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Are Alcohol Policies Associated with Alcohol Consumption in Low- and Middle-Income Countries?

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Abstract

Aims—To examine the associations between alcohol control policies in four regulatory domains with alcohol consumption in low- and middle-income countries (LAMICs), controlling for country-level living standards and drinking patterns.

Design—Cross-sectional analyses of individual-level alcohol consumption survey data and country-level alcohol policies using multi-level modeling

Setting—Data from 15 LAMICs collected in the Gender, Alcohol, and Culture: an International Study (GENACIS)

Participants—Persons aged 18–65

Measurements—Alcohol policy data compiled by the World Health Organization; individual-level current drinking status, usual quantity and frequency of drinking, binge drinking frequency, and total drinking volume; Gross Domestic Product based on purchasing power parity (GDP-PPP) per capita; detrimental drinking pattern scale; and age and gender as individual-level covariates

Findings—Alcohol policies regulating the physical availability of alcohol, particularly those concerning business hours or involving a licensing system for off-premises alcohol retail sales, as well as minimum legal drinking age, were the most consistent predictors of alcohol consumption. Aggregate relative alcohol price levels were inversely associated with all drinking variables ($p < .05$) except drinking volume. Greater restrictions on alcohol advertising, particularly beer advertising, were inversely associated with alcohol consumption ($p < .05$). Policies that set legal blood alcohol concentration (BAC) limits for drivers and random breath testing to enforce BAC limits were not significantly associated with alcohol consumption.

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Conclusions—Alcohol policies that regulate the physical availability of alcohol are associated with lower alcohol consumption in low- and middle-income countries.

Keywords

alcohol policy; low- and middle-income countries; alcohol consumption

INTRODUCTION

Although high-income countries (HICs) tend to have higher levels of alcohol consumption than low- and middle-income countries (LAMICs)—due mainly to a much higher proportion of abstainers in middle- and especially in low-income countries [1]—the relative harm associated with the given amount of alcohol consumed is much greater in LAMICs [2]. Alcohol is often consumed in more harmful patterns in developing countries [3] and is likely to interact with malnutrition, unsafe housing, and other aspects of lower living standards, increasing risks of mortality and morbidity [4]. With rising incomes and consumer purchasing power in LAMICs, along with more intensive marketing of branded alcohol beverages, alcohol consumption has increased in LAMICs [5]. Alcohol use is already the single largest behavioral risk factor for disease and disability in middle-income countries [6], and alcohol-related harms may increase further in LAMICs with increased consumption. Concerted policy and community efforts are needed to reduce alcohol-related harms in these parts of the world.

Alcohol policy is generally designed to reduce drinking and risky drinking situations by reducing the affordability of alcohol (e.g., through higher retail prices and taxes); regulating the physical availability of alcohol (e.g., through restrictions on alcohol sales and alcohol outlet densities); restricting alcohol advertising; and reducing the harms associated with risky, harmful, or hazardous drinking (e.g., through setting legal blood alcohol concentration (BAC) level for drivers and requiring servers to refuse to serve drinks to intoxicated patrons, etc.) [7, 8]. Much of the evidence demonstrating the effectiveness of these policies comes from HICs [5, 7, 9–21]. An emerging literature documents the current state of alcohol policy, public awareness, and enforcement efforts in LAMICs, mostly in single countries and mainly those concerning drinking driving [22, 23]. There is a paucity of policy-relevant research on LAMICs [24]. Cross-national studies of alcohol policies and alcohol consumption are rare, in part because of the difficulty of quantifying policies in a way that is comparable across countries [25]. To our knowledge, only two such studies have been reported to date [25, 26], both of which involve mostly HICs. No such study, particularly one that covers a broad range of regulatory domains, has been reported on LAMICs.

