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ALCOHOL USE AMONG FATALLY INJURED VICTIMS IN SAO PAULO, BRAZIL: BRIDGING THE GAP BETWEEN RESEARCH AND HEALTH SERVICES IN DEVELOPING COUNTRIES

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Abstract

Background and aims—Most studies reporting alcohol use among fatally injured victims are subject to bias, particularly that related to sample selection and to absence of injury context data. We developed a research method to estimate the prevalence of alcohol consumption and test correlates of alcohol use prior to fatal injuries, using the city of Sao Paulo, Brazil as a model.

Design, Setting and Participants—Cross-sectional study based on a probability sample of fatally injured adult victims (N=365) autopsied in Sao Paulo, Brazil. Victims were sampled within systematically selected 8-hour sampling blocks, generating a representative sample of fatal injuries occurring during all hours of the day for each day of the week between June 2014 and December 2015.

Measurements—The presence of alcohol and blood alcohol concentration (BAC) were the primary outcomes evaluated according to victims' socio-demographic, injury context data (type, day, time and injury place), and criminal history characteristics.

Findings—Alcohol was detected in 30.1% (CI 95%; 25.6–35.1) of the victims, with a mean BAC level of 0.11% w/v (CI 95%; 0.09–0.13) among alcohol-positive cases. Those black and mixed race presented a higher mean BAC than white victims (p=0.03). Less than one in every six suicides tested positive for alcohol, while almost half of traffic-related casualties were alcohol-

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positive. Having suffered traffic-related injuries, particularly those involving vehicle crashes, and injuries occurring during weekends and at night were significantly associated with alcohol use before injury ($p<0.05$).

Conclusions—Nearly one third of fatal injuries in Sao Paulo were alcohol-related, with traffic accidents showing a greater association with alcohol use than other injuries. The sampling methodology tested here, including the possibility of adding injury context data to improve population-based estimates of alcohol use before fatal injury, was found to be a reliable and lower cost strategy for avoiding biases common in death investigations.

Keywords

Alcohol; BAC; Brazil; Deaths; Injuries; Toxicology

Introduction

Epidemiology as a scientific discipline was established only in the 20th century, although there are many earlier examples, ranging from Hippocrates to John Snow, demonstrating strategies used to understand disease causation. Since then, minimizing biases or avoiding confounding in study designs has been one of the main core principals applied in this relatively recent research field (1).

Substance use associated with fatal injuries has been investigated as early as the 1950s, when the Philadelphia study provided evidence on the involvement of alcohol use among homicide victims (2). While systematic data collection on substance use among injured victims has progressed significantly during the last century, epidemiologic studies on this topic still suffer from several methodological weaknesses. Lack of adequate biological specimens, selection bias among victims sampled, and the absence of contextual data linked to time of the injury event are among the main limitations that prevent further development of valid estimates for substance use among injured subjects (3, 4).

For instance, in most jurisdictions worldwide, toxicology studies, including testing blood alcohol concentration (BAC), are not mandatory for all causes of death, and may only be undertaken if the police authority or medical examiner deem as necessary to establish the cause of death. This stipulation introduces serious bias in the selection of subjects in studies based only on routine death investigation procedures. Postmortem testing procedures using diverse sampling techniques (e.g. different post-death time periods for blood collection) are also another important source of bias that may influence alcohol findings at autopsy (5).

Nonetheless, a large number of studies have documented the positive association between many types of injuries and substance use, particularly alcohol which is the most prevalent substance found among homicide, suicide and road traffic casualties (3, 6). Moreover, both unintentional and intentional injuries account for more than one-fourth of all deaths attributed to alcohol consumption worldwide (7), with alcohol being a contributor factor for most of the injuries in Latin America and the Caribbean (8).

In Brazil, as well as in many other developing countries, there is a growing wealth of information on the harmful effects of alcohol use, but the systematic collection of data on alcohol-related injuries has not been implemented at the national level (9). Toxicological findings have the potential to inform and direct public health strategies to prevent alcohol- and drug-related injuries in developing nations such as Brazil. However, it is necessary to have a clear definition of a substance-related injury in order to account for as many forms of bias as possible that may be present when inferring that substance use is a contributing factor to an injury event (10).

