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Population-Level Alcohol Consumption and Homicide Rates in Latin America: A Fixed Effects Panel Analysis, 1961-2019

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Abstract

Latin America and the Caribbean (LAC) possesses 8% of the global population but approximately one-third of global homicides. The region also exhibits high per capita alcohol consumption, risky drinking patterns, and a heterogeneous mix of beverage preferences. Despite this, LAC violence receives limited attention in the English-language literature and there are no studies of the population-level alcohol-homicide association in the region. We examined the effects on total, male, and female homicide rates of total and beverage-specific alcohol consumption (22 nations, 1961-2019) and of risky drinking patterns (20 nations, 2005 and 2010). We collected homicide and alcohol data from the World Health Organization. Panel fixed effects models showed (1) per capita total and wine consumption were positively associated with total, male, and female homicide rates, though effects were much stronger for males, (2) per capita beer consumption was positively associated with total and male homicide rates, (3) per capita spirits consumption was not associated with homicide rates, and (4) nations with riskier drinking patterns had higher total, male, and female homicide rates than those with less risky drinking patterns.

Keywords: homicide, Latin America and the Caribbean, alcohol, culture, gender

Alcohol consumption in Latin America and the Caribbean (LAC) is among the highest globally, and its drinking pattern among the most dangerous. Annual per capita consumption in the Americas (which also includes North America, but alcohol data are often grouped in this manner) is ~8.4 liters, which is higher than the global average of 6.4L and second only to Europe at 9.8L. The Americas also has one of the lowest proportions of lifetime abstainers at ~17% of the population and the second highest prevalence of alcohol use disorders (AUD) at 8.2%. AUD in LAC is also second highest in the world for males at 11.5% and for females at 5.1% (Chrystoja et al., 2021; Medina-Mora et al., 2021). A significant proportion of consumption occurs via episodic heavy drinking in the Americas, while beverage preference throughout the LAC region specifically is highly heterogenous (World Health Organization, 2022a).

Alcohol use is a leading risk factor for disease burden in the Americas (Chrystoja et al., 2022). In 2016, one-third of all years of life lost were due to alcohol, with 30% of those due to self-harm and interpersonal violence. Alcohol is a leading cause of death for males aged 15-49 years, and about 1 in 12 male deaths is attributed to alcohol (Chrystoja et al., 2022; Medina-Mora et al., 2021). In the Americas generally, alcohol is responsible for 6.7% of Disability-Adjusted Life Years lost, compared to a global average of 5.1% (World Health Organization, 2018). In 2016, 372,00 deaths in the Americas were due to alcohol use (Chrystoja et al., 2022).

LAC violence rates are remarkably higher than in most world regions. The Pan American Health Organization labeled violence the social pandemic of the century in the Americas (Imbush, 2011). The region is home to <10% of the global population but one-third of global homicides. More than two-thirds of LAC nations meet the World Health Organization's (2022b) threshold of endemic violence (10 homicides per 100,000 residents), with the regional mean >10.

The population-level association between alcohol and homicide is consistent (Hockin et al., 2017; Norström, 2001; Rossow, 2004; Pridemore, 2016; Pridemore & Chamlin, 2006; Weiss et al., 2018), though there remains a scarcity of research on the topic and the mechanisms by which the association operates (Hockin et al., 2017), especially in LAC. Pyne et al. (2002) laid out three central areas of the research gap on alcohol-related harm to address in LAC, including the (1) uneven distribution of alcohol research in LAC, with up to 90% of studies on Brazil, Argentina, and Mexico (Cremonte et al., 2018), (2) lack of research on alcohol and violence, including gender differences, and (3) need for longitudinal studies. Our study addressed all three.

There are meaningful reasons to focus on alcohol, homicide, and LAC. First, at the national level using homicide rates as the primary outcome is due both to the serious nature of the crime and to measurement validity. The legal definitions of non-lethal violent crimes vary by nation, and sometimes even by jurisdiction within nations, and there is considerable variation in unrecorded non-lethal violent events across nations. Thus, cross-national scholars employ homicide rates due to their similarity in definition and measurement across nation. In LAC specifically, studies indicate that relative to measures of other crimes homicide is the least unrecorded crime and the most frequently employed indicator of violence (Vilalta, 2020). Therefore, employing homicide as an outcome allows us to make more reliable national comparisons and to contribute both to this nascent literature on LAC and the cross-national homicide literature more generally. Similarly, while we do not necessarily make the claim here, recent work by van Breen et al. (2023) suggests national homicide rates may be a proxy of sorts for the overall violent crime rate.

Second, LAC requires dedicated attention. Despite its persistent high violence rates, criminologists have only recently begun producing more systematic empirical analyses in the

region (Bergman, 2018; Briceño-León, 2012; Chainey et al., 2021; Elias et al., 2022; Escaño & Pridemore, 2023; Navas & Navas, 2022; Ponce et al., 2021). In the past, most studies treated LAC as a monolith via inclusion of a LAC dummy variable (Chon, 2011; Concha-Eastman et al., 2020; Fajnzylber et al., 1998; Neapolitan, 1994; Santos et al., 2018; Soares & Naritomi, 2010; Schargrodsky & Freira, 2021; Tuttle et al., 2018). This may be entirely reasonable in the context of those studies, but the LAC region has distinct experiences and challenges yet is rarely studied independently with samples of only LAC nations and over time (Croci & Chainey, 2022; Escaño & Pridemore, 2023; Rivera, 2016). Thus, the region deserves focused attention, and one of the areas of inquiry is naturally on the structural covariates of homicide rates.

