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A multi-level analysis of emergency department data on drinking patterns, alcohol policy and cause of injury in 28 countries

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Abstract

Background: While individual-level drinking pattern is an important risk factor for alcohol-related injury, societal-level pattern and alcohol policy are also important, and no research exists on the relationship of these variables with specific causes of injury.

Methods: A probability sample of 14,142 emergency department (ED) patients from 32 ED studies in 28 countries included in the International Collaborative Alcohol and Injury Study (ICAIS) is analyzed using multilevel modeling of individual-level volume and pattern of drinking, country-level detrimental drinking pattern (DDP), and alcohol policy using the International Alcohol Policy and Injury Index (IAPII). The IAPII includes four domains: availability, vehicular, advertising, and drinking context of self-reported drinking prior to the injury event, categorized as traffic, violence, fall, or other cause.

Results: Frequent heavy drinking was a strong predictor (p<.0.001) of injuries related to violence (OR=2.57), falls (OR=2.86), and other causes (OR=1.71), while episodic heavy drinking was a significant predictor of injuries related to violence and falls. DDP was a significant predictor (p<0.05) of traffic (OR=1.54) and violence-related injuries (OR=1.38) but lost significance when the IAPII was included. The IAPII was a significant predictor only for traffic injury (OR=0.97, p<0.001), and each domain with the exception of context were also significant.

Conclusions: Findings here clearly point to the importance of targeted policies for specific causes of injury as well as the importance of individual and societal drinking patterns, the latter of which may be difficult to influence by preventive measures aimed to reduce alcohol-related injury.

Keywords

Alcohol-Related Injury Cause; Drinking Patterns; Alcohol Policy

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Author Disclosures

Conflict of Interest
No conflict declared.

1. Introduction

Prior research on alcohol and injury, based on studies of patients admitted to the emergency department (ED), has found that while drinking prior to the injury event is an important risk factor for injury, the individual-level pattern of drinking and societal-level drinking pattern are also important.

Meta-analysis of patients reporting drinking prior to the event found that both the frequency of drinking and heavy drinking were significant predictors of alcohol-related injury (Cherpitel et al., 2003). A case-control ED study in Australia found that those reporting heavy daily drinking were at lower risk of injury than abstainers (Watt et al., 2004), while a Swiss ED found the risk of injury was greatest for episodic heavy drinkers (Gmel et al., 2006). ED data from six countries found the risk of alcohol-related injury was lower for heavier drinkers but modified by country-level drinking pattern, with greater risk associated with higher levels of detrimental drinking patterns (DDP) (Cherpitel et al., 2004; Rehm et al., 2001). ED data from 16 countries found that both study-level volume (higher overall average consumption) and country-level DDP were significant predictors of variation in alcohol-related injury across studies (Cherpitel et al., 2005).

While societal-level drinking appears to be an important risk factor for injury, little research has been conducted on alcohol control policy and risk of injury, although alcohol policy would likely be associated with aggregate drinking patterns in the same region or country. A multilevel analysis of EDs across 19 countries found country-level DDP and alcohol control policy regarding drink driving and alcohol access were predictive of patients' causal attribution of injury to their drinking, while drinking-driving policy was associated with a positive blood alcohol concentration (BAC) on ED admission, but neither policy was related to self-reported consumption prior to injury (Cherpitel et al., 2012).

A similar multi-level analysis across 28 counties using the International Alcohol Policy and Injury Index (IAPII) (Korcha et al., in press) found, controlling for individual-level volume and pattern of drinking and study-level volume, that the IAPPI was significantly predictive of cross-study variation in rates of self-reported drinking prior to injury, with country-level drinking pattern having little effect on this relationship (Cherpitel et al., in press).