While HICs tend to have mature markets for industrially-manufactured alcoholic beverages [8, 26–28], more pervasive informal market activities in LAMICs [6, 29–32] may undercut the effectiveness of policies to regulate alcohol prices or availability. It is important to improve understanding of what specific policies might be more effective and what might be less effective. By examining the associations of alcohol policies and alcohol consumption in LAMICs, the current study aims to help fill the gaps in the current literature and inform future policy efforts in LAMICs.

In approaching this study, we note that drinking may be profoundly influenced by socioeconomic and cultural conditions. Alcohol consumption tends to be positively associated with a country's living standards, even in LAMICs [1, 6]. Also, drinking is a social affair to sociability or foster or express social unity, often guided by a variety of cultural and social practices [33, 34]. Drinking cultures, set in a historical and cultural context [35], may shape individual drinking behaviors by conveying norms regarding acceptable levels and patterns of alcohol use [36]. To the extent that a society's dominant drinking culture are at odds with the alcohol policies' goals, they may represent the forces resistant to policy "effects." Conversely, in societies where abstinence as a cultural norm is widespread, alcohol control policies may be supportive of this norm (and vice versa).

Given the potential influence of living standards and drinking cultures on alcohol consumption, it is important to account for them in evaluating the effectiveness of alcohol policy. The research question addressed in the current study, therefore, is: are alcohol policies—specifically, those that regulate physical availability of alcohol, age eligibility for purchasing alcohol, alcohol advertising, and motor vehicle operation after consuming alcohol, as well as those likely to result in higher relative alcohol price levels—associated with alcohol consumption in LAMICs after adjusting for drinking culture and living standards? We use multilevel modeling to predict individual-level drinking variables with alcohol policy variables in random intercept models, controlling for relevant individual and country-level covariates. Such models allow us to test hypotheses involving the *associations* between alcohol policies and aggregate country drinking measures (recognizing that causality cannot be determined in these cross-sectional data).

METHODS

Data and Measures

Alcohol Consumption Variables—Alcohol consumption data were extracted from the Gender, Alcohol, and Culture: an International Study (GENACIS) dataset, collected from individuals ages 18–65 in 38 countries including 15 LAMICs. Table 1 presents a summary of the methods used to collect GENACIS data in the 15 LAMICs included in our study. Using national or state/regional sampling frames (the latter generally involving large population centers), surveys were conducted in these countries between 1998 and 2005. More detailed descriptions of GENACIS data collection methods are provided elsewhere [37–39].

Five individual-level alcohol consumption variables were used in the present study: current drinking, usual quantity and frequency of drinking, binge drinking frequency, and drinking volume, all in the prior 12 months. Current drinking indicates having consumed any alcoholic beverages. Usual quantity indicates the typical number of drinks per drinking occasion, measured in grams of pure alcohol consumed per drinking day. Drinking frequency was assessed by the number of days in the last 12 months when alcohol was consumed, calculated using mid-points from nine categorical responses of never, once, twice, 3–6 times, 7–11 times, 1–3 times a month, once or twice a week, 3 or 4 times a week, and every day or nearly every day. Quantified in the same way, binge drinking frequency is defined as the number of days when five or more drinks (containing approximately 60 grams

of ethanol) were consumed in a single day. Drinking volume was calculated by multiplying usual drinking frequency by quantity per drinking day to give the estimated grams of ethanol consumed in the past 12 months [37]. As questions on drinking measures were somewhat different across countries, every effort was made to reconcile the differences. Further details are provided in previous publications [37, 38]. Natural logs of all drinking variables except the dichotomous current drinking variable were used in our analyses because of their extremely skewed distributions with long tails at higher levels.

Country-Level Predictors and Covariates

Alcohol control policies: Information on alcohol policies for each country was obtained from the 2004 WHO Alcohol Status Report reflecting the status of alcohol policies as of May 1, 2002 [40], approximately the middle of the survey epoch range. The only exception was India where alcohol policies are state-based; since we were able to obtain information on alcohol policies for Karnataka state [41] where the GENACIS survey was conducted, we used this in lieu of WHO data. Guided by two previous cross-national studies [26, 28], we focus on five alcohol policy domains: physical availability of alcohol, age eligibility for purchasing alcohol, alcohol prices, alcohol advertising, and motor vehicle operation. We did not include drinking context, as there was no publicly available information on it prior to 2008. Table 2 shows the policy measures we used. In addition to considering each policy variable, we also considered a summary measure for each of the domains with multiple variables.