In this paper, we report results from a new research methodology developed to: (1) estimate the prevalence of alcohol consumption in a probability sample of fatally injured victims, thus avoiding inherent selection biases from studies based solely on toxicology surveillance data; and, (2) test the correlates of alcohol use prior to fatal injuries, particularly those related to socio-demographics, injury context (type, day, time and place of injury), and criminal history characteristics. The city of Sao Paulo, Brazil, was used as a model for the development and application of this research methodology which aims to improve population-level data on alcohol-related deaths.

Methods

Design of the study

This was a cross-sectional study based on a probability sample of all fatally injured victims autopsied in the city of Sao Paulo, in which all victims meeting inclusion criteria were systematically included within pre-selected 8-hour sampling blocks. This proportionate stratified sampling strategy generated a representative sample of fatal injuries occurring during all hours of the day for each day of the week during the data collection period. This procedure was applied separately and continuously at each study location until a minimum sample size (N=384) was ascertained across all sites combined, thus resulting in a representative sample of all fatal injuries occurring in the city of Sao Paulo from June 2014 to December 2015.

Setting and sampling methods

Sao Paulo is the most populous city in Brazil, with more than 11.5 million inhabitants across 96 regions (districts), comprising a total of 1,521 km^2 (11). Approximately 7,000 decedents from the city of Sao Paulo are autopsied at the Legal Medical Institute (IML/SP) annually. There are currently four facilities located in different regions of the city (Central, South, East and West), where all victims of sudden, unexpected or violent death are investigated by autopsy to determine cause. However, postmortem blood alcohol analyses may not be undertaken if there is sufficient evidence to establish the cause and manner of death, thus BAC is not available for all deaths; e.g., in 2005, on only 76% of the 2,684 registered homicide victims in Sao Paulo was blood alcohol analysis obtained (12).

For the present study, a probability sample was selected of all fatally injured adult victims autopsied at three of the four facilities of the IML/SP during the study period. Alcohol blood tests were performed for all selected victims independent of whether or not it was required

by the investigation; therefore, selection bias inherent in the present toxicological surveillance system was fully avoided. The facility located in the West Zone was not included in the study because its primary function was to perform autopsies on decomposed decedents.

To be eligible for the present study, only adult victims who had a sudden, unexpected, violent or otherwise non-natural cause of death were included. Victims excluded were those aged less than 18 years, decedents with more than 12h after death (e.g. decomposed bodies), those who received six or more hours of medical treatment (or survived for the same period) prior to death, or those with any other condition that would create postmortem artifacts which could influence BAC results (e.g. body immersed in water, blood contaminated with unabsorbed ethanol).

Following the standard probability sampling method adopted by studies conducted on alcohol and injury internationally in emergency departments (13), all victims were selected throughout an 8-hour period during the day shift on a given day for the first week, the evening shift on the same day of the week for the second week, and the night shift on the same day of the week for the third week, rotating this scheme by each day of the week every 3-weeks. This strategy guaranteed an equal representation of all times of day for a single day of the week for every three-week block of data collection in each location. Rotating three-week blocks of data collection throughout the study period assured a sample with an equal representation of all hours of the day for each day of the week.

Data were collected over 135 pre-selected sampling blocks of 8h each conducted during 19 continuous months across all sites. Every case that met inclusion criteria was included during the selected periods of data collection. A total of 656 victims were screened during the study period with 385 (58.7%) meeting the inclusion criteria. Reasons for non-inclusion included: medical treatment prior to death ≥6h, including those who died from complications following an injury or due to medical and surgical care (n=232); aged less than 18 years (n=28); blood specimens contaminated or unavailable (n=27); and decedents with >12h after death (n=4). To additionally insure that victims did not present any exclusion condition (e.g. treatment ≥6h) that was not apparent at the time of the autopsy, police records containing detailed data on the victims, including information on previous hospitalization, were also reviewed, and an additional 20 victims (3%) excluded, which resulted in a total sample size of 365 victims on whom blood alcohol tests were performed.