Third, LAC faces a heavy burden of alcohol. Cremonte et al.'s (2018) analysis of the epidemiology of alcohol consumption in LAC reveals serious problems to be studies. Violence may be one of those problems. Our data reveal substantial national-level heterogeneity across time and space in total consumption, beverage-specific consumption, and risky drinking patterns. Of course, there is also substantial national-level variation in violence rates in LAC, but there are few studies of the alcohol-violence association at any level in the region. Chon (2011) appears to be the only study to examine the cross-national association between alcohol and homicide in LAC in some way. This was not the key point of his study, however, and he addressed the association only indirectly using a larger global sample and employing a dummy variable for LAC nations. There are also other potential mechanisms at the event level, like consumption at *fútbol* (soccer) matches and festivals, and the cultural level, like risky drinking patterns, that are worth exploring in the region. We are unable to test for the effects of the first two here, but in the Discussion we use them to help contextualize our findings.

We tested three mechanisms through which population-level alcohol consumption may be associated with national homicide rates in LAC, examining the effects of total consumption, beverage-specific consumption, and risky drinking patterns. We tested for effects on total, male, and female homicide rates. Most research on alcohol-related harm, including population-level studies of alcohol and homicide, is on Western and developed nations (Crementon et al., 2018), with substantially less attention to LAC and to the global South more generally. Similarly, studies using more global samples may mask differential regional effects due to their social, historical, cultural, and policy contexts of alcohol. By focusing on LAC specifically we can account for regional context, discover region-specific associations, and determine if any associations in LAC are consistent with those found elsewhere.

Literature Review

The theoretical and empirical literatures suggest an association between per capita alcohol consumption and homicide rates. Bruun et al. (1975) outlined the total consumption model. Heavy drinkers suffer and inflict a large proportion of alcohol-related harm in a society, and per capita consumption is highly correlated with heavy drinking prevalence. Therefore, greater total consumption often means outcomes like a larger number of heavy drinkers, more drinking occasions, more intoxication occasions, and thus more harm (Norström, 2001; Rossow & Mäkelä, 2021). This suggests total per capita consumption may be positively associated with violence rates, and national and cross-national research provides evidence of this for total, male, and female homicide rates (Hockin et al., 2017; Rossow, 2001, 2004; Weiss et al., 2018).

There may also be beverage-specific effects on homicide rates, and thus "to the extent that various alcoholic beverages may be dominant in different drinking contexts, a differential effect of alcoholic beverages on violent behaviour may be expected" (Rossow, 2001, p. S79).

This is important in LAC given heterogeneous alcohol preferences throughout the large region. Smart (1996) argued that relative to beer, spirits consumption can increase blood alcohol concentration rapidly due to higher ethanol content. A standard drink is a standard drink, but ethanol concentration in spirits makes quicker and deeper intoxication easier. Per capita spirits consumption has been shown to be associated with homicide rates (Hockin et al., 2017; Norström, 2001; Razvodovsky, 2003). On the other hand, some studies showed effects of per capita beer or wine consumption on homicide rates (Hockin et al., 2017; Rossow, 2001), and there are no cross-national studies examining beverages-specific effects in LAC, and so we tested all three.

Finally, any population-level alcohol-homicide association may be better explained by risky drinking patterns. With harm more generally, "measuring drinking patterns to account accurately for the impact of alcohol consumption on people's health and wellbeing is more complex than simply ascertaining the amount of alcohol consumed" (World Health Organization, 2014, p. 35). Thus, alcohol-related harm in a nation may be less a function of consumption amount and more of consumption pattern. Contrary to the total consumption model, high population consumption does not always translate to more harmful drinking. Two nations may have similar per capita consumption, but in Nation A this amount could result from many more drinking occasions with less alcohol in each, while in Nation B there are fewer drinking occasions but a larger amount of alcohol in each. There is greater drinking to intoxication in the latter, increasing the risk for negative outcomes, including violence (Lenke, 1990; Norström et al., 2001; Rossow, 2001). Evidence supports this hypothesis. Several studies showed hazardous drinking patterns – measured via heavy episodic drinking, drinking pattern scores, or similar proxies – are strongly associated with homicide rates (Bye, 2008; Hockin et al., 2017; Pridemore, 2002, 2004; Pridemore & Chamlin, 2006; Weiss et al., 2018). Felson et al. (2011) found

adolescent drinking was more closely associated with violence in Nordic and East European nations, where drinking to intoxication is more common, than in Mediterranean nations, where moderate drinking is more common. The number of cross-national studies of this association remains limited, however, and we are aware of no such studies in LAC .

Data and Methods

Sample and Timeframe

Data on total and beverage-specific alcohol consumption were available for 1961-2019, and on drinking patterns for 2005 and 2010, and thus we tested effects with two different samples. LAC has 33 nations[1] in four parts: North America (Mexico), Central America, Greater and Lesser Antilles (the Caribbean), and South America. Nations generally considered part of LAC are those with the *lingua franca* rooted in Latin: Spanish, French, and Portuguese. Unreliable or missing homicide data for a large proportion of years led us to drop, in some combination for each sample, the Lesser Antilles[2] nations, Bolivia, Haiti, and Honduras. The final total and beverage-specific sample included 22 nations: Argentina, Belize, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Suriname, Trinidad and Tobago, Uruguay, and Venezuela. The final drinking patterns sample included 20 nations: Argentina, Belize, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, Peru, Suriname, Trinidad and Tobago, Uruguay, and Venezuela. We dropped Guyana and Panama from this sample due to missing data.

Dependent Variable

We obtained homicide data from the World Health Organization's (2022b) Mortality Database, using the International Classification of Diseases 7^{th}-10^{th} revision data files. The WHO

Mortality Database is the most reliable cross-national homicide data source (Pridemore & Rogers, 2023). Homicide is categorized as E964 and E980-E985 in ICD-7, E960-E978 in ICD-8, E960-E969 in ICD-9 and X85-Y09 in ICD-10[3]. We calculated rates using national population as the denominator (United Nations, 2022) and multiplying by 100,000. Using the Mortality Database means we employed only original raw homicide counts. An alternative WHO source, the Global Health Observatory, sometimes employs a range of data homicide sources and imputes homicide estimates for many nations, resulting in potentially fatal limitations for cross-national analyses (Kanis et al., 2017; Rogers & Pridemore, 2023).