We made concerted efforts to improve alcohol policy data to the extent possible. For example, we contacted GENACIS survey leaders to obtain policy data missing in the WHO report, and also asked those in countries where GENACIS data were regional whether alcohol policies were enacted and enforced nationally or varied by state or region. Those who replied—for example, survey leaders in Costa Rica and Nicaragua—confirmed that alcohol policies indeed were enacted and enforced nationally in their respective countries. As indicated above, we also used state-level policy data to the extent appropriate and possible.

Living Standards: Gross Domestic Product Per Capita: As a proxy for country-level living standards, we used 2004 gross domestic product based on purchasing power parity (GDP-PPP) per capita [42]. GDP-PPP is converted to international dollars using purchasing power parity rates to compare the welfare of inhabitants in real terms, controlling for differences in price levels [43].

Drinking Culture: Detrimental Drinking Pattern: Theoretical constructs or proxies that allow cross-national comparison of drinking cultures are rare. We considered one such available measure, detrimental drinking pattern (DDP). DDP captures the prevailing drinking pattern in a country that may affect the negative health impact of a given amount of alcohol consumed using a scale ranging from 1, for the least risky pattern, to 4 for the most risky [3]. The DDP scale is based on WHO's aggregate alcohol consumption data, population surveys, and key informant surveys conducted with experts selected by the WHO to assess the extent to which frequent heavy drinking, drunkenness, festive drinking at

community celebrations, drinking outside of meals, and drinking in public places are common in a particular society [44]. Central to the concept of DDP is the pattern of alcohol consumption commonly exhibited or socially accepted in a society, which may be considered normative in some societies but not in others [45]. Indicative of consuming any given volume in a more detrimental pattern [3], DDP as a proxy for country-level drinking culture may have a clear advantage over per capita consumption volume—an alternative proxy used in prior cross-national research [28], which is largely a function of individuals' drinking quantities and frequencies—as it allows us to avoid predicting individual-level drinking variables using country-level predictors that would be in effect aggregated from individual consumption data. The DDP scale was validated using population survey data from 13 countries, with a good correspondence between the orderings and country's values on the DDP scale [46], demonstrating the validity of the DDP scale as a summary measure of a country's cultural drinking pattern.

Data Analysis

Because of the nested data structure of individuals within countries, we fitted a series of multi-level random intercept models that allow prediction of variability in average drinking variables across countries after accounting for GDP-PPP per capita and DDP. As the predictors of interest in this study were country-level alcohol policies, only age and gender were included as fixed-effects individual-level covariates. An example of such a model predicting a continuous drinking variable is $y_{i,c} = \alpha_c + \beta_1 A_{i,c} + \beta_2 G_{i,c} + \varepsilon_{i,c}$ and $\alpha_c = \gamma_0 + \gamma_1 \text{GDP-PPP}_c + \gamma_2 \text{DDP}_c + \theta Z_c + u_c$ where: $y_{i,c}$ is the value of the drinking variable for the i^{th} respondent in the c^{th} country; $A_{i,c}$ and $G_{i,c}$ are their age and gender, respectively; Z_c is the value of a given alcohol policy variable for the c^{th} country; and u_c is a normal random variable with mean 0 and variance τ (i.e., the random intercept effect) uncorrelated with the level 1 residual ε . Model results reported in tables involve the estimated country-level parameter θ , interpreted as the change in the adjusted (for age and gender at the individual level, and for GDP-PPP and DDP at the country level) average drinking variable y for a country associated with an increase of 1 unit in the alcohol policy or domain composite variable Z .