Measures

Measures included the primary outcomes of the presence of alcohol and BAC levels, and their association with victims' socio-demographic, injury context and past criminal record characteristics as predictor variables. Except for toxicology findings, all data were extracted from police records obtained with approval from a confidential database maintained by the Police of the State of Sao Paulo. Prevalence estimates for the current number of total adult fatally injured victims registered in the city of Sao Paulo were obtained from official public databases (14) for comparison purposes with this study's population sample.

Toxicology

Blood specimens were collected into 4 ml Vacutainer® tubes containing sodium fluoride (6 mg) and EDTA (12 mg). Alcohol was measured in blood specimens obtained from the coronary sinus and/or the femoral vein from victims using headspace gas chromatography equipped with flame-ionization detection (HS-GC-FID - Agilent technologies, Santa Clara, CA, USA). Each measurement was performed in duplicate, with a BAC result higher than 0.01% (w/v) considered positive for the presence of alcohol.

Socio-demographic characteristics

Victims' socio-demographic characteristics included gender, age, ethnicity, educational status, and place of residence. Ethnic groups were dichotomized as whites and non-whites (black, mixed race and others) and age groups as ≤30; >30. Educational status was categorized as: primary or none (≤8 years of education), secondary (>8 years) or some college (>12 years), and place of residence classified as: Sao Paulo; another city in the State of Sao Paulo; any other city outside the State of Sao Paulo, including foreign locations.

Injury context

The type of injury that caused the fatality was classified as: traffic-related, homicide, self-inflicted or suspicious death (which included undetermined deaths or those requiring further examination for establishing the cause of death, such as falls, chemical or other poisoning, etc.). Data on day, time and place of the injury event (private or public setting), as well as the circumstances of death, such as the weapon or method that caused the injury (e.g. firearms, sharp weapons, sudden death) were also obtained. Information regarding any evidence of substance use (including alcohol) at the event scene and the presence of other people involved in the injury event (e.g. aggressors) was also collected.

Past criminal record

A criminal record was considered positive when a victim had any kind of previous criminal activity on file in the police records (such as trafficking, theft, driving under the influence, and past suicide attempts).

Statistical analysis

Databases were checked by at least two different researchers to avoid potential misinterpretation. Descriptive statistics were used to generate measures of frequency, means and confidence intervals (95% CI). All mean BAC levels (unless otherwise noted) refer to that found in victims with a positive confirmation for alcohol. Chi-square goodness of fit test was applied for comparing this study's sample distribution by injury type with estimates obtained from official sources.

The presence of alcohol was dichotomized as the dependent variable. Student's *t*-test was applied for mean BAC comparisons between groups based on independent dichotomous predictor variables, while one-way ANOVA was used for groups classified according to variables with three or more categories. Multiple logistic regression was used to obtain odds

ratios (ORs) with 95% CIs predicting alcohol's presence for predictor variables adjusted by age and gender. All analyses were conducted in STATA/IC statistical software Version 13.1.

Ethics

This study was conducted using confidential data, and all individuals' identities were strictly preserved. The Research Ethics Committee of the University of Sao Paulo Medical School and the Scientific Committee from the IML/SP approved the study protocol (#096/14).

Results

Univariate analysis

The final sample in this study had a similar distribution of injury types compared to the most recently reported population of fatally injured victims in the city of Sao Paulo (Table 1). Almost one third of the sample was positive for alcohol, with a mean BAC level of 0.11% w/v (CI 95% 0.09–0.13) among all alcohol-positive victims (Table 2).

The majority of victims were white men aged 30 years or older with only a primary school education, and most were from the city of Sao Paulo. Intentional injuries (homicides and self-inflicted) accounted for 40% of the deaths, with firearms being the most commonly used method among all deaths. Most of the injuries occurred in a public space during weekdays and at night. Only a small portion of the cases had an identified aggressor or had any evidence of substance use at the event scene, and 15.9% (CI 95% 12.3–20.4) of victims were positive for a past criminal record.

Less than one in every six suicides tested positive for alcohol, while one-third of homicides and almost half of all traffic-related casualties were alcohol-positive. Additionally, approximately 60% of vehicle crash deaths were positive for alcohol, a proportion almost twice as high as suicides by hanging and deaths by sharp weapons.