Main Independent Variables

We operationalized population-level alcohol consumption in three ways. First, we obtained data on total per capita consumption in liters of ethanol among those aged 15+ years. To test for beverage-specific effects we obtained data on per capita consumption in liters of ethanol among those aged 15+ for each of beer, wine, spirits, and other alcohol types. According to WHO, the latter consists of fermented beverages made from sorghum, maize, millet, rice, cider, fruit wine, and fortified wine (World Health Organization, 2022a). Third, we obtained data on WHO's Patterns of Drinking Score, which reflects how people drink rather than how much they drink and is calculated using surveys gauging risky drinking patterns. Scores range from 1 to 5, with higher scores reflecting riskier drinking (Rehm et al., 2001; Rehm et al., 2003; World Health Organization, 2011, 2014). These measures are consistent with prior research on population-level drinking and cross-national homicide rates (e.g., Hockin et al., 2017).

Control Variables

We included several controls based on the cross-national homicide literature. The first was poverty, for which we employed the commonly used proxy of infant mortality (World Bank,

2022a). We obtained data on income inequality from the Standardized World Income Inequality Database (SWIID) (2022). SWIID estimates the Gini coefficient in two ways, disposable income inequality and market-income inequality. We used the latter because Solt's (2020) analyses suggested it is a better estimate across countries and over time. We controlled for general economic well-being using GDP per capita in current US$ (World Bank, 2022b). We controlled for urbanism using the proportion of a nation's population living in urban areas (World Bank, 2022c). We included controls for the proportion of the male population aged 15-24 (World Bank, 2022d, 2022e) and for the percentage of the labor force unemployed (World Bank, 2022f). Finally, we controlled for education using information from the Human Development Index, which combines adult literacy rates with primary, secondary, and tertiary gross enrollment rates (United Nations Development Program, 2022).

Model Estimation

We estimated effects for total, male-, and female-specific homicide rates using the following panel two-way fixed effects models:

$$\text{homicide}_{it} = \beta_0 + \beta_1 \text{ Total Per Capita Alcohol Consumption} + \beta_2 X_{it} + \alpha_i + \varepsilon_{it}$$

$$\text{male homicide}_{it} = \beta_0 + \beta_1 \text{ Total Per Capita Alcohol Consumption} + \beta_2 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$\text{female homicide}_{it} = \beta_0 + \beta_1 \text{ Total Per Capita Alcohol Consumption} + \beta_2 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$\text{homicide}_{it} = \beta_0 + \beta_1 \text{Beer}_{it} + \beta_2 \text{Wine} + \beta_3 \text{Spirits} + \beta_4 \text{Other} + \beta_5 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$\text{male homicide}_{it} = \beta_0 + \beta_1 \text{Beer}_{it} + \beta_2 \text{Wine} + \beta_3 \text{Spirits} + \beta_4 \text{Other} + \beta_5 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$\text{female homicide}_{it} = \beta_0 + \beta_1 \text{Beer}_{it} + \beta_2 \text{Wine} + \beta_3 \text{Spirits} + \beta_4 \text{Other} + \beta_5 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$\text{Ln (homicide}_{it}) = \beta_0 + \beta_1 \text{ Drinking Pattern Score} + \beta_2 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$\text{Ln (male homicide}_{it}) = \beta_0 + \beta_1 \text{ Drinking Pattern Score} + \beta_2 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$$\text{Ln (female homicide}_{it}) = \beta_0 + \beta_1 \text{ Drinking Pattern Score} + \beta_2 X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

$Homicide_{it}$, male $homicide_{it}$, and female $homicide_{it}$ represent the homicide rate for nation *i* in year *t.* The main β parameters represent the main independent variable in each model. βX_{it} is the vector of time-varying nation-level variables, α_i and γ_t are unit and time fixed effects that account for unit-specific (time invariant) and time-specific (unit invariant) unobserved confounders, and ε_{it} is the error term.

For the first six models we dropped the education, Gini, and unemployment controls due to a high level of data missingness resulting from our time frame going all the way back to 1961. In subsequent models examining the stability of our results we included these three controls in models using more recent years for which data were available. None was significantly associated with homicide rates, and retaining these would not have allowed us to examine such a long time period for the effects of total and beverage-specific consumption on homicide rates. We did retain these controls in the drinking patterns models because data missingness was not an issue when we used only 2005 and 2010.

For the first six models examining total and beverage-specific effects, tests revealed no significant autocorrelation but did find heteroskedasticity, and so we used heteroskedasticity-robust standard errors (Stock & Watson, 2008). We also found these six models were overfitted when time-fixed effects were included, with too many predictors and not enough degrees of freedom. To resolve this, we shortened the time interval to 2015 and used 5-year average period indicators for 1961-1964, 1965-1969, 1970-1974, 1975-1979 1980-1984, 1985-1989 1990-1994, 1995-1999, 2000-2004, 2005-2010, 2011-2015. We ignored any missing data when creating the 5-year averages. For the final three models testing the effects of drinking patterns we used the natural log of the homicide rates because multiple indicators suggested non-normality and Tukey's ladder suggested a natural log correction (Rogers & Pridemore, 2017). During these

years none of the nations in our sample scored a 1 (Least Risky) or 5 (Most Risky). Our models compared nations with Medium Risky and with Very Risky drinking patterns to nations with a Somewhat Risky drinking pattern. Heteroskedasticity and serial correlation were present in these three models and thus we used robust clustered standard errors (Stock & Watson, 2008).

