Check for updates

European Journal of Criminology

Article

Population-level alcohol consumption and national homicide rates

European Journal of Criminology
1–18
© The Author(s) 2017
Reprints and permissions:
sagepub.co.uk/journalsPermissions.nav
DOI: 10.1177/1477370817731042
journals.sagepub.com/home/euc
SAGE

Sara Hockin
Georgia State University, USA

Meghan L. Rogers
University of North Carolina – Wilmington, USA

William Alex Pridemore
University at Albany – State University of New York, USA

Abstract

We explored the cross-national association between population-level alcohol consumption and homicide victimization rates. The very few prior studies of this association had small homogeneous sample sizes and usually tested only for a linear effect, ignoring other commonly hypothesized explanations. We employed a cross-sectional design, with data from 83 nations, and controlled for several possible covariates. We used exploratory data analysis, weighted least squares regression, and piecewise regression to model total, male, and female homicide victimization rates. We tested for linear effects of total per capita consumption, threshold effects, effects due to risky drinking patterns, and beverage-specific effects of per capita beer, wine, and spirits consumption. We found cross-national homicide rates were not sensitive to threshold effects and nations with riskier drinking patterns did not have higher homicide rates than nations with less risky drinking patterns. Results showed total per capita alcohol consumption was associated with total, male, and female homicide rates, though this association concealed beverage-specific effects. Per capita beer and spirits consumption was positively and significantly associated with total, male, and female homicide victimization rates, whereas our findings suggested per capita wine consumption might be negatively associated with homicide rates. The impact of alcohol consumption on cross-national homicide rates is understudied relative to other population health outcomes, and the few prior analyses did not test the four most common explanations of a possible association. Our findings provide an important contribution to better understanding this complicated relationship.

Corresponding author:
Sara Hockin, Department of Criminal Justice and Criminology, Georgia State University, 1213 Urban Life Building, Atlanta, GA 30302, USA.
Email: shockin1@gsu.edu

Keywords
Alcohol, binge drinking, cross-national analysis, homicide, victimization

More than 3 million deaths worldwide are attributable to alcohol consumption annually, making it a leading risk factor for premature mortality (Lim et al., 2012; WHO, 2014). Yet alcohol has received limited attention in criminology in recent decades relative to allied disciplines. A growing body of work, however, shows alcohol is related to the risk of individual-level violent offending (Felson and Staff, 2010) and victimization (Felson and Burchfield, 2004), including homicide victimization (Pridemore, 2016). Population-level research on the alcohol–homicide association is rarer, though time series analyses provided evidence of a relationship in Canada (Rossow, 2004), Russia (Pridemore and Chamlin, 2006), Sweden (Norström, 2001), and the US (Norström, 2011).

Although the empirical literature on cross-national homicide is growing rapidly, studies of the cross-national association between population-level alcohol consumption and homicide rates are exceedingly scarce. A small number of studies found an association (Bye, 2008; Norström et al., 2001) but were limited to a very a few European nations. Another limitation is that these studies tested only for a linear association, ignoring other potential explanations of a population-level alcohol–homicide association, including threshold effects, national drinking patterns, and beverage-specific effects of beer, wine, and spirits.

We make several key contributions to the literature on cross-national homicide and the association between population drinking and violence rates. First, we used a much larger and much more diverse sample of nations than prior studies. Second, we tested each of the four most common explanations of this association. Third, we tested for effects on total, male, and female homicide victimization rates. These contributions make ours the most comprehensive study thus far of the population-level alcohol–homicide association cross-nationally.

Literature review

The literature suggests four main ways population-level alcohol consumption may be associated with homicide rates: a linear effect based on total consumption, a threshold effect where an impact occurs only when total consumption reaches a certain level, a non-linear effect based on a nation's prevailing pattern of hazardous drinking, and an effect due to beverage preference. We tested for all four types of effects in our study.

The total consumption model and linear effects

One argument for a population-level association between alcohol and homicide rates rests on the idea of total alcohol consumption, first proposed by Bruun and colleagues (1975) in their examination of alcohol policies and public health. The relevant component of the total consumption model here is that higher levels of overall consumption in a nation indicate a larger number of heavy drinkers who are most prone to violent offending and victimization (Rossow, 2001). This is analogous to the idea that, as overall

individual consumption increases, so does the number of drinking occasions and the number of occasions on which a person is intoxicated (Norström et al., 2001), both of which increase the risk for violent offending and victimization. Thus, this suggests a positive association between total population-level alcohol consumption and homicide victimization rates (Parker, 1998).

A handful of studies employed time series analyses of single nations or cross-sectional analyses of multiple nations to examine this association. Rossow (2004) performed a time series analysis of alcohol sales and homicide in Canada using 50 years of data. She examined the association for separate provinces and for the nation as a whole, finding a linear model more adequately represented the association relative to other models. Pooling estimates from provinces resulted in a statistically significant positive association, with a 1-liter increase in per capita consumption leading to an increase in homicides per capita of 0.12. The effect size was stronger for males than for females. Norström and colleagues (2001) conducted time series analysis with a sample of 14 European countries, finding a linear association between per capita consumption and male homicide victimization rates for about half of these nations. Bye (2008) conducted a similar analysis of six East European countries and found a positive association between total consumption and homicide rates, with a linear model best fitting the data.

Threshold effects

Whereas most scholars assume any relationship between alcohol consumption and homicide rates is linear, others suggest any linear association may be masking a threshold effect (Hahn et al., 2010; Pridemore, 2013). The argument is that increases in individual- or population-level total alcohol consumption below a certain threshold should not be expected to result in increased violence. Above that threshold of consumption, however, certain social problems may accrue. Some studies found evidence of a threshold effect for the relationship between violence and alcohol consumption at the individual level (O'Leary and Schumacher, 2003; Pridemore, 2013, 2016; Shepherd and Brickley, 1996). To our knowledge there are no population-level studies examining this possibility, which means we are unsure of the level of total consumption that would serve as a threshold for an association with homicide rates. Therefore, we make a novel contribution to the literature by testing the threshold hypothesis, and we do so by exploring several potential threshold levels.