The mean BAC was similar among alcohol-positive victims for men and women. A higher mean BAC was found in victims older than 30 years of age (compared to those aged ≤30 years) and among white victims (compared to non-whites). Traffic-related injuries presented the highest mean BAC among all injury types, followed by homicides. Pedestrians hit by vehicles, and deaths from sharp weapons and falls averaged the highest mean BAC compared to other methods of death.

Victims who had a criminal record had a lower mean BAC than those without among all alcohol-positive cases. A lower mean BAC was also found among victims who did not have an identified aggressor (compared to those who did) and those who had any evidence of substance use at the event scene (compared to those with no evidence) (Table 2).

Bivariate analysis

Multiple logistic regression results, controlling for gender and age, according to alcohol's presence among all victims are also showed in Table 2. Men were more likely to be alcohol-positive than women, but the presence of alcohol did not differ by age or ethnicity. However, those with higher educational levels were less likely to be alcohol-positive.

Alcohol use was more likely among victims of traffic-related injuries and homicide victims. Moreover, an increased OR for alcohol use was found for vehicle crashes compared to other methods, and deaths occurring on weekends and at night were more likely to be alcohol positive compared to those on weekdays or during daytime.

Discussion

The methodology applied in this study was found to be a reliable strategy for investigating alcohol use among fatally injured victims in a city with high rates of external causes of mortality, and provided a sample with a similar distribution to that of fatal injuries currently represented in the city of Sao Paulo, supporting the population-based nature of the estimates presented here.

Moreover, findings here suggest the presence of relevant social disparities and differences in injury context associated with alcohol use among fatally injured victims in the biggest city in Brazil. Almost one in every three victims was under the influence of alcohol at the time of the injury event, and the average BAC among alcohol-positive victims was nearly twice as high as the legal level of intoxication in Brazil (i.e. 0.06% w/v for traffic-related criminal offenses).

The prevalence of alcohol use prior to fatal injury reported in the present study was similar to that from studies of non-fatally injured patients in Latin American countries (ranging from 10 to 32%) (4), but smaller than previous estimates among homicide (43%) and fatal traffic-related casualties (39.4%) in Sao Paulo from toxicology reports based on routine autopsy procedures. Furthermore, the mean BAC previously reported in the same geographical area among homicide victims (0.16% w/v) and traffic-related fatalities (0.17% w/v) were both higher than that reported here (12, 15).

This heterogeneity in findings across studies is likely due to a number of reasons, including differences in the methods used to collect biological specimens from the studied populations, the postmortem interval between death and specimen collection during autopsy, and variations in sampling methods (16). These differences across studies highlight the importance of applying representative sampling methods in order to avoid selection bias in injury research, particularly when comparisons within the same locality are desired for surveillance purposes.

The majority of fatalities associated with alcohol use were due to unintentional injuries in Sao Paulo, unlike estimates of alcohol-attributable mortality (8) and risk of non-fatal alcohol-related injury (17) which have been found to be higher for intentional injuries in the Latin American region. Although findings cannot be interpreted as causally related, they suggest that traffic-related mortality is strongly associated with alcohol consumption in the city of Sao Paulo, whereas for intentional injuries such as homicides, other precipitating factors (e.g. gang-related crimes) might play a major role. In the present study, homicide victims were found to have the highest prevalence of a past criminal record compared to all other injury type (data not shown), which could be considered a proxy for intentional

injuries associated with gang-related crimes. Additionally, for all injuries, victims with a criminal record had a lower mean BAC than those without any criminal background.

It is known that other factors such as social deprivation, involvement in illicit drug markets, enforcement of drug laws, and drug use disorders (18–20) may also impact the likelihood of violence perpetration, and exactly how these factors might be associated, either independently or in combination with acute alcohol use and violence-related injury requires additional investigation. Studies have already demonstrated that black and mixed race young people in Brazil are overrepresented among victims of violence (21), but reasons why blacks and mixed race averaged a higher mean BAC than their white counterparts across all fatalities should be further explored.

It was also interesting to note that the highest BAC levels were observed among pedestrians hit by vehicles, stabbing, and falls. This corroborates the “victim-precipitated” hypothesis that has been commonly verified among homicide victims in which the victim may act as a positive precipitator in the injury event (2). In relation to the context in which the injury occurred, deaths that had an identified aggressor were found to have a higher mean BAC among victims than those without identified participants. Moreover, victims who were found with any evidence of substance use at the event scene showed a smaller mean BAC than those without such evidence, while the place of injury was not found to differ according to alcohol use, all of which should be further explored in future research.