Results

Descriptive Statistics

Table 1 shows mean annual values for total, male, and female homicide rates between 1961 and 2019 for 25 nations in the LAC region. This is for illustrative purposes only as we did not include all these nations in our analyses due to missing or unreliable data. Colombia had the highest and Peru the lowest total, male, and female mean homicide rate over this period. Some nations like Haiti and Honduras show lower rates than Peru in this table, but official data on these nations are unreliable as they are known to have much higher homicide rates. Table 1 also shows mean annual values for per capita consumption of total, spirits, beer, wine, and other alcohol, and preferred alcohol type from 1961 and 2019 for 25 nations in the LAC region. Guatemala had the lowest mean total per capita alcohol consumption at 2.3L, and Argentina the highest at 12.3L. The tenth column reveals the heterogeneity in the region on preferred alcohol type. For a few nations (e.g., Bolivia, Jamaica) the preferences are not distinct. For several nations, however, the preference is clear. The table also shows mean annual values for drinking pattern scores averaged for 2005 and 2010 for 25 nations in the LAC region. No nation scored a 1 (Least Risky) or 5 (Most Risky) in these two years. Argentina and Cuba had the lowest mean drinking pattern score at 2 (Somewhat Risky). Belize and Guatemala had the highest mean drinking pattern score at 4 (Very Risky), and both nations had a clear preference for spirits, though their per capita spirits consumption did not stand out relative to other LAC nations. Table

2 shows summary statistics for all variables in the per capita consumption sample at the beginning (1961), middle (1990), and end (2019) years of our timeframe. Table 3 shows summary statistics for all variables in the drinking patterns sample.

There is substantial temporal and geographic heterogeneity in alcohol beverage preference and in drinking patterns in LAC. Figure 1 shows that spirits were the beverage of preference at the beginning of our study period, with spirits per capita consumption twice that of beer and wine. Beer consumption increased steadily throughout the period, however, and the popularity of spirits began to decline in the 1980s. Beer became the dominant alcohol beverage in the early 2000s. In the large and populous nations of Mexico and Brazil, drinking is less integrated into everyday life, and these nations are known for heavy episodic drinking during national holidays and other significant social events (Pyne et al., 2002). In the Southern Cone, on the other hand, daily wine consumption is part of the drinking culture in nations like Chile, Uruguay, and Argentina. Thus, while these nations rank among the highest in LAC for per capita consumption, they tend to have less risky drinking patterns.

Panel Fixed Effects Models

Holding all other variables constant and accounting for unit and time fixed effect unobserved heterogeneity, Table 4 shows positive and significant effects of total per capita alcohol consumption on total, male, and female homicide rates. Overall, a one-liter increase in per capita consumption is associated with an increase of 1.35 total homicides per 100,000 residents ($p = .014$). While significant for both males and females, effects were much stronger for men ($b=2.50$, $p=.018$) than women ($b=0.23$, $p=.005$).

Table 5 provides results for beverage-specific effects on total, male, and female homicide rates, holding all other variables constant and accounting for unit and time fixed effect

unobserved heterogeneity. Results show no significant effects of per capita spirits consumption on homicide victimization in LAC. Per capita beer consumption is positively and significantly associated with the total homicide rate (b=4.36, p=.38), though Models 2 and 3 reveal this is a function of effects on male (b=8.47, p=.035) but not female (b=0.21, p=.45) victimization rates. Per capita wine consumption is positively and significantly associated with total (b=3.10, p=.002), male (b=5.65, p=.002), and female homicide rates (b=0.58, p<.001) in LAC, though effect size is much larger for male relative to female victimization. Finally, while there are no significant effects of other types of alcohol consumption on homicide rates, effect sizes for total and male homicide victimization are very large (b=9.72 and b=18.07, respectively) and p-values relatively low (p=.13 for both). This may deserve further attention at lower levels of analysis or in specific places, as official consumption of other alcohol types is very low.

Table 6 provides results for effects of drinking pattern scores on the natural logarithm of total, male, and female homicide rates in LAC, holding all other variables constant and accounting for unit and time fixed effect unobserved heterogeneity. We compared nations with medium and with very risky patterns to nations with somewhat risky drinking patterns. Recall no nations exhibited the least or most risky drinking patterns. Relative to nations with a somewhat risky drinking pattern, nations with a medium risky drinking pattern and nations with a very risky drinking pattern possessed significantly higher total, male, and female homicide rates.

Discussion

Rates of interpersonal violence in LAC are higher than in any other region in the world. Homicide is endemic in the region, the regional mean homicide rate is greater than 10 per 100,000 residents, LAC is responsible for about one-third of all homicides in the world despite possessing less than 10% of global population, and violence has been declared the social

pandemic of the century in the Americas. Within the Americas generally (including North America) alcohol consumption is high, with regional per capita consumption second only to Europe, and drinking patterns are among the riskiest in the world, with ~8% of all male deaths attributable to alcohol. Despite this, the causes and consequences of interpersonal violence in LAC receive limited attention in the English-language literature. The same is true of alcohol, and of the association between alcohol and violence. A few other studies included LAC nations in larger global samples, but this masks region-specific effects. Thus, our study makes important contributions to the violence, substance use, and area studies literatures. Despite generally high violence and consumption rates, Table 1 shows tremendous variation in both, and in beverage preference, in this large region. Ours is among the first studies to directly address the alcohol-homicide association in LAC, especially (for total and beverage-specific effects) over such a long period.