Non-linear effects due to hazardous drinking

Another hypothesis for an association between population-level drinking and homicide rates is an effect due to the prevailing drinking pattern within a nation or culture. In some countries light drinking in small amounts is integrated into everyday social activities, such as wine with meals. This is indicative of what some scholars refer to as a 'wet' drinking culture and is characteristic of Southern European countries such as France and Italy (Parker, 1998). This may result in high per capita consumption but be less strongly associated with rates of acute harm because the number of drinks per drinking occasion is lower (Lenke, 1990). In other countries, drinking to intoxication is the prevailing

pattern of consumption. Often referred to as binge drinking, this 'dry' drinking culture is more prevalent in Northern European countries such as Norway and Sweden (Norström, 1995). In these nations, drinking occasions are more infrequent, consumption per occasion is heavier, and total annual per capita consumption tends to be lower. Thus, although two countries may report similar levels of total alcohol consumption per capita, their drinking patterns and thus alcohol's association with harmful consequences could be different.

Much of the empirical literature on drinking patterns and violence focuses on an apparent north–south gradient of drinking cultures in Europe. Traditionally this was categorized as the dry drinking culture with a preference for beer in Northern and Central Europe and the wet drinking culture with a preference for wine in Southern Europe. One study concluded the 'north–south gradient in the alcohol effect on accidents and homicide accords with the expectation based on national differences in intoxication drinking' (Norström et al., 2001: 162). Time series analyses of West European countries found countries in the Nordic region, which tend to exhibit a dry drinking pattern, showed a stronger relationship between alcohol and homicide than countries in Southern Europe (Norström et al., 2001; Rossow, 2001). Lenke (1990) found Sweden had a stronger link between violence and alcohol than France, which he suggested is due to the binge drinking patterns in Sweden, though Norström (1988) found no effect of consumption patterns for Denmark and Finland. Some of these studies, though (like the Norström, 1988, analysis), were of suicide and not homicide.

One reason for a potential impact of drinking pattern on homicide rates and other negative outcomes such as mortality (Razvodovsky, 2003a) may be due to the pharmacological effects of intoxication relative to less hazardous drinking patterns. This implies that, in cultures where drinking to intoxication is the prevailing pattern, homicide rates will be higher (Lenke, 1990; Norström et al., 2001; Rossow, 2001). At the individual level, research suggests offending, victimization, and even severity of injury are associated with intoxication (Shepherd et al., 1989; Wells and Graham, 2003). At the structural level, Rossow et al. (1999: 1028) emphasized a wet drinking environment 'may be a provocative setting for violent behavior and that violence may easily be triggered by others' drunkenness.'

Another argument for an association between a national pattern of binge drinking and homicide is the decline in the strength of social bonds that results from problem drinking. Norström (1995) studied the relationship between alcohol and national suicide rates and found it stronger in countries with a dry drinking pattern. He theorized that, in dry drinking cultures, frequent and heavy drinking might be viewed as more unacceptable by peers. This ostracizes the heavy drinker and weakens bonds with family, friends, and the community. Homicide may follow a similar pattern because those with weaker social bonds are more likely to become victims and offenders.

Studies of Eastern Europe and Russia compared drinking patterns and homicide and found stronger associations in countries with hazardous drinking patterns. Using data on men in Poland, the Czech Republic, and Russia, Bobak and colleagues (2004) found, despite Russia having lower per capita alcohol consumption compared with the other countries, its binge drinking and negative consequences of drinking were highest. Pridemore (2002) found cross-sectional and longitudinal associations between alcohol

consumption and homicide rates and speculated the association is due to Russia's pattern of binge drinking and perhaps its beverage preference for spirits. There are fewer studies on the impact of population-level differences in drinking pattern for countries outside Europe. In one study, Norström (2011) disaggregated data from the US to examine regional differences in the relationship between intoxication and homicide and found mixed results. A study of emergency room data from 14 countries by Cherpitel et al. (2005) found drinking patterns and drinking before an injury event were significantly associated with violence-related injuries.

Bobak and colleagues (2004) warned using the term 'binge drinking' might mask heterogeneity in how much is consumed and the effects of different large amounts. Further, over time wet and dry cultures have become less distinct and it is increasingly difficult to differentiate between them, at least in Europe. There are also some nations, especially East European nations such as Russia (Pridemore, 2006), that possess a binge drinking pattern but also have very high per capita consumption. Rehm et al. (2001) developed a hazardous drinking pattern score based on several indicators of problem drinking, including heavy drinking occasions, high usual quantity of alcohol per occasion, daily or near daily drinking, getting drunk, festive drinking, drinking with meals, and drinking in public places. A nation will exhibit a more hazardous drinking pattern when it ranks high in multiple facets of the scale, and a nation ranking high on one part of the scale may have a lower overall score. This hazardous drinking scale allowed us to test the hypothesis that a cross-national association between alcohol consumption and homicide rates is not a linear function of total consumption but is due to a nation's prevailing drinking pattern.

Beverage preference

Cultural preferences for different types of alcohol may also contribute to the differences in population-level homicide rates. Most studies that assess the effects of alcohol type on violence and/or homicide examine the varying impacts of beer, wine, and spirits.

Smart (1996) suggested two reasons for a differential impact on violence by beverage type. First, compared with beer, on average blood-alcohol concentration when consuming spirits can increase to a higher level quicker. Although units of ethanol (that is, a 'standard drink') are equivalent across beverage types, spirits represent a very efficient ethanol delivery vehicle because of the much higher ethanol content (Pridemore, 2006). Although the pharmacological impact of types of alcohol on behavior is an individual-level factor, it may act as a compositional effect and aggregate to the national level if there is a clear beverage preference for spirits in a nation.