None of the mentioned studies analyzed injury by cause, and little is known about the association of individual-level drinking pattern, societal drinking pattern, or alcohol control policy and specific causes of alcohol-related injury, although it would be expected that the strength of these relationships would vary across causes of injury. The available literature suggests that risk of injury from drinking prior to the event is greater for injuries related to violence than for injuries related to traffic, falls, or other causes (Cherpitel, 1996; Kuendig et al., 2008; Macdonald et al., 2006), with violence-related injuries showing a steeper dose-response relationship than injury from non-intentional causes (Borges et al., 2004; Cherpitel, 2007; Vinson et al., 2003). Data on drinking and driving in the U.S. found the highest risk of injury was among episodic heavy drinkers who drank more than their usual amounts prior to the motor vehicle crash (Gruenewald et al., 1996; Treno and Holder, 1997), while another study of crash-involved drivers found more frequent drinkers were at lowest risk for a crash (Hurst et al., 1994).

To fill this gap in the literature regarding the association of individual-level drinking pattern, societal drinking pattern, and alcohol control policy with risk of alcohol-related injury by specific causes, this paper aims to address: 1) how individual-level drinking pattern predicts the likelihood of an alcohol-related injury, controlling for individual-level volume of consumption and aggregate-level volume and pattern, 2) at the aggregate level, how country-level detrimental drinking pattern is associated with variation in the study-level proportion of alcohol-related injury controlling for individual-level drinking pattern and individual-and aggregate-level volume of consumption, and 3) how alcohol control policy is associated with variation in the study-level proportion of alcohol-related injury controlling for individual- and aggregate-level drinking pattern and volume of consumption.

These data will increase our understanding of the association of individual and societal drinking pattern and alcohol control policy with the risk of specific causes of alcohol-related injury and may guide intervention and prevention strategies to reduce this alcohol-related harm.

2. Methods

2.1 Samples

Data were collected from 1996 to 2016 and are from the International Collaborative Alcohol and Injury Study (ICAIS), including 61 ED sites in 32 ED studies from 28 countries. The ICAIS is composed of alcohol and injury data, obtained using the same instrumentation and protocols, from the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP) (Cherpitel, 1989) and collaborative studies conducted by the World Health Organization (WHO), the Pan American Health Organization (PAHO), and the National Institute on Alcohol Abuse and Alcoholism (NIAAA) (see Table 1).

Samples of injured patients 18 years and older who arrived at the ED within six hours following the injury event were selected into the sample in the order in which they were admitted to the ED, including those arriving by ambulance. Samples were selected to provide an equal representation of each shift for each day of the week. After obtaining informed consent, trained interviewers administered a structured 25-minute questionnaire that included items related to the cause of injury, drinking before the injury event, quantity, and frequency of usual drinking, frequency of high consumption occasions in the last 12 months, and demographic characteristics. Completion rates were 66% for the ERCAAP studies, 91% for the WHO studies, 88% for the NIAAA studies, and 93% for the PAHO studies. Non-interviews were due to refusing to participate (the main reason), incapacitation, leaving prior to completing the interview, being in police custody, and language barriers. Patients were followed into the hospital and interviewed there if they were too severely injured to be approached in the ED.

2.2 Dependent Variable

Alcohol-related injury as the dependent variable was measured by self-reported consumption within six hours prior to the injury event, by cause of injury, categorized as traffic, violence-related falls, and other causes. Injury categories were not mutually exclusive, as data were not obtained on the primary cause of injury (147 patients were included in more than one injury category).

2.3 Individual-Level Predictors

2.3.1 Individual-Level Volume.—Individual-level volume was based on questions on the usual quantity and frequency of drinking over the last 12 months. The frequency of usual consumption was obtained for any alcoholic beverage in all studies. Quantity was obtained in most studies from the number of drinks consumed for each beverage type and drink size. For those reporting more than one beverage, the maximum beverage-specific quantity was used. In some of the ERCAAP studies, the quantity of consumption was obtained from the number of drinks for all beverage types combined. Overall volume of alcohol consumption for all studies was estimated in standard drinks, each containing 16ml of pure ethanol.

2.3.2 Individual-Level Pattern of Drinking—Individual-level drinking pattern was constructed from the frequency of usual consumption, categorized as frequent (≥ weekly) or infrequent (< weekly), and the frequency of consuming 12 or more drinks and 5–11 drinks on occasion, which were then summed for a 5+ measure. Pattern of drinking were then categorized into five mutually exclusive categories: 1) infrequent light/non-heavy (drinks less than weekly/never 5+), 2) frequent light/non-heavy (drinks at least weekly/never 5+), 3) infrequent light/infrequent heavy (drinks less than weekly/5+ less than weekly), 4) frequent light/infrequent heavy (drinks at least weekly/5+ less than weekly), 5) frequent heavy (5+ at least weekly).