Our results showed that (1) per capita total and wine consumption were positively associated with total, male, and female homicide rates, though the effect for males was much stronger than for females, (2) per capita beer consumption was positively associated with total and male homicide victimization rates, (3) per capita spirits consumption was not associated with homicide rates, and (4) nations with riskier drinking patterns had higher total, male, and female homicide victimization rates than those with less risky drinking patterns. The importance of studying LAC region-specific effects is clear from this pattern of results. While findings from the limited number of other cross-national studies of alcohol and violence are mixed, they tend to show some patterns from which ours diverge. For example, spirits consumption is often found to be associated with violence rates, but we found no association, and wine consumption commonly has null or even negative effects on violence (though see Rossow, 2001, for positive effects in

some nations), but we found positive associations with total, male, and female homicide rates. On the other hand, our findings are consistent with prior research for positive effects on homicide of total consumption and the stronger effects for male relative to female homicide victimization rates.

Chon (2011) was the only study to examine the cross-national association between alcohol and homicide in LAC in some way, though he did so indirectly. His study reconsidered Neapolitan's (1994) attempt to explain high homicide rates in LAC via 'machismo,' arguing this led to a violent subculture in the region. Chon (2011, p. 306) countered that "Latin Americans do not commit a high level of homicide because they are intrinsically violent or have violent subculture." Instead, he argued, a large proportion of citizens in these nations face economic conditions known to be associated with higher violence rates. Chon's results challenged the machismo explanation but did not allow him to thoroughly examine the alcohol-homicide association in the region, which was not central to his analysis. First, he used a larger global sample and employed a dummy variable for LAC nations. Second, he used only a per capita total alcohol consumption measure. Third, his analysis was cross-sectional, while our panel approach provided a stronger design, allowing us to employ six decades of data and control for unit and time fixed effects. Fourth, it appears Chon employed the imputed homicide data from the World Health Organization instead of raw counts from WHO's Mortality Database. This presents potentially serious limitations because, among other things, the homicide estimates (1) draw from different data sources depending upon nation and (2) use population-level variables, including alcohol consumption patterns, to impute homicide rates (Kanis et al., 2017; Rogers & Pridemore, 2023). In cross-national homicide studies, the latter means that commonly used

structural covariates – including poverty, percent young male, urbanization, and in this case alcohol – are included on both sides of the regression equation.

Although restrictive alcohol control policies are relatively uncommon in LAC (Andreuccetti et al., 2012), a few studies found alcohol policies designed to limit consumption reduced homicides. Interventions limiting alcohol sales after certain hours produced homicide declines in Brazil (Duailibi et al., 2007), Colombia (Sanchez et al., 2011), and Peru (Malaga et al., 2019). Similarly, laws in Brazil limiting alcohol consumption during election periods were associated with homicide declines (Biderman et al., 2008). The findings of these studies may tap into drinking activity theory, which considers the convergence of alcohol availability, consumption, and harms. Studies of this include those of situational settings like elections and sporting events that alter the chances of what Livingston et al. (2007) called the "proximity effect." Thus, a reduction of alcohol-related harm in LAC nations may accrue from eliminating or limiting consumption in such settings (Briceño-León et al., 2008; Cano & Rojido, 2022; Stringer et al., 2019).

Fútbol (soccer) is one of the most important cultural institutions in the LAC region (Ridge, 2022), and Crawford (2009) discussed the intersection of sporting events and alcohol consumption, especially beer. Increases in violence are not uncommon during *fútbol* matches. Alcohol consumption added to already heightened emotions can be a dangerous mix and may increase the likelihood of violent outcomes. Most studies of alcohol consumption and violence among *fútbol* fans have been on Europe, with mixed empirical results (Ostrowsky, 2018). There are no such studies in LAC nations, however, although the number of fans and others killed in or around stadiums is significantly higher in LAC than in Europe (Ostrowsky, 2018). For instance, in Brazil between 2009 and 2019 there were 157 killed, the death toll in Argentina during the last

20 years was 136, and at least 170 were killed in Colombia between 2001 and 2019. The number of non-lethal violent events is far higher. Some measures have been taken by governments to curb violence in and around stadiums during matches, including alcohol sales restrictions.

In addition to sporting events, festivals are another common situational setting in the region that allow individuals to congregate and to consume alcohol (Crawford, 2009; Ostrowsky, 2018). These events are typically male dominated, making participants susceptible to excessive behavior in performative gender roles related to masculinity, which can increase the risk of violence. Women are also vulnerable to victimization during these events. Studies have shown, for example, that domestic violence increases during major soccer events like World Cup tournaments (Kirby & Birdsall, 2022). Some scholars refer to this as the holy trinity of alcohol, sports, and domestic violence (Williams & Neville, 2014), and when the latter increases so do the chances of femicide (Zara & Gino, 2018). Separately, studies also showed that alcohol consumption increased across LAC during the pandemic (Garcia-Cerde et al., 2021), as did domestic violence and femicide (de Souza Santos et al., 2022).

Heavy episodic drinking and hazardous consumption differ between men and women in LAC nations, and gender appears to play a major role in drinking patterns and alcohol-related injuries in the region. The level of negative consequences resulting from the association between gender roles and alcohol consumption appears to be higher in LAC than in Western Europe (Andreuccetti et al., 2012; Graham et al., 2011). In LAC binge drinking is more common among men, especially given the number of male-dominated social occasions like sporting events and festivals that promote binge drinking. Female involvement in many of these events is more limited, and it is less acceptable for them to be seen to be intoxicated than men (Pyne et al., 2002). Thus, Andreuccetti et al. (2014) concluded alcohol-related injuries had less to do with

alcoholic beverage of choice but more with the culture and contextual gender roles in which the choice of alcohol exists in these nations.