Another explanation is alcohol expectations (Smart, 1996). Behavior when drinking different beverages may depend on cues from peers and culture. MacAndrew and Edgerton (1969) called this 'drunken comportment,' arguing behavior while intoxicated is partially due to social learning, with some cultures using alcohol as an excuse for bad behavior. Pernanen (1993) emphasized cultural norms of specific contexts. Intoxication can create excessive behavior (Scribner et al., 1995) that develops into normative behavior in certain situations (Pernanen, 1993; Scribner et al., 1995). Thus, nations with cultural scripts for drinking or when drinking certain beverages may be prone to more violence. Thus, Rossow (2001) argued '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.'

Studies showed spirits consumption had a stronger association with homicide rates than beer or wine. Using Swedish national time series data, Norström (2001) found an association between spirits (but not beer or wine) sales and homicide rates. Razvodovsky (2003b) found the Belorussian violent mortality rate – especially deaths 'due to homicides, suicides, accidents and injuries, and to a lesser degree with mortality due to road accidents' – to be more closely related to per capita spirits (specifically vodka) consumption than to overall alcohol consumption.

Hypotheses

Based on our discussion of the theory and research, we tested four hypotheses:

1. There is a positive association between total per capita alcohol consumption and cross-national homicide victimization rates.

2. There is a threshold effect such that nations in which total per capita alcohol consumption is over a certain level will have higher homicide rates.

3. Nations that score higher on the World Health Organization's Patterns of Drinking Scale (WHO, 2014) will have higher homicide rates than those that score lower.

4. Nations with greater total per capita consumption of spirits will have higher homicide rates.

Data and method

Sample

The unit of analysis in this study was the nation. The Appendix lists the nations in the sample. Owing to missing data, sample sizes varied across models from 77 to 83 nations.

Dependent variable

The dependent variables were total, male-, and female-specific homicide victimizations per 100,000 residents, averaged over six years (2005–10). We obtained data on homicide – defined using the World Health Organization's International Classification of Diseases codes as deaths due to injuries purposely inflicted by another person, ICD-10 X85-Y09 – from the World Health Organization Statistical Information System (WHOSIS) database (WHO, 2015b).

Population-level alcohol consumption

We operationalized population-level alcohol consumption in various ways to capture the theoretical concepts that generated our hypotheses. We obtained data on all alcohol consumption measures from the WHO's Global Information System on Alcohol and Health

(GISAH) (WHO, 2015a). These data are also available via the *Global Status Report on Alcohol and Health 2014* (WHO, 2014) and the *Global Status Report on Alcohol and Health 2011* (WHO, 2011).

To test the first hypothesis we measured total per capita consumption in liters of ethanol among those aged 15+ years. We used the same measure, but with several various thresholds, to test the second hypothesis. To test the third hypothesis about hazardous drinking patterns we used the WHO's Patterns of Drinking Score (Rehm et al., 2001, 2003; WHO, 2014), which reflects how people drink rather than how much they drink and is calculated using surveys measuring risky drinking patterns. The score ranges from 1 to 5, with higher scores representing riskier drinking patterns (see WHO, 2014, Appendix IV for details on survey questions and methods). To test beverage preference hypotheses we obtained data on total per capita consumption in liters of ethanol for each of beer, wine, spirits, and other alcohol types among those aged 15+ years. According to the WHO's *Global Status Report on Alcohol and Health, 2014*, 'other' alcohol types are defined as fortified wines, rice wine, and other fermented beverages made from sorghum, millet, or maize (WHO, 2014: 31)

Control variables

We included several structural covariates of national homicide rates. These included infant mortality as a proxy for poverty (obtained from WHO, 2015b; Pridemore, 2008), the male–female sex ratio (WHO, 2015b), the proportion of the working-age population unemployed (World Bank, 2015), the proportion of the population living in urban areas (World Bank, 2015), and the education component of the Human Development Index (United Nations, 2013).

Method

Exploratory data analysis, including various graphing techniques such as scatterplots with best-fit lines and notched box plots, indicated multiple variables required transformation to make them approximately normal. To establish the transformation that would result in the most approximately normal distribution of variables we utilized histograms, quantile-quantile normal plots, and Box–Cox power transformation.

To test hypotheses 1, 3, and 4 we estimated a series of weighted least squares regression (WLS) models, weighting by the square root of the gender-specific population. We utilized WLS over alternative methods to ensure prediction errors were homoscedastic.

To test the second hypothesis we utilized piecewise regression models, also known as threshold models. There is not a strong theoretical statement as to what the threshold for total alcohol consumption's effect on homicide rates might be so we explored the data graphically and decided to estimate thresholds at increments of 5 liters. Once we established the range of significant threshold effects we then estimated between those increments at a one-unit increase. To establish a difference in thresholds (that is, slopes) we used linear estimation of differences in slopes and intercepts. The linear estimation of differences ultimately amounts to conducting a *t*-test of the slopes (Baum, 2006).

Table 1. Descriptive Statistics.

Variable	*n*	Mean / proportion	SD	Min.	Max.	Source
Homicide victimization	83	6.62	10.13	0.06	55.34	WHO-WHOSIS
Male homicide victimization	83	11.33	18.58	0.06	99.61	WHO-WHOSIS
Female homicide victimization	81	2.07	2.23	0.09	11.28	WHO-WHOSIS
Total per capita (15+) consumption in liters of alcohol	83	8.59	4.01	0.10	17.50	WHO-Data Repository
Drink pattern	77					
Least risky	12	0.16		0.00	1.00	WHO-Data Repository
Somewhat risky	22	0.29		0.00	1.00	WHO-Data Repository
Medium risky	35	0.45		0.00	1.00	WHO-Data Repository
Very risky	6	0.08		0.00	1.00	WHO-Data Repository
Most risky	2	0.03		0.00	1.00	WHO-Data Repository
Beer per capita consumption	82	358.15	188.40	1.80	720.00	WHO-Data Repository
Spirit per capita consumption	82	275.03	193.42	3.07	1083.60	WHO-Data Repository
Wine per capita consumption	82	196.86	191.42	0.37	715.95	WHO-Data Repository
Other per capita consumption	82	37.47	117.77	0.00	867.15	WHO-Data Repository
Poverty	83	0.86	0.62	0.20	4.05	WHO-WHOSIS
Sex ratio	83	102.25	30.57	85.38	298.55	WHO-WHOSIS
Unemployment	83	8.17	5.24	0.50	34.37	World Bank
Percent urban	83	67.75	19.25	9.49	100.00	World Bank
Education index	83	0.73	0.10	0.43	0.91	UN-HDR

Results

Table 1 provides descriptive statistics for all dependent and independent variables.