Due to the relatively small number of level-2 units (i.e., countries) available for model estimation and to simplify model coefficient interpretation, the associations of each policy variable or domain composite with each of the dependent drinking variable were estimated in separate models. The relatively small number of countries available also precluded the inclusion of random effects for gender and age. Although such variability is likely present in the data and its omission may also lead to underestimation of parameter standard errors, the study of such variability was not a focus of the current study. All models were estimated using the mixed effects modeling functionality in Stata Version 12.

RESULTS

Alcohol Policies in LAMICs

The far-right column in Table 2 shows the distributions of alcohol policies in LAMICs included in this study. The vast majority (87%) of countries in our sample had a licensing

system for alcohol retail sales, and only a small minority did not, with none of them having a government monopoly. While a majority (60%) of the countries also had restrictions on business hours for off-premise alcohol sales, most of the them (80%) did not have restrictions on the density of off-premise alcohol retail outlets. All but two countries had a minimum legal drinking age (MLDA) of 18. Maximum legal BAC levels for drivers were in place in all the countries, with 53% of the countries having a BAC of 0.05 mg/dl or lower and the rest having higher BAC levels. About 40% of the countries never or rarely conducted random breath testing (RBT) to enforce the BAC limit, and the rest reported occasional enforcement, with none conducting RBT often or very often.

Results of Multi-level Analyses: Predictors of Alcohol Consumption

Table 3 summarizes the results of our multi-level analyses to examine the associations of individual alcohol policy variables and domain composites with each drinking variable. Controlling for GDP-PPP per capita and DDP, variables in the physical availability domain were significantly and inversely associated with most drinking variables, with requiring licenses for alcohol retail sales and imposing restrictions on business hours being associated with all drinking variables, and density of alcohol outlets with country averages of usual drinking frequency, binge drinking frequency, and total drinking volume. MLDA was significantly and inversely associated with all drinking variables.

Although the medium level of the domain composite of relative alcohol prices, as compared to the low level, was not significantly associated with any drinking variables, the high level was inversely associated with all drinking variables but average drinking volume. As for individual alcoholic beverage types, spirit price levels were inversely associated with average usual quantity, the medium level of wine price with usual drinking frequency, and the high level of wine price with binge drinking frequency, with the low level as the reference category.

More restrictive policies on alcohol advertising were inversely associated with some drinking outcomes. Greater restrictions on beer advertising were inversely associated with average usual quantity and drinking volume, restrictions on wine advertising with usual quantity, and restrictions on spirit advertising with usual quantity and total drinking volume. BAC level and RBT level were not significantly associated with any of the drinking variables.

For all drinking variables, coefficients for age and male (compared to female) were significant and positive so that alcohol consumption volume and frequencies were higher for men and for those who were older. GDP-PPP per capita was significantly and positively associated with most of the drinking variables. DDP was inversely associated with current drinking rates, usual drinking frequency, and total drinking volume in models to examine the associations of physical availability, alcohol advertising, and RBT with drinking outcomes. Given that these variables are not the substantive focus of the paper, specific results involving them are not reported here to reduce reporting complexity.

DISCUSSION

Our findings are consistent with past research from HICs to varying degrees. Consistent with such research [9, 15–17], we found that alcohol policies intended to reduce the physical availability of alcohol, particularly through restricted business hours and government monopoly or licensing system for alcohol sales, were associated with lower alcohol consumption in LAMICs as well. As found in recent research, MLDA was inversely associated with alcohol consumption, suggesting that exposure to permissive MLDA laws could affect not only drinking in young adulthood but also later in life [47]. These findings may temper previously-expressed concerns that policies intended to reduce the availability of alcoholic beverages in formal markets may not be effective in LAMICs because of the presence of large informal alcohol markets [29–32, 48, 49]. With increased marketing of industrially-manufactured alcoholic beverages, along with increased purchasing power in LAMICs [5], regulating formal alcohol markets may be an important strategy to reduce alcohol consumption and related harms.