2.4 Aggregate-Level Predictors

2.4.1 Study-Level Volume of Consumption.—The study-level average volume was derived from the mean volume among drinkers in each ED study and reflects the socio-cultural environment related to drinking for the area in which the respective ED data were collected. This measure is likely a better predictor of alcohol-related injury than one reflecting the general population, such as per capita consumption, which applies to a country as a whole.

2.4.2 Ambulance System.—The mode of emergency care delivery type in a country follows either the Franco-German model, in which emergency services are taken to the patient with few transported back to the hospital (primarily in Europe), or the Anglo-American model, in which patients are transported by ambulance to the ED (predominately in English speaking countries (AlShaqusi, 2010)). The type/cause and severity of injury seen in the ED would likely depend on the type of ambulance system operating in a country, with ED admissions under the Franco-German model reflecting more serious injuries.

2.4.3 Country-Level Drinking Pattern.—Country-level detrimental drinking pattern (DDP) is an indicator of the "detrimental impact" on health and other drinking-related harms at a given level of alcohol consumption, with scores ranging from 1 (the least detrimental pattern of drinking) to 4 (the most detrimental). DDP was derived from country-level survey and key informant data across a large number of countries based on indicators of alcohol's integration in society (e.g., drinking in public places, drinking to intoxication, drinking with meals) (Rehm et al., 2001; Rehm et al., 2003).

2.4.4 Alcohol Control Policy.—The International Alcohol Policy Injury Index (IAPII), which was developed as an international index to predict injury morbidity and mortality (Korcha et al., in press), was used as the alcohol policy measure. The IAPII includes ten policy items drawn from the WHO's Global Information System on Alcohol and Health (GISAH) (World Health Organization, 2016) and grouped into four regulatory domains: *physical availability* (legal minimum drinking age, government monopoly of retail sales, restrictions on outlet density, restrictions on outlet hours and days of operation), *vehicular* (random breath testing, legal blood alcohol concentration (BAC) limits, penalties for exceeding the maximum BAC), *advertising/promotion* (a composite measure of restrictions on the majority of media advertisements), and *drinking context* (community mobilization programs, mandatory server training). The IAPII draws on a point system used in previous alcohol indices (Brand et al., 2007; Carragher et al., 2014) and generates a score weighted for effectiveness in reducing adverse alcohol-related harms (Babor et al., 2003). Items are also weighted, using the per capita gross national income (GNI) for each country as a proxy measure, for the level of enforcement. Sores range from 1 (the most lenient alcohol policy) to 100 (the most restrictive alcohol policy).

2.5 Analysis

Only current drinkers, defined as those who reported consuming any alcoholic beverage in the last 12 months, were included in the analysis (n=14,142).

Multi-level analysis was used to examine individual and study-level aggregate predictors separately for each cause of injury. Individual-level volume and study-level average volume were both log-transformed in the analysis. Modeling for the non-independence of observations, where individuals within clusters are correlated, a two-level regression analysis for a binary dependent variable with a random intercept model was specified. Injury patients, clustered within each study, are considered level-one data, and the 32 ED studies (rather than the countries from which the studies were conducted) are treated as level-two units. Among the level-two variables, study-level average volume was aggregated by the study as described above, while DDP, ambulance system, and alcohol policies were all derived at the country level. Note that policy scores reflected the same period during which the ED data were collected for each site and thus may differ across years for the same country (e.g., China). The values of DDP and the four policy domain scores across the ED studies can be found elsewhere (Cherpitel et al., in press).