Some of our findings are mixed relative to the prior literature, though they do not depart strongly. One potential difference is the positive effect of beer consumption (though Hockin et al. 2018, found a positive beer-homicide association in their cross-national study with a global sample). Studies show that while total alcohol consumption decreased in the past 30 years in LAC, the same is not true of beer. Our Figure 1 shows beer consumption increased during this period and that beer is now the dominant alcoholic beverage in the region, overtaking spirits consumption in the early 2000s (World Health Organization, 2022a). LAC now possesses one of the highest levels of beer consumption among all regions in the world. Arancibia et al. (2021) suggested a few reasons for this. First, since the early 1990s most nations in the region began to develop the infrastructure to mass produce this beverage. During this period, the price of barley and malt decreased as the region increased production, thus reducing dependence on imports. The combination of these forces made beer more accessible and affordable over time in LAC. Second, research suggests that marketing significantly increased the cultural integration of beer consumption in the region at social occasions like festivals, sporting events, and traditional events and celebrations (Arancibia et al., 2021; Robaina et al., 2020). Third, as in other regions the alcohol industry strongly influenced national alcohol policy in LAC many nations, resulting in an increasingly favorable business environment (Arancibia et al., 2021; Robaina et al., 2020). Finally, the region is mostly tropical and humid, perhaps making beer a favorable refreshing beverage compared to wine or spirits. Over time, commercialization, industrialization, marketing, climate, and cultural integration has made beer the alcoholic beverage of choice over wine and spirits in LAC.

These and related dynamics might have influenced the nature of consumption generally and of specific alcoholic beverage types in the region, and that might influence their association with violence in complex ways. There may be a couple of reasons why we found no effects between spirits and homicide. The overall trend of spirit consumption decreased at a time when other social forces began to push the LAC homicide rate higher. Alternatively, unrecorded alcohol consumption accounts for about 15% of LAC's total alcohol volume consumed. Distilled spirits account for 92% of this illicit alcohol production and consumption. Research suggests this is due to the high price of spirits in the formal market, making spirits more susceptible to entering the illicit market and making it more affordable (Euromonitor International, 2018). Our measure of spirits consumption only included recorded consumption, potentially influencing our results. Lastly, it is reasonable that the population-level association between spirits and violence, and the typical lack of an association between wine and violence rates (though see Rossow, 2001), often found elsewhere simply do not hold in LAC. Those previous studies primarily examined Western and developed nations. Different world regions exhibit different drinking patterns, drinking cultures, and overall cultures, and thus it is not unusual to find regional differences in their national-level alcohol-violence associations. Our region-specific findings may tap into something unique about the experience of LAC that demands further clarifying attention, and more research on the region is needed to contextualize the beverage-specific effects on homicide, and the alcohol-violence association more generally.

Limitations

Due to unreliable data or a large proportion of missing observations for some nations, we were unable to include all LAC nations. A common definition of LAC includes 33 nations, however, and we included 22 of these in our analyses. Second, we excluded the common

controls of income inequality, unemployment, and education in our total and beverage-specific models because data on these variables were not consistently available in the early years of our 6-decade study period. However, recent analyses of social structure and homicide in the region using panel analyses (but not examining alcohol consumption) from 2000 to present showed no significant effects of any of these variables on homicide rates in the region (Escaño & Pridemore, 2023). Third, our results are generalizable only to LAC and not to a global sample, though determining region-specific effects was the goal of our study. Fourth, there is substantial sub-national variation on alcohol consumption and violence within many nations, and thus within-nation studies would be informative, though reliable local data on alcohol and violence are sparse. Finally, while we had decades-long panel data for our per capita consumption models, our drinking patterns analyses covered only two years due to data availability from WHO.

Conclusion

LAC ranks among the highest in the world for alcohol-related burdens and experiences the highest regional homicide rates globally. Our goal was to determine if the two covary over time and space in the region, especially given (1) limited attention to cross-national research on this association, (2) a focus in the literature on Western nations, with limited research on LAC and the global south more generally, and (3) the gaps in alcohol research in the region outlined by Pyne et al. (2002). Focusing on region-specific effects allows us to consider cultural and social forces influencing homicide and alcohol consumption in LAC.

The population-level association between alcohol and violence may operate through different mechanisms and vary for men and women, and so we tested for the potential effects on total, male, and female homicide victimization rates of total per capita consumption, beverage-specific per capita consumption, and risky drinking patterns. Our results showed effects of per

capita total, wine, and beer, but not spirits, consumption, and that nations with riskier drinking patterns had higher total, male, and female homicide victimization rates than those with less risky drinking patterns. Where effects were present they were significantly stronger for male relative to female homicide victimization. Our findings for total consumption and drinking patterns were consistent with prior research, though departed somewhat from earlier findings for some beverage-specific effects. This reveals the importance of examining region-specific associations, which allows for a richer interpretative lens via consideration of political, geographic, social, and cultural contexts (Stamatel, 2006). Finally, among other things, future alcohol research on the region should consider subnational effects in individual nations, the impact on violence of alcohol policies, the role of alcohol in violence against women, and the effects of large social events like holidays, festivals, and *fútbol* matches on drinking and violence.

Endnotes

[1] Which nations are part of LAC is contested by area specialists. Some argue that non-Spanish- or Portuguese-speaking nations should be excluded due to linguistic, cultural, and political differences. While French-speaking, Haiti is sometimes excluded. English-speaking nations in the Caribbean – Belize, Guyana, Jamaica, and Trinidad and Tobago – are sometimes defined as the West Indies and not part of LAC due to their similarities in language, culture, politics, and overwhelmingly African diaspora (Colburn, 2002).

[2] Sovereign nations of the Lesser Antilles are Antigua and Barbuda, Bahamas, Barbados, Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, and St. Vincent and the Grenadines. Other islands are not sovereign nations or are territories of other nations.

[3] Our homicide data from ICD-9 and ICD-10 do not include deaths from legal interventions, though we were unable to separate out these deaths from the ICD-7 and ICD-8. These are a very small proportion of all homicides. Further, as a sensitivity test we estimated effects using only years with ICD-9 and ICD-10 data. Interpretations for all alcohol variables (i.e., total and beverage specific consumption) remained the same as those using all the years in the sample (and thus ICD-7 and ICD-8). The only substantive difference was for one non-alcohol variable, poverty, which was significant in all models using only the ICD-9 and ICD-10 data years.