We found that the high level of relative aggregate alcohol prices was inversely associated with all drinking variables but average drinking volume. Prices of individual alcoholic beverage types were also inversely associated with some drinking variables, for example, spirit price levels with average usual drinking quantity. These associations are mostly consistent with the evidence from HICs that higher prices may depress consumption [11–13]. As previously suggested [50], there may be similar price effects on alcohol demand in both developing and developed countries, at least on some aspects of drinking behaviors.

We found no significant associations between policies to regulate motor vehicle operation and alcohol consumption, which may be due, at least in part, to a varying degree of enforcements of such policies and a wide variety of cultural and socioeconomic conditions across LAMICs that may influence drinking and driving, which we were unable to assess.

The inverse associations between restrictions on alcohol advertising, particularly beer, and drinking variables suggest potential effectiveness of such policies. As found in tobacco research, advertising bans may be even more effective in LMICs than in HICs, even when they are limited and not comprehensive [51]. In the context of the emerging evidence that points to the persuasive power of alcohol marketing, possibly sufficient to turn non-drinking adults into drinkers in LAMICs [52] and the global exposure of young people to alcohol marketing [53–55], our findings support regulatory attention to restrict alcohol advertising in LAMICs.

We acknowledge the following limitations to the present study:

First, given the cross-sectional design of this study, causal relations between alcohol policies and drinking variables cannot be established. Caution is urged in interpreting our findings. While the significant associations observed may hint at the potential effectiveness of alcohol policies, it is equally possible that more restrictive policies are enacted in countries where alcohol is consumed less due to more conservative drinking cultures. Longitudinal research to evaluate the effectiveness of newly introduced alcohol policies in changing drinking norms and behaviors is warranted.

Second, there are measurement challenges involved in administering surveys cross-nationally, which may have hampered the reliability of our estimates reported in Table 3. Questions about drinking patterns were not exactly the same in all countries included in GENACIS. Some of the survey data were regional, which may not be generalizable to entire countries. Although additional stratification (e.g., by regions or states) was present in the data for a subset of countries, the small number of such strata precluded estimation of formal random effects at these levels. Omission of such strata may have led to underestimates of parameter standard errors and hence affect inferences. In these respects, this study shares limitations similar to those of prior studies using GENACIS data that the findings are less valuable for precise prevalence estimates than for identifying patterns of association between societal-level predictors and alcohol consumption across countries [37].

Third, WHO's alcohol policy data were collected through country self-reports with little external validation, which we acknowledge as an important limitation. Also, as widely noted [5, 7, 22], regulations are effective when backed up with enforcement. Not significant or weak associations between a specific policy and alcohol consumption, possibly due to weak enforcement, may have led to the underestimation of the effectiveness of the policy.

Fourth, with only 15 LAMICS countries included as level-2 units, the power to detect significant differences in effect sizes was limited.

Finally, while drinking cultures and norms, both on the societal and intimate network levels, may modify the effectiveness of alcohol policy, the measure of country-level drinking culture we used, DDP, captured such cultural norms only to a limited degree. We were unable to fully assess specific values, norms, and behaviors related to drinking, a limitation imposed by the paucity of comparably assessed measures across countries.

Even with these limitations, the current study has important strengths. Given that prior research on alcohol policy in LAMICs mostly involves single countries [1, 22], our study contributes to this literature by providing an important overview of alcohol policies implemented in LAMICs, which may be useful in generating hypotheses for future testing of more or less effective alcohol policies in the developing world using stronger, longitudinal designs. Importantly, the present study is the first one that evaluates the associations of alcohol policies and regulatory domains with drinking variables in LAMICs to offer clues as to what policy might work in LAMICs.