Models were estimated in Mplus, Version 8 (Muthén and Muthén, 2017). Data were weighted in several studies to account for overrepresentation of weekend evenings when the alcohol-related injury would more likely present to the ED. Parameters are estimated by maximizing a weighted log-likelihood function, and standard error computations use a sandwich estimator. In Mplus, a model is specified for the within (level one) predictors of alcohol-related injury, which describe the regression of the dependent variable on observed covariates where the intercept is a random effect that varies across studies and the between (level two) predictors, which describe the linear regression of the random intercept on observed study-level covariates.

All variables, with the exception of the IAPII, were entered simultaneously in models for each injury cause (Table 2). The IAPPI and its four domains were then each entered separately, together with level-two variables, into the models from Table 2 which include the level-one variables, to examine the relationship of the IAPII and each of its domains with each cause of injury (Table 3).

All models controlled for gender (male), age (18–29 years), education (< high school and college vs. high school), employment (≥30 hours/week), and emergency care delivery type (ambulance delivers treatment in the home vs. ambulance transports patient to the ED).

3. Results

Table 1 shows the 32 ED studies included in the analysis with N's by cause of injury and the proportion of alcohol-related injury for each cause among current drinkers.

Table 2 shows estimates for predicting any drinking prior to injury for each injury cause. Demographic characteristics were used as control variables in the models. The individual-level usual volume of consumption was significantly predictive of each alcohol-related injury cause ($p<0.001$). Individual-level heavy drinking pattern was also predictive of all alcohol-related injury causes except traffic injuries. Frequent heavy drinking was a strong predictor ($p<0.001$) for injuries related to violence (OR=2.57), falls (OR=2.86), and other causes (OR=1.71), while episodic heavy drinking was also a significant predictor of injuries related to violence and falls. DDP was a significant predictor ($p<0.05$) of study-level variation in alcohol-related traffic injuries (OR=1.54) and those related to violence (OR=1.38); the greater the country-level harmful drinking pattern, the greater the likelihood of alcohol-related injury.

The IAPII and each of its four domains was then added, separately, to the model for each cause of alcohol-related injury (Table 3). The IAPII was a significant predictor of study-level variation in alcohol-related injury only for traffic injury (OR=0.97, $p<0.001$), and each domain, with the exception of context, was also significant; the greater the restrictiveness of alcohol policy, the lower the rate of alcohol-related traffic injury. The IAPPI was not a significant predictor in a study-level variation of alcohol-related injuries from violence, falls, or from other causes.

DDP was found to maintain significance in predicting the study-level variation in alcohol-related injuries from violence when the IAPII and each of its separate domains were entered into the model, but for alcohol-related traffic injuries, DDP only maintained significance when the *context* domain was included (OR= 1.47; $p< 0.05$).

4. Discussion

This is the first study to analyze the association of individual and societal-level drinking pattern and alcohol control policy with specific causes of alcohol-related injury, extending findings from previous studies of all causes combined (Cherpitel et al., in press; Cherpitel et al., 2012). While the average volume of consumption over the last year was predictive, separately for reporting drinking prior to injuries from traffic, violence, falls and other causes, drinking pattern was not predictive of alcohol-related traffic injuries. A pattern of frequent heavy drinking was most predictive for non-traffic related injuries, while episodic heavy drinking was also predictive of violence-related injuries and injuries from falls. An elevated risk for heavy episodic drinkers from all causes of injury combined has been found elsewhere, with lighter drinkers who on occasion drinking heavily at greater risk than other drinkers (Gmel et al., 2006). That study, however, analyzed the risk of injury, while the present study analyzed the risk of an alcohol-related injury. Other studies of drinking and driving have found the risk of injury associated with drinking pattern, with the highest risk of injury associated with occasional heavy drinking (Gruenewald et al., 1996; Treno and Holder, 1997) and with less frequent drinking (Hurst et al., 1994), unlike findings here.

Country-level DDP was examined as a predictor of cross-study variation in the rate of alcohol-related injury, controlling for individual-level volume and pattern of drinking. It was found to be significant for traffic- and violence-related injuries but not for falls or injuries from other causes. This is not surprising, since 'drinking in public places' is a component of the overall DDP score, which may result in needing to drive and a subsequent motor vehicle crash, or mingling with others who may also be drinking and a subsequent violence-related encounter. Given this, the context of drinking may be a more important predictor of alcohol-related injury than the pattern of usual drinking, at least for some causes. However, aggregate-level public drinking context, controlling for individual-level volume and pattern, DDP, and alcohol policy, has been found to be predictive of study-level variation in alcohol-related injuries from violence in ED samples but not of alcohol-related traffic injuries (Cherpitel et al., 2018). In analysis here, when alcohol policy was considered, DDP remained a significant predictor of study-level variation in alcohol-related violence injuries but not for traffic injuries.

