using the Mexican National Survey of Addictions (ENA, 2011).
* Binge drinking last year: Identification weakness test F (2, 8 640) 10.52. Overidentification test Chi2 = 2.88 Prob> Chi2 = 0.0895; ‡ Binge drinking last month: Identification weakness test F (2, 8 640) 25.79. Overidentification test Chi2 = 3.61 Prob> Chi2 = 0.0574; § Marginal effects; # Beer price per liter; & significant at 1%; ≠ Density per 100 000 inhabitants; ∞ significant at 10%; ∅ significant at 5%; *p* value in parentheses
Estimation of the models with the sample design of the ENA 2011

Table III
**SECOND STAGE: LIKELIHOOD OF EXPERIENCING PSYCHOLOGICAL DISCOMFORT DUE TO BINGE DRINKING.
MEXICO, JUNE TO AUGUST 2011**

	Binge drinking in the last year			Binge drinking in the last month		
	Model without instruments	Lineal model	Probit bivariate model*‡	Model without instruments	Lineal model	Probit bivariate model*‡
Predicted binge drinking§	0.074 (0.00)#	0.555 (0.02)&	0.387 (0.00)#	0.069(0.00)#	0.427 (0.02)&	0.381 (0.00)#
Men	-0.150 (0.00)#	-0.284 (0.00)#	-0.212 (0.00)#	-0.146 (0.00)#	-0.225 (0.00)#	-0.204 (0.00)#
Married	0.016 (0.17)	0.027 (0.23)	0.020 (0.10)≠	0.015 (0.19)	0.009 (0.55)	0.012 (0.27)
Employed	-0.040 (0.00)#	-0.053 (0.00)#	-0.040 (0.00)#	-0.037 (0.00)#	-0.036 (0.00)#	-0.034 (0.00)#
Age when started consumption (>20 years)	-0.015 (0.27)	0.026 (0.33)	0.019 (0.20)	-0.020 (0.1)≠	-0.005 (0.73)	0.001 (0.91)
Catholic religión	0.019 (0.16)	-0.018 (0.51)	-0.013 (0.43)	0.024 (0.08)≠	0.018 (0.26)	0.013 (0.29)
Urban	0.001 (0.92)	0.015 (0.30)	0.012 (0.29)	-0.001 (0.94)	0.008 (0.53)	0.007 (0.55)
Health entitlement	-0.031 (0.00)#	-0.011 (0.40)	-0.008 (0.41)	-0.032 (0.00)#	-0.015 (0.21)	-0.012 (0.26)
Highest education level						
Elementary	0.000 (0.97)	0.057 (0.02)&	0.044 (0.01)#	-0.002 (0.75)	0.030 (0.06)≠	0.030 (0.01)&
Middle School	0.008 (0.25)	0.023 (0.10)≠	0.017 (0.09)≠	0.009 (0.14)	0.017 (0.16)	0.005 (0.63)
Socioeconomic level						
Low	0.020 (0.27)	-0.0005 (0.97)	0.000 (0.96)	0.022 (0.22)	0.015 (0.24)	0.013 (0.25)
Middle	0.016 (0.13)	-0.007 (0.69)	-0.004 (0.70)	0.017 (0.07)≠	0.007 (0.58)	0.005 (0.63)

Own estimations using the Mexican National Survey of Addictions (ENA, 2011).
* Marginal effects
‡ Rho likelihood ratio test = 0: Chi2 = 6.24 Prob> Chi2 = 0.0125
§ Predict binge drinking: predicted value of binge drinking from the first stage.
# significant at 1%
& significant at 5%,
≠ significant at 10%
p-value in parentheses.
Estimation of the models with the sample design of the ENA 2011.

the data. However, the use of IV allowed us to reduce the reverse causality bias. We could not observe whether the individuals previously presented some type of psychological discomfort and that this was aggravated by alcohol consumption, nor observe whether the current consumption pattern was due to a past consumption pattern.

This study is representative of the population that consumed alcohol at least once in their life. Our analysis did not include participants who reported never having consumed alcohol as alcohol consumers is a population of high interest for public policies as they may be at higher risk of phycological discomfort. Our study showed that high consumers are even at higher risk of phycological discomfort compared to alcohol consumers that did not binge drink.

The ENA 2011 does not have a variable that indicates which municipality each participant belongs to. However, even though IVs are aggregated at the state level for this analysis, there is sufficient variability both in prices per liter of beer and in the density of alcohol

selling outlets that significantly explain binge drinking. The data from the ENA 2011 is nationally representative, therefore, the results of the study could be extrapolated to the population between 18 and 65 years of age who have consumed alcohol at some time in their life.

Individuals who present binge drinking and psychological discomfort together could experience individual consequences such as a decrease in the quality of life, low levels of education and unemployment.[37] In addition, economic consequences such as increased use of health services, decreased labor productivity and associated costs.[38,39] It is important to increase the supply of services focused on prevention, and training of human resources to prevent or mitigate these consequences.

Although average per capita alcohol consumption in Mexico (6.6 liters) is low compared to the average in the Americas in 2016 (8.0 liters),[40] the prevalence of binge drinking is high.[41] This is the first study in Mexico that analyzes the relationship between binge drinking and psychological distress, addressing potential reverse

causality. We obtained consistent and unbiased estimates with the use of instrumental variables. Failing to address this potential reverse causality would lead to underestimate the association, based on the results of the model without the IV.

This study highlights the need to develop interventional programs focused on prevention, treatment and rehabilitation actions for the population that experiences both psychological discomfort and binge drinking. Specific interventions at primary care facilities for prevention and treatment should be considered for the population with both disorders.[42] Strategies for reducing alcohol consumption should focused on reducing the availability of alcoholic beverages as the density of alcoholic selling outlets has been associated with binge drinking in Mexico.[43]

Declaration of conflict of interests. The authors declare that they have no conflict of interests.

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