Overall, our findings suggest that some alcohol policies found to be effective in HICs may also work in LAMICs. Expansion of industrial production and marketing of alcohol is driving alcohol use to rise in emerging markets; cost-effective and affordable interventions to restrict alcohol-related harm exist, and are in urgent need of scaling up [56]. With few civic organizations being present whose mandate is to reduce alcohol-related harms, there has been a lack of non-governmental organization engagement [53, 57], while alcohol-industry funded organizations have promoted a 'partnership' role with governments to design national alcohol policies, as observed in some low-income countries [58]. There is a need to develop public health infrastructures in those countries to develop, enact, and then enforce comprehensive alcohol policies [5].

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Table 1

Countries Included and GENACIS Survey Characteristics

Country	Country Income Designation ^a	Survey Year	Age Range	Sample Size	Sampling Frame	GDP-PPP Per Capita ^b	DDP Score ^c
Argentina	upper-middle	2003	18–65	1000	regional	11456	2
Belize	upper-middle	2005	18+	3973	national	6391	4
Brazil	lower-middle	2002	17+	712	regional	8258	3
Costa Rica	upper-middle	2003	18+	2526	regional	9206	3
Czech Republic	upper-middle	2002	18–64	1273	national	16265	2
Hungary	upper-middle	2001	19–65	2243	national	15342	3
India	low	2003	16+	2597	regional	2849	3
Kazakhstan	lower-middle	2002	18+	1170	regional	7196	4
Mexico	upper-middle	1998	18–65	5711	national	9357	4
Nicaragua	low	2005	18+	2030	regional	2482	4
Nigeria	low	2003	18+	2064	regional	920	2
Peru	lower-middle	2005	18–65	1531	regional	5170	3
Sri Lanka	lower-middle	2002	18+	1193	regional	3827	3
Uganda	low	2003	18+	1478	regional	1442	3
Uruguay	upper-middle	2004	18–65	1000	national	12108	3

^a 2004 World Bank country income designations as reported in World Health Organization (2011) Global Status Report on Alcohol and Health^b 2004 Gross domestic product based on purchasing-power-parity (GDP-PPP) per capita as reported in the *International Monetary Fund World Economic Outlook Database*^c Detrimental drinking pattern (DDP) scores as reported in the World Health Organization Global Information System on Alcohol and Health database

Table 2

Alcohol Policies in 15 Low- and Middle-Income Countries

Domain	Alcohol Policies	Measures		Number of Countries (%)	
Physical availability	a. Restrictions on off-premise alcohol retail sales	0: no restriction 1: licensing system		2 (14%) 12 (86%)	
	b. Restrictions on density of off-premise alcohol retail outlets	m. beer outlet	0: No 1: Yes	11 (79%) 3 (21%)	
		n. wine outlet	0: No 1: Yes	11 (79%) 3 (21%)	
		o. spirits outlet	0: No 1: Yes	12 (80%) 3 (20%)	
		Outlet density [†] :	Sum of m–o		
		c. Restrictions on business hours for off-premise alcohol sales	0: none 1: on hours or days		6 (40%) 9 (60%)
	<i>Physical availability index</i>		Sum of a–c	-	
Eligibility to purchase alcohol	Minimum Legal Drinking Age	Age as a continuous measure		12 (7%) 18 (87%) 19(7%)	
Alcohol prices	d. Relative beer price level	Level of average beer price as a fraction of GDP-PPP per capita 0: low (0.000066699 or lower) 1: medium (0.0000677 – 0.00018) 2: high (0.000181 or higher)		4 (27%) 6 (40%) 5 (33%)	
	e. Relative wine price level	Level of average wine price as a proportion of PPP GDP per capita 0: low (0.000189 or lower) 1: medium (0.000190 – 0.001066) 2: high (0.001067 or higher)		6 (40%) 4 (27%) 5 (33%)	
	f. Relative spirit price level	Level of average spirit price as a proportion of PPP GDP per capita 0: low (0.00038 or lower) 1: medium (0.00039 – 0.00077) 2: high (0.00078 or higher)		4 (29%) 5 (36%) 5 (36%)	
	<i>Relative alcohol price level</i>		Using the sum of d–f: 0: low (0,1) 1: medium (2,3) 2: high (4–6)	- - -	
	Motor vehicles operation	i. Level of restriction involving legal BAC limit for adults	0: low (BAC higher than 0.50 mg/dl) 1: high (BAC of 0.50 mg/dl or lower)		7 (47%) 8 (53%)