Using the IAPII, which was specifically developed to predict injury in an international context (Korcha et al., in press), alcohol policy was associated with the study-level variation in alcohol-related injury only for traffic: the more stringent the policy, the lower the rate of traffic injury. A stricter policy regarding random breath testing, legal BAC limit, and penalties for exceeding the maximum BAC would be expected to prevent individuals from driving under the influence of alcohol but to have less effect on deterring individuals from drinking in other contexts. It should be noted; however, that alcohol-related traffic injuries as analyzed here not only included drivers in the event but also passengers and pedestrians, both of whom would presumably be less affected by drink-driving policies.

An alcohol-related injury in these analyses was defined as self-reported drinking of any amount within six hours prior to the injury and, while this casts a wide net to capture all those who may have had an alcohol-related injury, it likely over-represents the alcoholrelatedness of the event, since a relatively small amount of alcohol consumed early in the six-hour period might have little to do with occurrence or causation of the injury. Additionally, the validity of patient selfreports may be a concern. Under-reporting of drinking could potentially occur for drivers with traffic injuries, but over-reporting by those injured in violence-related events could also potentially occur. Nevertheless, self-reported consumption within six hours prior to injury has been found to be a valid measure based on estimated BAC obtained at the time of arrival at the ED. Only a small percentage (.5– 3%) are positive for BAC but deny drinking prior to the event, while a substantial proportion (upwards of 60%) report drinking but have a negative BAC (Cherpitel et al., 1992).

It also bears noting here that injury categories were not mutually exclusive, and 147 of the 14,142 patients were included in more than one category. For example, a patient who was involved in a violent encounter or a pedestrian struck by a car may each have been injured by falling and so would be included in both categories. Although data collection spanned a 20-year period (19962016), aggregate-level variables for each site were estimated for the same period during which the ED data were collected, and in many some countries and regions no other (newer) data were available. Data on DDP and alcohol policy items included in the IAPII reflect the same time-period during which the respective ED data were collected. While key informants in each country verified that policy items were accurate (Cherpitel et al., in press), policy domains may not adequately represent the geographic level relevant to the specific ED study.

Given the diversity of the regions and countries analyzed here and the large and comparable samples across a large number of studies, findings suggest that both individual-level patterns of drinking, as well as societal-level pattern and alcohol policy all, play a significant part in explaining variation in rates of alcohol-related injury, but observed effects are not homogeneous across causes of injury. Alcohol-related traffic crashes were most responsive to alcohol policy but did not appear to be influenced by the individual’s usual drinking pattern, while the opposite was true for violence-related injuries and those from falls and other causes. Country-level drinking pattern was predictive of both traffic- and violence-related injuries, and it continued to be a significant predictor for violence-related injuries when alcohol policy was considered but not for traffic injuries. Findings here clearly point to the importance of targeted policies for specific causes of injury as well as the importance of individual and societal drinking patterns, the latter of which may be difficult to influence by preventive measures aimed to reduce alcohol-related injury.

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Contributors

Cherpitel conceived of the study and prepared the manuscript. Witbrodt wrote the analysis section, performed the analysis and prepared the tables. Ye consulted on all aspects of the paper, especially the analysis. Korcha assisted with the methods and preparation of the tables. All authors have contributed to and approved the final article.

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Highlights

- Heavy drinking pattern predicts all causes of alcohol-related injury but traffic.
- Detrimental drinking pattern (DDP) predictive of traffic and violence injuries.
- When alcohol policy accounted for, DDP is only predictive of violence injuries.
- Alcohol policy is only predictive of traffic injuries.

Table 1.

Alcohol-related injury by cause across 32 emergency department (ED) sites in 28 countries.