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Table 1 Average Total, Male, and Female Homicide Rate; Annual Total Per Capita Consumption in Liters of Ethanol Among Those Aged 15+ for All Type, Beer, Wine, Spirits, and Other Type; Most Consumed Alcohol Type; and Drinking Pattern Score for Each Nation, 1961-2019

Nation	Total Homicide	Male Homicide	Female Homicide	All Type	Beer	Wine	Spirits	Other Type	Preferred Alcohol	Drinking Pattern Score
Argentina	4.9	9.79	1.74	12.35	1.71	9.2	1.29	0.23	Wine	2
Belize	9.7	29.6	2.2	5.93	2.49	0.18	3.2	0.07	Spirits	4
Bolivia	0.07*	0.11*	0.07*	3.07	1.51	0.08	1.45	0.02	Beer	3
Brazil	29.08	53.74	4.76	4.84	2.39	0.36	2.07	0.02	Beer	3
Chile	3.27	5.81	0.79	8.8	1.75	5.02	2.01	0.002	Wine	2.5
Colombia	43.5	81.4	6.67	5.07	3.38	0.05	1.61	0.01	Beer	3
Costa Rica	5.2	8.86	1.46	4.31	1.23	0.1	2.92	0.01	Spirits	3
Cuba	5.21	7.76	2.63	3.52	1.38	0.08	2.04	0.01	Spirits	2
Dominican Republic	5.74	9.92	1.46	4.35	1.72	0.08	2.52	0.02	Spirits	2.5
Ecuador	10.09	18.09	1.99	2.74	1.54	0.09	1.09	0.009	Beer	3.5
El Salvador	39.57	74.63	6.64	2.36	0.86	0.02	1.46	0.006	Spirits	3
Guatemala	23.42	42.48	4.54	2.28	0.75	0.02	1.5	0.004	Spirits	4
Guyana	8.31	13.62	3.04	5.71	1.47	0.05	4.19	0.02	Spirits	3

Haiti*	0.79	1.35	0.24	5.08	0.06	0.01	4.99	0.003	Spirits	3
Honduras*	6.5	11.6	1.42	2.36	1.07	0.02	1.26	0.001	Spirits	3
Jamaica	5.02	9.01	1.08	3.39	1.64	0.13	1.55	0.10	Beer	2.5
Mexico	16.16	29.59	2.88	4.24	3.16	0.08	0.95	0.06	Beer	3.5
Nicaragua	9.77	17.7	1.9	3.43	0.86	0.02	2.54	0.001	Spirits	3.5
Panama	7.7	13.65	1.62	5.07	2.98	0.12	1.95	0.001	Beer	3**
Paraguay	8.07	14.53	1.47	6.2	2.13	0.57	3.46	0.03	Spirits	3
Peru	1.9	3.22	0.59	5.57	2.2	0.23	3.13	0.004	Spirits	3
Suriname	4.08	5.84	2.28	5.81	2.29	0.11	3.36	0.07	Spirits	3
Trinidad & Tobago	11.84	19.91	3.89	4.93	1.96	0.15	2.27	0.04	Spirits	2.5
Uruguay	4.23	6.9	1.68	6.92	1.65	4.1	1.04	0.18	Wine	3
Venezuela	16.04	29.7	2.27	7.37	4.58	0.13	2.63	0.02	Beer	3

**Note:* Nations with * did not have enough data from the WHO Mortality Database to include them in our models, so this table shows the average annual homicide rate using WHO's imputed values. For these nations this is solely illustrative to provide information about their level of violence. In all modeling we used only nations with non-imputed raw homicide data from the WHO Mortality Database. The data are only available from 2000 to 2018 (World Health Organization, 2022c).
***Note:* Nations with ** only reported for one year.

Table 2 Summary Statistics for Total and Beverage-Specific Sample at Beginning (1961), Middle (1991), and End (2019) of Time Frame (N = 1,450)

	1961		1991		2019	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Total homicide rate (per 100,000 residents)	12.14	11.12	14.09	20.92	13.20	10.81
Male homicide rate (per 100,000 male residents)	22.01	20.93	25.66	39.52	23.89	20.15
Female homicide rate (per 100,000 female residents)	2.35	1.65	2.76	2.96	2.9	2.42
Total consumption	4.22	3.41	5.57	2.53	4.69	1.68
Spirits	2.29	1.84	2.77	1.63	1.51	0.79
Beer	1.02	0.89	2.02	1.33	2.56	1.10
Wine	0.90	3.00	0.75	2.05	0.51	0.96
Other types	0.01	0.01	0.02	0.07	0.09	0.16
Infant mortality (per 1,000 births)	100.42	42.10	38.26	20.19	15.56	9.18
Percent of population living in urban areas	44.09	15.67	59.58	16.79	69.18	16.49
Percent of population that is male and aged 15-24	17.61	1.022	19.61	1.29	17.89	2.39
Gross Domestic Product per capita in US$	360.37	213.50	1999.14	1305.35	8098.99	4855.96

Table 3 Summary Statistics for Drinking Pattern Score Sample (age 15+) for 2005 and 2010 (*N* = 50)

Variable	Mean	Standard Deviation	Minimum	Maximum
Homicide rate	17.11	14.60	0	57.37
Male homicide rate	31.00	27.49	1.42	103.93
Female homicide rate	3.93	3.16	0.11	13.56
Natural logarithm of homicide rate	2.44	1.02	-0.26	4.04
Natural logarithm of male homicide rate	2.97	1.06	0.35	4.64
Natural logarithm of female homicide rate	1.01	0.94	-2.12	2.60
Drinking pattern score	2.88	0.61	2	4
Infant mortality	20.28	13.79	5.1	102.6
Percent young males	18.79	1.90	13.84	22.58
GDP per capita in US$	6997.86	5726.00	781.27	30279.39
Unemployment	7.26	3.33	1.95	18.7
Education	0.70	0.07	0.45	0.83
Income inequality	46.24	3.75	37.2	54
Percent urban	60.43	19.88	18.45	94.41

Table 4 Panel Fixed Effects Models for Total, Male, and Female Homicide Rate Regressed on Total Per Capita Alcohol Consumption in LAC Nations, 1961-2019.