Our test of the first hypothesis of a linear association between total alcohol consumption and homicide rates is shown in Table 2. Results showed that, net of other structural covariates, there was a positive and significant association between total national per capita alcohol consumption and total, male, and female homicide victimization rates. A test of the differences in slopes revealed the effect was significantly stronger for men than for women.

Table 3 shows our test of the second hypothesis of threshold effects on homicide rates at specific levels of total per capita alcohol consumption. We examined several possible thresholds for total, male-, and female-specific models. Results did not support the hypothesis. For the total and male models we found a positive and significant

Table 2. WLS models for the effect of square root total per capita consumption of liters of alcohol on total, male, and female homicide victimization rates.

	Ln Homicide victimization			Ln Male homicide victimization			Ln Female homicide victimization		
	b	SE	*p*	*b*	SE	*p*	*b*	SE	*p*
Sqrt total per capita (15+) consumption of alcohol in liters	0.94 (0.48)	0.20	<.001	0.96 (0.46)	0.21	<.001	0.47 (0.31)	0.16	.004
Ln Poverty	1.38 (0.60)	0.25	<.001	1.51 (0.60)	0.27	<.001	1.08 (0.67)	0.18	<.001
Ln Sex Ratio	−2.27 (–0.20)	1.02	.029	−2.50 (–0.22)	1.01	.016	−2.15 (–0.24)	0.80	.009
Ln Unemployment	−0.56 (–0.21)	0.22	.014	−0.56 (–0.20)	0.24	.021	−0.40 (–0.22)	0.16	.015
Percent urban	0.02 (0.24)	0.01	.009	0.02 (0.23)	0.01	.011	0.01 (0.14)	0.01	.117
Education index	−4.99 (–0.36)	1.69	.004	−5.59 (–0.37)	1.81	.003	−1.60 (–0.16)	1.19	.185
Constant	12.32	4.96	.015	14.13	4.97	.006	10.37	3.84	.009
N	83			83			81.00		
F	16.02			16.99		<.001	14.74		<.001
R^2	.56			.57			.54		
Adj R^2	.55			.54			.51		

Note: Standardized betas are in parentheses.

association between per capita consumption and homicide victimization rates up to 9 liters of alcohol consumption, though there was no association above that threshold. There was a positive and significant association between per capita consumption and female homicide victimization rates for the entire distribution. However, this association was significantly stronger for nations with less than 7 liters consumption per capita than in nations with greater than 7 liters consumption per capita. Results for total, male, and female homicide victimization rates are essentially opposite those predicted by theory.

Our test of the drinking patterns hypothesis is presented in Table 4. We estimated WLS models, comparing nations with the somewhat, medium, very, and most risky drinking patterns with nations with the least risky drinking patterns. We found nonsignificant effects of risky drinking patterns on total, male, or female homicide victimization rates. As a sensitivity check we estimated a series of models that left out each of the other four categories (somewhat risky, medium risky, very risky, most risky) one at a time and compared the other categories with it. None of these models showed effects of drinking patterns on total, male, or female homicide victimization rates.

Table 3. Threshold models for the effect of square root total per capita consumption of liters of alcohol on total, male, and female homicide victimization rates.

	Ln Homicide victimization			Ln Male homicide victimization				Ln Female homicide victimization		
	b	SE	*p*	*b*	SE	*p*		*b*	SE	*p*
Slope <9	0.35	0.07	<.001	0.36	0.08	<.001	Slope <7	0.39	0.08	<.001
	(0.61)			(0.59)				(0.63)		
Slope >=9	0.05	0.08	.536	0.04	0.09	.621	Slope >=7	0.14	0.04	.001
	(0.07)			(0.06)				(0.36)		
Ln Poverty	1.12	0.25	<.001	1.19	0.27	<.001	Ln Poverty	1.00	0.17	<.001
	(0.51)			(0.50)				(0.62)		
Ln Sex ratio	−2.02	0.79	.012	−2.36	0.83	.006	Ln Sex ratio	−1.96	0.54	.001
	(–0.26)			(–0.28)				(–0.34)		
Ln Unemployment	−0.37	0.22	.096	−0.35	0.23	.138	Ln Unemployment	−0.56	0.16	.001
	(–0.17)			(–0.15)				(–0.34)		
Percent urban	0.00	0.01	.709	0.00	0.01	.686	Percent urban	0.01	0.01	.090
	(0.04)			(0.04)				(0.16)		
Education index	−3.40	1.75	.056	−4.00	1.84	.033	Education index	−1.84	1.15	.115
	(–0.24)			(–0.26)				(–0.18)		
Intercept <9	14.79	3.98	<.001	17.21	4.19	<.001	Intercept <7	12.36	2.75	<.001
Intercept >=9	13.72	4.04	.001	16.05	4.26	<.001	Intercept >=7	10.96	2.72	<.001
Slope diff.	−0.29	0.11	010	−0.32	0.12	.008	Slope diff.	−0.25	0.08	.004
Intercept diff.	−1.07	0.44	.016	−1.16	0.46	.014	Intercept diff.	−1.41	0.32	<.001
N	83			83			*n*	81		
F	11.34		<.001	12.39		<.001	*F*	13.74		<.001
R^2	.55			.57			*R*	.60		
Adj R^2	.50			.53			Adj *R*	.56		

Note: Standardized betas are in parentheses.