				N's (all)				% self report drinking (current drinkers)			
Region	***Country***	***City/Study, Year***	***Sites***	***Traffic***	***Violence***	***Falls***	***Other***	***Trafic***	***Violence***	***Falls***	***Other***
	Mozam bique	Maputo, 2001	1	113	108	103	136	34.7	44.9	16.0	15.4
Africa	South Africa	Cape Town, 2001	1	93	286	30	56	71.7	88.2	80.6	48.8
	Tanzania	Moshi, 2013	1	375	75	37	29	49.7	69.4	54.6	7.1
Asia/Pacific	Australia	Fremantle, 1997	1	63	71	128	402	26.5	63.6	23.4	19.0
	China	Changsha, 2001	1	190	118	91	134	15.1	45.4	24.9	14.7
		5 Cities, 2009[a]	5	573	370	683	920	39.1	56.9	66.7	36.2
	India	Bangalore, 2001	1	92	188	39	228	86.7	84.5	76.9	62.2
	Korea	5 Cities, 2007–09[b]	6	481	146	583	843	19.1	74.2	40.4	24.5
	New Zealand	Auckland, 2000	1	24	26	52	55	60.0	89.1	32.9	29.0
		Auckland, 2015–16	1	57	48	153	229	10.2	73.3	24.0	18.1
	Taiwan	Taipei, 2009–10	2	426	65	253	295	3.4	34.2	19.9	10.9
Europe	Belarus	Minsk, 2001	1	18	45	182	217	6.3	81.4	28.2	30.7
	Czch Republic	Prague, 2001	1	39	18	259	195	2.8	31.3	5.4	11.9
	Ireland	5 Cities, 2003–04[c]	6	188	250	826	831	18.0	74.1	29.5	12.3
	Poland	Warsaw/Sosno wiec, 2002–03	2	59	53	227	206	11.1	63.3	3.5	14.6
	Sweden	Malmü, 2001	1	106	35	214	143	7.6	60.0	13.4	19.1
	Switzerland	Lausanne, 2006–07	1	42	38	145	182	26.7	71.4	25.2	11.9
North America	Canada	Orangeville (ON), 2002	1	29	2	63	128	3.6	100.0	2.0	10.5
		Vancouver, 2009	2	22	18	51	94	27.8	83.3	36.6	13.3
		Vancouver/Victoria, 2013–15	3	95	97	449	555	8.7	42.2	20.6	13.1
	Mexico	Pachuca, 1996–97	3	87	93	85	224	37.6	54.5	33.5	10.3
		Mexico City, 2002	1	44	72	186	159	22.6	59.3	13.0	18.4
	United States	Santa Clara (CA), 1995–96	1	31	24	35	63	18.4	63.2	28.4	7.8
Central/South America	Argentina	Mar Del Plata, 2001	2	160	98	194	233	26.1	56.2	28.3	18.0
	Brazil	São Paulo, 2001	1	82	45	160	213	32.1	47.1	6.6	11.4
	Costa Rica	San Jose, 2012	2	211	90	433	287	14.1	51.4	11.0	9.7
	Dom.Republic	Santo Domingo, 2010	1	220	95	80	110	24.7	35.0	13.3	23
	Guatamala	Guatamala City, 2011	1	120	130	152	143	40.3	58.3	23.9	14.5
	Guyana	Georgetown, 2010	1	86	217	69	116	22.6	35.8	18.6	18.4
	Nicaragua	Managua, 2010	2	110	187	118	135	32.6	57.1	27.0	41.2
	Panama	3 Cities, 2010[d]	3	103	90	128	184	41.3	54.1	25.7	16.3
	Trinidad/Tobago	4 Cities, 2015[e]	4	39	56	60	99	42.9	34.2	31.6	14.3

[a]Beijing, Hangzhou, Chengdu, Hengyang, and Changsha.

[b]Kyonggi, Seoul, Suwon, Chuncheon, and Donggu.

[c]Dublin, Galway, Letterkenny, Sligo, and Waterford.

[d]La Chorrera, Colon, and Vearaguas.