Domain	Alcohol Policies	Measures	Number of Countries (%)
	h. Enforcement of RBT	0: none 1: rarely 2: sometimes 3: often 4: very often	4 (27%) 2 (13%) 9 (60%) 0 0
	Motor vehicles operation index	Sum of h, i	
	Alcohol advertising j. Beer advertising (Range: 0–12) k. Wine advertising (Range: 0–12) l. Spirits advertising (Range: 0–12)	Sum of restrictions on advertising of each beverage type on each of the four media, national TV, national radio, print media, and billboards, assessed using the scale of: 0: no 1: voluntary/self-regulation 2: partial statutory restriction 3: ban	Mean=3.9; SD [*] =3.8 Mean=4.3; SD [*] =3.6 Mean=4.4; SD [*] =3.4
	Alcohol advertising restrictions index	Sum of j–l	-

* SD: standard deviation

[†] Estimates for beer and wine outlet density were identical, which differed only slightly from the estimate for spirits outlet density. For brevity of reporting, we report the estimates using the summary measure of outlet density restrictions for all three beverage types.

Source (with the exception of India): *World Health Organization Global Status Report: Alcohol Policy (2004)*, Geneva, Switzerland: *World Health Organization*

Data for Karnataka state where GENACIS survey was administered in India are from *Gururaj et al., (2011). Alcohol Related Harm: Implications for public health and policy in India*, National Institute of Mental Health & Neuro Sciences. Bangalore, India.

Table 3

Coefficient Estimates of the Associations between Country-Level Alcohol Policy Variables and Country-Level Average Adjusted Drinking Outcomes in Low- and Middle-Income Countries

Alcohol Policies	Alcohol Consumption			
	Current Drinking Exp(θ) (95% CI)	Usual Quantity θ (95% CI)	Usual Frequency θ (95% CI)	Binge Drinking Frequency θ (95% CI)
Physical Availability				
<i>Physical availability index^a</i>	0.73** (0.60, 0.90)	-0.23** (-0.40, -0.06)	-0.30*** (-0.41, -0.20)	-0.14** (-0.22, -0.06)
Licensing system ^b	0.58* (0.34, 0.97)	-0.50* (-0.91, -0.09)	-0.65*** (-0.93, -0.38)	-0.23* (-0.45, -0.01)
Density of outlets ^b	0.83 (0.65, 1.05)	-0.13 (-0.33, 0.07)	-0.19* (-0.35, -0.03)	-0.11* (-0.20, -0.02)
Restrictions on business hours ^b	0.54** (0.36, 0.81)	-0.40* (-0.77, -0.03)	-0.63*** (-0.83, -0.44)	-0.30*** (-0.46, -0.15)
Eligibility to Purchase Alcohol				
Minimum legal drinking age	0.81 (0.69, 0.94)*	-0.14 (-0.28, -0.002)*	-0.14 (-0.26, -0.03)*	-0.07(-0.14, -0.0003)*
Alcohol Price Levels				
<i>Relative alcohol prices level^c</i> :				
medium	0.83 (0.45, 1.53)	0.15 (-0.41, 0.70)	-0.42 (-0.85, .01)	-0.25 (-0.53, 0.03)
high	0.26** (0.12, 0.57)	-0.87* (-1.58, -0.17)	-0.94** (-1.48, -0.41)	-0.42* (-0.78, -0.06)
Beer price level ^c :	0.82 (0.39, 1.75)	0.12 (-0.47, 0.72)	-0.43 (-0.97, 0.12)	-0.22 (-0.54, 0.10)
high	0.47 (0.16, 1.38)	-0.46 (-1.31, 0.40)	-0.41 (-1.20, 0.37)	-0.17 (-0.63, 0.29)
Wine price level ^c :	0.61 (0.32, 1.17)	-0.18 (-0.75, 0.38)	-0.66** (-1.06, -0.25)	-0.21 (-0.47, 0.06)
medium	0.44 (0.16, 1.20)	-0.49 (-1.36, 0.37)	-0.60 (-1.22, 0.02)	-0.46* (-0.86, -0.05)
high	0.69 (0.34, 1.38)	-0.57* (-1.07, -0.06)	-0.45 (-1.01, 0.12)	-0.28 (-0.60, 0.03)
Spirit price level ^c :	0.42 (0.17, 1.04)	-0.78* (-1.45, -0.12)	-0.60 (-1.34, 0.14)	-0.12 (-0.53, 0.29)
medium				
high				
Motor Vehicles Operation				
<i>Motor vehicles operation index^d</i>				
BAC level ^d : .05 mg/dl	1.10 (0.87, 1.41)	0.09 (-0.11, 0.28)	-0.06 (-0.24, 0.11)	0.03 (-0.07, 0.13)
RBT level ^e : rare enforcement	1.08 (0.61, 1.94)	-0.05 (-0.56, 0.47)	-0.18 (-0.61, 0.24)	0.20 (-0.05, 0.45)
occasional enforcement	1.23 (0.47, 3.23)	0.35 (-0.41, 1.12)	-0.06 (-0.78, 0.66)	-0.17 (-0.58, 0.25)
	1.41 (0.75, 2.66)	0.36 (-0.14, 0.87)	-0.12 (-0.60, 0.35)	-0.01 (-0.28, 0.27)