Table 5 presents the results of our tests of the beverage-specific hypothesis. The pattern of results was the same for total, men, and women. Per capita beer and spirits consumption were both positively and significantly associated with total, male, and female homicide victimization rates. For male victimization rates the effect of beer consumption was stronger than the effect of spirits consumption, whereas the effect size of both was the same for female victimization rates. We also found nations with higher per capita wine consumption appeared to have lower homicide victimization rates, though *p*-values did not allow for strong conclusions. Tests for differences in slopes showed no significant differences between men and women in the strength of the effects of beer, spirits, or wine. There was a non-significant effect of per capita consumption of other types of alcohol on total, male, or female homicide victimization rates.

Table 4. WLS models for the effect of drinking pattern on total, male, and female homicide victimization rates.

	Ln Homicide victimization			Ln Male homicide victimization			Ln Female Homicide Victimization		
	b	SE	*p*	*b*	SE	*p*	*b*	SE	*p*
1. Least risky									
2. Somewhat risky	0.52	0.34	.127	0.62	0.36	.092	0.36	0.28	.192
	(0.17)			(0.18)			(0.16)		
3. Medium risky	0.30	0.34	.386	0.32	0.36	.373	0.21	0.27	.447
	(0.11)			(0.11)			(0.10)		
4. Very risky	0.15	0.59	.803	0.07	0.63	.907	0.42	0.48	.381
	(0.03)			(0.01)			(0.11)		
5. Most risky	0.94	0.66	.161	0.96	0.71	.181	1.01	0.53	.063
	(0.17)			(0.15)			(0.25)		
Ln Poverty	1.39	0.27	<.001	1.54	0.29	<.001	0.87	0.22	<.001
	(0.64)			(0.65)			(0.55)		
Ln Sex ratio	−5.15	3.58	.155	−5.44	3.82	.159	−5.95	2.90	.045
	(–0.15)			(–0.15)			(–0.24)		
Ln Unemployment	−0.35	0.21	.100	−0.35	0.22	.123	−0.26	0.17	.129
	(–0.13)			(–0.12)			(–0.14)		
Percent urban	0.01	0.01	.091	0.01	0.01	.103	0.01	0.01	.229
	(0.15)			(0.14)			(0.11)		
Education index	−3.24	1.37	.021	−3.86	1.46	.010	−1.02	1.11	.361
	(–0.25)			(–0.27)			(–0.11)		
Constant	26.94	16.50	.107	29.13	17.59	.102	28.20	13.39	.039
N	77			77			77		
F	14.29			15.68		<.001	10.21		<.001
R^2	.66			.68			.58		
Adj R^2	.61			.63			.52		

Note: Standardized betas are in parentheses.

Sensitivity analyses

We undertook sensitivity analyses to explore the stability of our results and ensure assumptions of WLS and threshold models held. All models were homoscedastic and variance inflation factors were within an acceptable range. We analyzed residuals and leverage values to see if outliers affected our conclusions. For the first two hypotheses, despite removal of outliers the overall conclusions remained the same. For the third hypothesis (drinking patterns), however, after removing outliers nations with a 'somewhat risky' drinking pattern had significantly higher female homicide victimization rates than nations with the least risky drinking pattern, though the effect size was small (b = 1.02, p = .039). Finally, for the fourth hypothesis after removing outliers for the male homicide victimization model the square root of wine per capita consumption was

Table 5. WLS models for effect of beverage-specific consumption on total, male, and female homicide victimization rates.

	Ln Homicide victimization			Ln Male homicide victimization			Ln Female homicide victimization		
	b	SE	*p*	*b*	SE	*p*	*b*	SE	*p*
Sqrt beer per capita consumption	0.09	0.03	<.001	0.10	0.03	.001	0.05	0.02	.016
	(0.36)			(0.35)			(0.23)		
Sqrt spirit per capita consumption	0.07	0.02	<.001	0.07	0.02	.002	0.04	0.02	.009
	(0.27)			(0.26)			(0.23)		
Sqrt wine per capita consumption	−0.04	0.02	.081	−0.04	0.02	.086	−0.03	0.01	.050
	(–0.19)			(–0.18)			(–0.21)		
Sqrt other per capita consumption	−0.01	0.02	.794	−0.01	0.02	.627	0.00	0.01	.940
	(–0.02)			(–0.04)			(0.01)		
Ln Poverty	1.01	0.25	<.001	1.13	0.27	<.001	0.84	0.18	<.001
	(0.44)			(0.45)			(0.52)		
Ln Sex ratio	−2.01	0.97	.042	−2.26	0.97	.022	−1.95	0.76	.013
	(–0.18)			(–0.20)			(–0.22)		
Ln Unemployment	−0.33	0.23	.155	−0.32	0.24	.190	−0.21	0.16	.202
	(–0.12)			(–0.11)			(–0.11)		
Percent urban	0.02	0.01	.007	0.02	0.01	.007	0.01	0.01	.080
	(0.24)			(0.24)			(0.16)		
Education index	−3.56	1.64	.033	−4.07	1.74	.022	−0.75	1.16	.520
	(–0.26)			(–0.27)			(–0.08)		
Constant	9.81	4.72	.041	11.58	4.72	.017	8.50	3.67	.024
N	82			82			80		
F	13.75			14.68		<.001	12.34		
R^2	.63			.65			.61		
Adj R^2	.59			.60			.56		

Note: Standardized betas are in parentheses.

negative and significant ($b = -0.04$, $p = .027$). For female homicide victimization the square root of per capita spirits consumption was no longer significant ($b = -0.03$, $p = .185$).

Discussion

Our study makes important contributions to the understanding of the cross-national association between population-level drinking and homicide rates. We employed a much larger and more diverse sample than prior studies, examined effects for total, male, and female victimization rates, and tested the four most common explanations of this potential association.