[e]Mount Hope, San Fernando, Port-of-Spain, and Scarborough.

Table 2.

Odds ratios (ORs) from multi-level models examining individual- and study- level predictors of drinking to predict drinking in the 6 hours before injury among current drinkers by injury cause[a]

	Traffic injuries		**Violence-related injuries**		**Falls**		**Other injuries**	
(N)	***(2 619)***		***(2 281)***		***(4 024)***		***(5 365)***	
	OR	*(95%CI)*	OR	*(95%CI)*	OR	*(95%CI)*	OR	*(95%CI)*
Level 1 effects								
Demographics								
Male	1.48	*(1.26–1.72)******	1.40	*(1.10–1.80)****	0.94	*(0.79–1.11)*	0.69	*(0.59–0.81)******
Age < 30 years	1.02	*(0.85–1.23)*	1.01	*(0.84–1.22)*	0.76	*(0.61–0.969)****	1.00	*(0.87–1.15)*
Primary education [b]	0.92	*(0.73–1.16)*	1.02	*(0.83–1.25)*	1.12	*(0.87–1.45)*	1.29	*(1.05–1.59)****
College education [b]	0.67	*(0.50–0.91)****	0.99	*(0.74–1.34)*	0.92	*(0.76–1.11)*	0.99	*(0.78–1.25)*
Employed [b]	0.83	*(0.71–0.97)****	1.03	*(0.78–1.36)*	0.69	*(0.57–0.84)****	0.68	*(0.57–0.80)******
Alcohol volume past year[d]	1.40	*(1.27–1.54)******	1.35	*(1.20–1.52)******	1.46	*(1.33–1.60)******	1.51	*(1.41–1.61)******
Drinking pattern Infrequent light/non-heavy	0.92	*(0.65–1.32)*	1.07	*(0.65–1.75)*	0.96	*(0.65–1.41)*	0.80	*(0.61–1.05)*
Frequent light/non-heavy	Ref.	*(OR=1)*	Ref.	*(OR=1)*	Ref.	*(OR=1)*	Ref.	*(OR=1)*
Infrequent light/occasional heavy	1.17	*(0.85–1.60)*	1.99	*(1.27–3.10)**	2.26	*(1.61–3.17)******	1.32	*(1.00–1.74)*
Frequent light/occasional heavy	0.98	*(0.73–1.32)*	2.01	*(1.44–2.81)****	1.81	*(1.40–2.35)******	1.11	*(0.88–1.41)*
Frequent heavy	1.57	*(1.06–2.34)*	2.57	*(1.98–3.34)******	2.86	*(2.24–3.66)******	1.71	*(1.38–2.14)******
Level 2 effects								
Detrimental drinking pattern (DDP)[e]	1.54	*(1.06–2.24)**	1.38	*(1.12–1.71)**	1.13	*(0.82–1.55)*	1.12	*(0.79–1.59)*
European ambulance system	0.54	*(0.15–2.00)*	2.16	*(0.98–4.75)*	0.76	*(0.38–1.54)*	1.04	*(0.48–2.29)*
Study-level average volume[f]	1.15	*(0.86–1.52)*	1.03	*(0.88–1.20)*	0.91	*(0.75–1.11)*	0.73	*(0.57–0.93)**
Residual variances (coefficients)	0.77	*(0.20–1.34)******	0.31	*(0.11–0.51)****	0.50	*(0.04–0.95)**	0.36	*(0.05–0.67)**

*Notes: *p<0.05;*

**p<0.01;

***p<0.001. C.I. = Confidence Interval

[a]Injury causes are not mutually exclusive.

[b]Reference = secondary school education.

[c]Employed 30 hours per week (reference=else).

[d]Individual volume consumption (in 16 ml standard drink, log-transformed).

[e]Combination of four policy measures: legal intoxication level for driving, random breath test, sanction on driving under the influence (DUI), open container law (high value more restrictive).

[f]Study mean of volume consumption (in 16 ml standard drink, log-transformed). Sample size (n) for each causal injury group reflects number of observations retained in multi-level regression models (cases with missing values are dropped from analysis).

Table 3.