	Model 1: Total Homicide			**Model 2: Male Homicide**			**Model 3: Female Homicide**		
	FE (n = 235 periods, 22 nations)			**FE (n = 235 periods, 22 nations)**			**FE (n = 235 periods, 22 nations)**		
	B	**SE**	**P**	**B**	**SE**	**P**	**B**	**SE**	**P**
Total per capita consumption	1.35	0.51	0.014	2.50	0.97	0.018	0.23	0.07	0.005
Infant mortality	0.08	0.24	0.29	0.13	0.05	0.01	0.01	0.02	0.44
Percent urban	-0.16	0.24	0.51	-0.27	0.46	0.55	-0.04	0.05	0.39
Percent young males	0.007	0.52	0.99	0.01	0.99	0.99	0.05	0.10	0.60
GDP per capita	0.00004	0.0006	0.94	0.0001	0.001	0.88	-0.00007	0.0001	0.49
Constant	3.33	12.57	0.79	5.01	23.37	0.83	0.80	3.01	0.79
R^2 (within-nations)	0.21	—	—	0.21	—	—	0.39	—	—
R^2 (between-nations)	0.03	—	—	0.04	—	—	0.0006	—	—

Note. Robust standard errors.

Table 5 Panel Fixed Effects Models for Total, Male, and Female Homicide Rate Regressed on Per Capita Spirits, Beer, Wine, and Other Type Consumption in LAC Nations, 1961-2019.

	Model 1: Total Homicide			**Model 2: Male Homicide**			**Model 3: Female Homicide**		
	FE (n = 174 periods, 22 nations)			**FE (n = 174 periods, 22 nations)**			**FE (n = 174 periods, 22 nations)**		
	B	**SE**	**P**	**B**	**SE**	**P**	**B**	**SE**	**P**
Spirits	0.13	0.53	0.82	0.31	1.01	0.76	-0.02	0.11	0.89
Beer	4.36	1.97	0.038	8.47	3.76	0.035	0.21	0.27	0.45
Wine	3.10	0.86	0.002	5.65	1.65	0.002	0.58	0.11	0.0001
Other types	9.72	6.24	0.13	18.07	11.46	0.13	1.36	1.39	0.34
Infant mortality	0.38	0.15	0.016	0.70	0.28	0.02	0.06	0.02	0.02
Percent urban	-0.47	0.11	0.0001	-0.86	0.50	0.10	-0.09	0.04	0.03
Percent young males	0.48	0.26	0.08	0.91	1.17	0.44	0.17	0.11	0.13
GDP per capita	0.0001	0.0005	0.83	0.0003	.001	0.77	-0.00004	0.00009	0.63
Constant	-11.21	16.68	0.02	-21.35	32.96	0.52	-1.87	3.05	0.55
R^2 (within-nations)	0.29	—	—	0.29	—	—	0.45	—	—
R^2 (between-nations)	0.00001	—	—	0.0001	—	—	0.006	—	—

Note. Robust standard errors.

Table 6 Panel Fixed Effects Models for Natural Logarithm of Total, Male, and Female Homicide Rate Regressed on Drinking Pattern Score in LAC Nations, 2005 and 2010.

	Model 1: Natural Logarithm of Total Homicide			**Model 2: Natural Logarithm of Male Homicide**			**Model 3: Natural Logarithm of Female Homicide**		
	FE (n = 34 periods, 20 nations)			**FE (n = 34 periods, 20 nations)**			**FE (n = 34 periods, 20 nations)**		
	B	**SE**	**P**	**B**	**SE**	**P**	**B**	**SE**	**P**
Drinking Pattern Score									
2 (Somewhat Risky)	—	—	—	—	—	—	—	—	—
3 (Medium Risky)	1.52	0.16	0.0001	1.59	0.16	0.0001	1.25	0.12	0.0001
4 (Very risky)	1.33	0.27	0.0001	1.34	0.28	0.0001	1.33	0.15	0.0001
Infant mortality	-0.05	0.04	0.25	-0.07	0.05	0.16	0.05	0.03	0.14
Gini index	-0.08	0.05	0.12	-0.07	0.05	0.18	-0.15	0.03	0.0001
Percent urban	0.02	0.04	0.65	0.04	0.05	0.43	-0.09	0.03	0.00
Percent young males	1.57	0.15	0.0001	1.58	0.16	0.0001	1.65	0.12	0.0001
GDP per capita	.0006	.00004	0.0001	0.0006	0.00004	0.0001	0.0004	0.00002	0.0001
Unemployment	0.67	0.05	0.0001	0.69	0.05	0.0001	0.64	0.03	0.0001
Education	-0.26	7.41	0.97	-0.88	7.77	0.91	10.35	4.76	0.04
Constant	-33.48	6.00	0.0001	-30.42	6.44	0.0001	-29.46	4.67	0.0001
R^2 (within-nations)	0.97	—	—	0.96	—	—	0.98	—	—
R^2 (between-nations)	0.17	—	—	0.02	—	—	0.02	—	—

Note. Standard errors clustered on country are in parentheses.

Figure 1 Regional Mean Series for Per Capita Total, Beer, Wine, Spirits, and Other Alcohol Consumption, 1961-2019