To our knowledge there are no prior cross-national tests of the threshold hypotheses. Several studies found individual-level threshold effects of drinking on injury and violence (O'Leary and Schumacher, 2003; Pridemore, 2013; Shepherd and Brickley, 1996) and there are theoretical reasons to expect population-level threshold effects. For example, we may not expect higher homicide rates in nations with 3 relative to 1 or 2 liters per capita consumption. Yet at some point in the alcohol consumption distribution – say for nations with greater than 10 liters of consumption relative to those with less than 10 liters – we might expect homicide rates to be greater because very high consumption levels might be indicative of more problem drinkers or of riskier national drinking patterns. Thus, there may be some threshold below which alcohol consumption does not contribute to population-level social problems, or at least serious ones such as homicide.

Our analyses did not support the threshold hypothesis and we found essentially the opposite of what was expected. Models for total and male drinking revealed a linear association between per capita consumption and homicide rates up to 9 liters per capita consumption but no association above that amount. There was an association between per capita consumption and female homicide victimization across the entire distribution, but the strength of the association was significantly weaker in nations with more than 7 liters consumption per capita. On one hand, a weaker or no association above a certain threshold may be due to a small number of nations at the high end of the consumption distribution and thus little power to find an effect. Even so, this would not follow theoretical expectations of a threshold effect because the association would hold across the entire distribution of per capita consumption. If the findings are true, then this is a curious effect of opposite expectations that deserves further theoretical and empirical scrutiny.

We found non-significant effects on homicide rates of drinking culture as measured by risky drinking patterns. Nations with riskier drinking patterns did not have higher homicide rates than nations with less risky drinking patterns. Even countries with the riskiest drinking pattern did not have higher homicide rates than countries with the least risky drinking pattern. At the individual and aggregate levels, prior research suggested hazardous drinking was associated with homicide victimization (Pridemore, 2016), violent crimes (Rossow, 1996), suicide (Pridemore, 2006, 2013), and other health outcomes (Rehm et al., 2003). It may be this measure is not sensitive enough to distinguish between less and more risky drinking patterns. Recent scholarship, for example, indicates distinctions between wet and dry cultures are blurring, at least in Europe. There may also be theoretical explanations. If nations with riskier drinking patterns have a greater proportion of problem drinking occurring in isolation owing to weakened social bonds among heavy drinkers, then we might expect no real differences in homicide rates since most victims and offenders are acquainted in some way. No matter the explanation, if this finding holds it is another curious lack of association that requires reconsideration of the nature of the population-level alcohol–homicide association.

Our analyses provided support for the hypothesis of a positive linear relationship between total per capita alcohol consumption and homicide rates. There are multiple potential reasons for such an association. The one most commonly discussed is that an increase in overall per capita alcohol consumption indicates an increase in the number of heavy drinkers or the number of occasions on which people drink. These can lead to more motivated offenders, more vulnerable potential victims, and more opportunities

(Norström et al., 2001; Rossow, 2001). The linear relationship is consistent with the findings in prior studies examining alcohol and homicide cross-nationally (Bye, 2008; Norström, et al., 2001; Rossow, 2004). However, our final set of findings suggested the relationship may be more nuanced than this simple association.

We found a complex pattern of beverage-specific relationships. Per capita beer and spirits consumption was positively and significantly associated with total, male, and female homicide victimization rates. The effect on male homicide victimization rates was stronger for beer than for spirits, whereas effect sizes were the same for women. Per capita wine consumption appeared to be negatively associated with homicide, but the results were not strong enough to draw definitive conclusions. These findings for spirits are generally consistent with previous research (Norström, 2001). For example, using a time series design (Pridemore and Chamlin, 2006) found a strong association between alcohol consumption and homicide in Russia, a country where the population historically tended to prefer spirits, specifically vodka (Pridemore, 2002), to beer and wine. Using data from Belarus, Razvodovsky (2003b) found the correlation between spirits consumption and homicide was stronger than the association for all types of alcohol combined. Problem drinkers tend to seek out cheaper sources of ethanol such as spirits (Mäkelä et al., 2011), and spirits can result in quicker and deeper intoxication given their ethanol content.

We also found per capita beer consumption to be positively associated with cross-national homicide rates. MacAndrew and Edgerton's (1969) concept of drunken comportment might help explain this finding. The cultural norms and expectations for behavior when consuming different types of drinks influence the extent to which a person might act aggressively or violently. For both males and females, wine consumption might happen more with meals, in environments with more social control, and where expectations about behavior while intoxicated are stricter. On the other hand, beer may be more associated with festive drinking occasions and in public spaces where social control is weaker. Thinking on the population-level association between alcohol and violence has focused mostly on total or spirits consumption. Our finding suggests reconsideration, especially given the increased market share of beer (and especially those with higher alcohol content) in recent years in nations where wine or spirits were traditionally the alcohol beverage of preference. Another explanation might be methodological. Beer's weak or lack of association with violence in previous cross-national studies might result from samples limited to mostly or only European nations. Our study included a larger and more diverse sample of nations –in terms of both geography and level of development – than previous studies.

Limitations

We used a cross-sectional design that limits our ability to make strong causal inferences from this single study. Annual measures of key concepts such as drinking pattern and beverage-specific per capita consumption are unavailable from many nations. Second, although our sample of nations was much larger and much more inclusive relative to the few prior studies of the population-level alcohol–homicide association, our sample was still composed of a large portion of European and developed nations. Developed nations, of course, are more likely to keep the valid records required for analyses such as ours. As

is usually the case with cross-national studies, African nations are largely absent from our sample, as are many Asian nations.

Cross-national variation in homicide may not be representative of variation in other violent crimes (Aebi and Linde, 2012; Lynch & Pridemore, 2010) and so our results may be generalizable only to homicide. Compared with data on other crime types, however, homicide victimization data are the most reliable and available data for a larger number of nations (Smit et al., 2012). Further, legal definitions of non-lethal violent crimes vary by nation, which makes it difficult to compare outcomes across nations. The WHO case definition of homicide is the same across nations, thus allowing for valid comparisons.