Alcohol Policies	Alcohol Consumption				
	Current Drinking Exp(θ) (95% CI)	Usual Quantity θ (95% CI)	Usual Frequency θ (95% CI)	Binge Drinking Frequency θ (95% CI)	Total Drinking Volume θ (95% CI)
Alcohol Advertising^d					
<i>Alcohol advertising index</i>					
Beer advertising	0.99 (0.97, 1.00)	-0.02* (-0.03, -0.01)	-0.01 (-0.03, 0.01)	-0.002 (-0.01, 0.01)	-0.03* (-0.06, -0.01)
Wine advertising	0.95* (0.90, 1.00 [†])	-0.06** (-0.11, -0.02)	-0.03 (-0.08, 0.01)	-0.01 (-0.04, 0.01)	-0.09* (-0.16, -0.02)
Spirit advertising	0.96 (0.89, 1.03)	-0.06* (-0.11, -0.01)	-0.04 (-0.09, 0.01)	-0.004 (-0.04, 0.03)	-0.09 (-0.18, 0.01)
	0.95 (0.88, 1.02)	-0.07* (-0.12, -0.02)	-0.04 (-0.10, 0.01)	-0.01 (-0.04, 0.03)	-0.11* (-0.20, -0.01)

* p<.05,
** p<.01,
*** p<.001;

^aTreated as a continuous predictor
^bCategorical predictor with 'no restriction' as the reference category
^cCategorical predictor with 'low level' as the reference category
^dCategorical predictor with 'BAC higher than 0.05 mg/dl' as the reference category
^eCategorical predictor with 'no enforcement' as the reference category
[†]The upper limit of the 95% CI is 0.998.

θ is the country-level alcohol policy parameter in the multilevel model: $Y_{i,c} = \alpha_c + \beta_1 A_{i,c} + \beta_2 G_{i,c} + \varepsilon_{i,c}$ where $\alpha_c = \gamma_0 + \gamma_1 GDP_PPP_c + \gamma_2 DDP_c + \theta Z_c + u_c$.

Drinking outcomes are modeled separately and each alcohol policy variable Z is estimated in a separate model.

Models estimating usual quantity, usual frequency, binge drinking frequency, and total volume utilize multilevel linear regression models; models estimating current drinking utilize multilevel logistic regression models.