Odds ratios (ORs) examining level-2 International Alcohol Policy Index (IAPII) and four individual policy domains to predict drinking in the 6 hours before injury among current drinkers by injury cause [a]

	Traffic injuries		**Violence-related injuries**		**Falls**		**Other**	
(N)	***(2619)***		***(2281)***		***(4024)***		***(5365)***	
Level 2 effects [b]								
	OR	*(95%CI)*	OR	*(95%CI)*	OR	*(95%CI)*	OR	*(95%CI)*
IAPII	0.97	*(0.96, 0.98)****	1.01	*0.99 1.02*	0.99	*0.97, 1.00*	0.99	*0.97, 1.00*
DDP	1.15	0.83, 1.60	1.47	*(1.12,1.93)***	0.97	*0.66, 1.41*	0.98	*0.68, 1.40*
European average volume	0.75	0.22, 2.58	2.00	*0.91, 4.71*	0.87	*0.47, 1.62*	1.16	*0.59, 2.28*
Study-level average volume	1.15	0.90, 1.47	1.02	*0.87, 1.20*	0.91	*0.77, 1.09*	0.73	*0.58, 0.92*
Availability Domain	0.94	(0.91, 0.96)***	1.02	*0.99, 1.01*	0.96	*0.91, 1.01*	0.96	*0.93, 1.00*
DDP	1.26	0.88, 1.80	1.47	*(1.15, 1.88)***	1.00	*0.72, 1.40*	0.99	*0.71, 1.38*
European ambulance system	0.54	0.15, 1.87	2.17	*0.98, 4.82*	0.72	*0.37, 1.40*	0.98	*0.48, 2.04*
Study-level average volume	1.12	0.88, 1.44	1.03	*0.88, 1.20*	0.90	*0.75, 1.07*	0.72	*0.57, 0.90*
Vehicular Domain	0.91	*(0.88,0.94)****	1.00	*0.96, 1.05*	0.97	*0.92, 1.01*	0.98	*0.94, 1.02*
DDP	1.03	*0.72, 1.47*	1.37	*0.98, 1.93*	0.97	*0.65, 1.45*	1.03	*0.66, 1.59*
European ambulance system	0.92	*0.30, 2.85*	2.11	*0.94, 4.44*	0.92	*0.51, 1.07*	1.13	*0.59, 2.16*
Study-level average volume	1.11	*0.91, 1.34*		*0.88, 1.19*	0.90	*0.76, 1.07*	0.73	*0.57, 0.92*
Advertising Domain	0.86	*(0.77, 0.96)****	1.00	*0.90, 1.10*	0.92	*0.83, 1.01*	0.96	*0.72, 1.06*
DDP	1.37	*0.94, 1.99*	1.36	*(1.05,1.75)***	1.06	*0.73, 1.45*	1.09	*0.77, 1.54*
European ambulance system	0.93	*0.24, 3.64*	2.17	*0.93, 5.09*	1.02	*0.55, 1.89*	1.21	*0.54, 2.68*
Study-level average volume	1.19	*0.90, 1.56*	1.02	*0.87, 1.20*	0.92	*0.76, 1.12*	0.73	*0.57, 0.94*
Context Domain	0.98	*0.93, 1.04*	1.02	*0.99, 1.06*	0.97	*0.92, 1.03*	0.96	*0.92, 1.00*
DDP	1.47	*(1.02, 2.11)**	1.47	*(1.15, 1.87)***	1.05	*0.74, 1.49*	1.03	*0.74, 1.43*
European ambulance system	0.59	*0.83, 2.19*	2.10	*0.96, 4.24*	0.82	*0.40, 1.68*	1.16	*0.53, 2.54*
Study-level average volume	1.16	*0.87, 1.55*	1.01	*0.87, 1.18*	0.92	*0.76, 1.13*	0.77	*0.59, 0.99*

Notes:

*p<0.05

**p<0.01

***p<0.001 C.I. = Confidence Interval.

[a] Injury causes are not mutually exclusive.

[b] Multi-level models were estimated separately for the overall IAPII and each of the four domains and included all level-1 and level-2 predictors displayed in Table 2.