Finally, there are theoretical reasons to expect moderating effects, so future studies should consider interactions testing how structural or cultural characteristics of nations – poverty, social protection, strength of social institutions, religiosity, availability and quality of emergency medical response – may moderate the impact of alcohol consumption on homicide rates.

Conclusion

Our study makes novel contributions to understanding the nature of the cross-national association between population-level alcohol consumption and homicide rates. We tested the efficacy of the four main hypotheses used to characterize this association, we tested effects separately for men and women, and we used a much larger and much more diverse sample of nations. We found no support for threshold effects or effects due to national drinking patterns. We did find evidence of a linear effect of total per capita consumption on total, male, and female homicide victimization rates. However, our analyses showed this impact of total consumption concealed more nuanced beverage-specific effects on homicide rates, with population-level beer and spirits consumption positively associated and wine consumption possibly negatively associated with cross-national total, male, and female homicide victimization rates.

Future research should refine our tests of these hypotheses, as we are among the first to examine them. This should include further study of our findings for threshold effects and the failure of risky drinking patterns to explain cross-national variation in homicide rates. Interaction effects also deserve consideration, as national culture and social structure could magnify or dampen effects of population drinking on violence. Scholars also should test other potential explanations of this association and if any effects vary by male and female victimization rates.

Although the current body of literature on the connection between population-level alcohol consumption and homicide rates still poses many unanswered research questions, the results of this study, in combination with other cross-national studies, indicate alcohol policy has the potential to impact drinking behaviors at the population level and related public health outcomes. Countries that attempt to address population-level alcohol problems should consider a comprehensive policy approach targeting both macro- and individual-level factors that impact alcohol consumption, such as legal locations and hours of alcohol sales, drinking age, and addiction treatment programming. Gauging the impact on violence of alcohol policy and related harm-reduction interventions is also important. Understanding the nature of the effect of population-level drinking on violence rates is a valuable part of harm reduction, and the relationship deserves the attention already received by other negative outcomes associated with alcohol consumption.

Acknowledgements

We thank Kirsten Hill for her contributions to earlier versions of this manuscript.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

Aebi MF and Linde A (2012) Regional variation in Europe between homicide and other forms of external death and criminal offences. In: Liem MCA and Pridemore WA (eds) *Handbook of European Homicide Research: Patterns, Explanations, and Country Studies*. New York, NY: Springer.

Baum CF (2006) *An Introduction to Modern Econometrics Using Stata*. College Station, TX: Stata Press.

Bye EK (2008) Alcohol and homicide in Eastern Europe: A time series analysis of six countries. *Homicide Studies* 12: 7–27.

Bobak M, Room R, Pikhart H, Kubinova R, Malyutina S, Pajak A, Kurilovitch S, Topor R, Nikitin Y and Marmot M (2004) Contribution of drinking patterns to differences in rates of alcohol related problems between three urban populations. *Journal of Epidemiology and Community Health* 58: 238–242.

Bruun K, Edwards G, Lumio M, Mäkelä K, Pan L, Popham RE, … Skog O (1975) *Alcohol Control Policies in Public Health Perspective*. Helsinki, Finland: Finnish Foundation for Alcohol Studies.

Cherpitel CJ, Ye Y and Bond J (2005) Attributable risk of injury associated with alcohol use: Cross-national data from the emergency room collaborative alcohol analysis project. *American Journal of Public Health* 95: 266–272.

Felson RB and Burchfield KB (2004) Alcohol and the risk of physical and sexual assault victimization. *Criminology* 42: 837–860.

Felson RB and Staff J (2010) The effects of alcohol intoxication on violent versus other offending. *Criminal Justice & Behavior* 37: 1343–1360.

Hahn RA, Kuzara JL, Elder R, Brewer R, Chattopadhyay S, Fielding J, Naimi TS, Toomey T, Middleton JC and Lawrence B and Task Force on Community Preventive Services (2010) Effectiveness of policies restricting hours of alcohol sales in preventing excessive alcohol consumption and related harms. *American Journal of Preventive Medicine* 39: 590–604.

Lenke L (1990) *Alcohol and Criminal Violence: Time Series Analyses in a Comparative Perspective*. Stockholm: Almqvist & Wiksell International.

Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H et al. (2012) A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: A systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 380: 2224–2260.

Lynch J and Pridemore WA (2010) Crime in international perspective. In: Wilson JQ and Petersilia J (eds) *Crime and Public Policy*. New York: Oxford University Press, 5–52.

MacAndrew C and Edgerton RB (1969) *Drunken Comportment: A Social Explanation*. Clinton Corners, NY: Eliot Wener Publications.

Mäkelä P, Hellman M, Kerr WC and Room R (2011) A bottle of beer, a glass of wine, or a shot of whiskey? Can the rate of alcohol-induced harm be affected by altering the population's beverage choices? *Contemporary Drug Problems* 38: 599–619.

Norström T (1988) Alcohol and suicide in Scandinavia. *British Journal of Addiction* 83: 553–559.

Norström T (1995) Alcohol and suicide: A comparative analysis of France and Sweden. *Addiction* 90: 1463–1469.

Norström T (2001) Per capita alcohol consumption and all-cases mortality in 14 European countries. *Addiction* 96: S113–S128.

Norström T (2011) Alcohol and homicide in the United States – is the link dependent on wetness? *Drug and Alcohol Review* 30: 458–465.

Norström T, Hemström Ö, Ramstedt M, Rossow I and Skog OJ (2001) Mortality and population drinking. In: Norström T (ed.) *Alcohol in Postwar Europe: Consumption, Drinking Patterns, Consequences, and Policy Responses in 15 European Countries*. Stockholm: National Institute of Public Health, 149–167.

O'Leary KD and Schumacher JA (2003) The association between alcohol use and intimate partner violence: Linear effect, threshold effect, or both? *Addictive Behaviors* 28: 1575–1585.

Parker RN (1998) Alcohol, homicide, and cultural context: A cross-national analysis of gender-specific homicide victimization. *Homicide Studies* 2: 6–30.

Pernanen K (1993) Causal attributions in the explanation of alcohol-related accidents. *Addiction* 88: 897–906.

Pridemore WA (2002) Vodka and violence: Alcohol consumption and homicide rates in Russia. *American Journal of Public Health* 92: 1921–1930.

Pridemore WA (2006) Heavy drinking and suicide mortality in Russia. *Social Forces* 85: 413–430.

Pridemore WA (2008) A methodological addition to the cross-national empirical literature on social structure and homicide: A first test of the poverty–homicide thesis. *Criminology* 46: 133–154.

Pridemore WA (2013) The impact of hazardous drinking on suicide among working-age Russian males: An individual-level analysis. *Addiction* 108: 1933–1941.

Pridemore WA (2016) Hazardous drinking and violent death among males: Evidence from a population-based case-control study. Forthcoming in *Social Problems*.

Pridemore WA and Chamlin MB (2006) A time series analysis of the effects of heavy drinking on homicide and suicide rates in Russia, 1956–2002. *Addiction* 101: 1719–1729.

Razvodovsky YE (2003a) *Alcohol and Mortality Crisis in Belarus*. Grodno: Author.

Razvodovsky YE (2003b) Association between distilled spirits consumption and violent mortality rate. *Drugs: Education, Prevention, and Policy* 10: 235–250.

Rehm JUR, Monteiro M, Room R, Gmel G, Jernigan D, Frick U and Graham K (2001) Steps towards constructing a global comparative risk analysis for alcohol consumption: determining indicators and empirical weights for patterns of drinking, deciding about theoretical minimum, and dealing with different consequences. *European Addiction Research* 7: 138–147.

Rehm J, Rehn N, Room R, Monteiro M, Gmel G, Jernigan D and Frick U (2003) The global distribution of average volume of alcohol consumption and patterns of drinking. *European Addiction Research* 9: 147–156.

Rossow I (1996) Alcohol-related violence: The impact of drinking pattern and drinking context. *Addiction* 91: 1651–1661.

Rossow I (2001) Alcohol and homicide: A cross-cultural comparison of the relationship in 14 European countries. *Addiction* 96: 77–92.

Rossow I (2004) Alcohol consumption and homicides in Canada, 1950–1999. *Contemporary Drug Problems* 31: 541.

Rossow I, Pape H and Wichstrøm L (1999) Young, wet & wild? Associations between alcohol intoxication and violent behaviour in adolescence. *Addiction* 94: 1017–1031.

Scribner RA, MacKinnon DP and Dwyer JH (1995) The risk of assaultive violence and alcohol availability in Los Angeles County. *American Journal of Public Health* 85: 335–340.

Shepherd J and Brickley M (1996) The relationship between alcohol intoxication, stressors and injury in urban violence. *British Journal of Criminology* 36: 546–566.

Shepherd J, Irish M, Scully C and Leslie I (1989) Alcohol consumption among victims of violence and among comparable U.K. populations. *British Journal of Addiction* 84: 1045–1051.

Smart RG (1996) Behavioral and social consequences related to the consumption of different beverage types. *Journal of Studies on Alcohol* 57: 77–84.
Smit PR, de Jong RR and Bijleveld CH (2012) Homicide data in Europe: Definitions, sources, and statistics. In: Liem MCA and Pridemore WA (eds) *Handbook of European Homicide Research: Patterns, Explanations, and Country Studies*. New York, NY: Springer.
United Nations (2013) *Human Development Report*. URL (accessed 1 September 2017): http://hdr.undp.org/en/content/education-index.
Wells S and Graham K (2003) Aggression involving alcohol: Relation to drinking patterns and social context. *Addiction* 98: 33–42.
World Bank (2015) World DataBank. URL (accessed 1 September 2017): http://databank.worldbank.org/data/databases.aspx.
WHO (World Health Organization) (2011) *Global Status Report on Alcohol and Health 2011*. Geneva: World Health Organization.
WHO (World Health Organization) (2014) *Global Status Report on Alcohol and Health 2014*. Geneva: World Health Organization.
WHO (World Health Organization) (2015a) Global Information System on Alcohol and Health. URL (accessed 1 September 2017): http://apps.who.int/gho/data/node.main.GISAH?lang=en.
WHO (World Health Organization) (2015b) WHO Statistical Information System. Global Health Observatory. URL (accessed 31 August 2017): http://www.who.int/whosis/en/.

Appendix

Sample of nations.

Argentina	Denmark	Latvia	Saint Vincent and the Grenadines
Armenia	Ecuador	Lithuania	Serbia
Australia	Egypt[a,b]	Luxembourg	Seychelles
Austria	El Salvador	Maldives[c]	Singapore
Azerbaijan	Estonia	Malta	Slovakia
Bahamas	Fiji	Mauritius	Slovenia
Bahrain[a]	Finland	Mexico	South Africa
Barbados	France	Montenegro	Spain
Belarus	Germany	Netherlands	Sri Lanka
Belgium	Greece	New Zealand	Sweden
Belize	Guatemala	Norway	Switzerland
Brazil	Hungary	Panama	Thailand
Bulgaria	Iceland	Paraguay	TFYR Macedonia
Canada	Ireland	Poland	Trinidad and Tobago
Chile	Israel	Portugal	Turkey
Colombia	Italy	Qatar[a,b]	Ukraine
Costa Rica	Jamaica	Republic of Korea	United Arab Emirates[a]
Croatia	Japan	Republic of Moldova	United Kingdom
Cuba	Kazakhstan	Romania	United States of America
Cyprus	Kuwait[a]	Russian Federation	Uruguay
Czech Republic	Kyrgyzstan	Saint Lucia	

Notes:
a. Missing for drinking pattern.
b. Missing for hazardous drinking pattern.
c. Available only for total alcohol consumption.