These contextual data were extracted from police reports, which may differ from research based on self-reports of non-fatally injured patients (22), with the former less accurately reflecting the place of drinking prior to injury. Nonetheless, such data should be considered relevant for furthering the understanding of how alcohol use might be associated with different injury types and alcohol use contexts.

Findings here also suggest that the type of injury, method of death, time of the day and day of the week are predictors for alcohol use prior to death, even after adjusting for gender and age differences. These findings, based on multiple data sources on injuries currently provided by death investigation services in Sao Paulo, show significant potential for guiding public health interventions to reduce violence-related injuries (23, 24) and informing law enforcement effectiveness against drunk driving (25, 26), as demonstrated by similar strategies implemented elsewhere.

In summary, findings here suggest that estimates of alcohol use based on probability samples including all types of injuries may be a more reliable and cost-effective option for current surveillance systems on alcohol-related fatalities, particularly in developing countries where the lack of resources for death investigations limits the implementation of more comprehensive fatality monitoring strategies.

Lastly, by linking toxicology findings with the context of injury through a low cost method of utilizing established data sources, we have demonstrated the feasibility of exploring additional factors that are likely to influence alcohol’s association with injury without imposing extra costs to current death investigation services. This kind of strategy coupled with studies able to generate risk estimates based on alcohol use may contribute to a better

understanding and definition of an alcohol-related injury in Brazil, as well as guide similar approaches to other issues such as other drug use that have rarely been addressed among injured victims.

Limitations

The goal of this study was to improve the current understanding of an alcohol-related fatal injury, and some limitations apply. First, the associations discussed here cannot be interpreted as causally related due to the cross-sectional design of this research.

Second, although our primary goal was to reduce any bias involved in the sampling of subjects, we understand that we could not address all the factors that might influence the investigation of fatalities, such as sudden changes in health service attendance or police evaluations that may vary across different departments within the city. Furthermore, while our sampling method guaranteed an equal representation of all hours of the day for each day of the week, we did not attained the same representation regarding all months of the year, which should be considered by surveillance systems and future studies on this topic.

Nevertheless, we were able to considerably reduce the usual sources of selection bias that likely underestimate (e.g. victims who went through medical treatment before dying) or overestimate (e.g. only victims whom authorities select for toxicology analysis) alcohol use among fatal injuries. For example, if we had not applied the selected inclusion criteria used here, one third of the original sample that went to treatment for more than 6h would have been included, resulting in an underestimate of alcohol involvement due to alcohol's decline in blood in a period of 6–8h (27). Although these excluded victims could be under the influence of alcohol at the time of injury, because alcohol testing is not a routine procedure in most emergency departments in Sao Paulo, casualties that presented any indication that their BAC may have been influenced either by survival time or treatment time before death were excluded.

Third, other drug use (alone or in combination with alcohol) was not evaluated in this study, and should be considered in future analysis of the predictor variables studied here. Finally, while police records are typically considered as having strong internal reliability, their external generalizability is limited (28). Information bias derived from police records is common, particularly regarding the definition of intentionality in cases of fatal injuries (e.g. a homicide may turn out to be a suicide, or vice-versa). However, by examining not only the medical findings at the time of autopsy, but also the police reports several months after the fatal injury event, this potential source of bias has been diminished.

Conclusions

In conclusion, the methodology reported here was found to be a reliable and low cost strategy to avoid those biases common in death investigations, and included the potential of testing for correlates such as injury context that would contribute to more accurate population-based estimates of alcohol use before fatal injury. Alcohol is currently found among nearly one third of all injury fatalities in the city of Sao Paulo, and both social disparities and differences in injury context seem to play a key role in the manner in which alcohol use is associated with these deaths. Traffic-related fatalities, particularly those

involving vehicle crashes, and fatalities occurring on weekends and at night were associated with alcohol use before injury. Ultimately, furthering the understanding of alcohol use and underlying factors involved in fatal injuries by bridging the gap between health services and research through alternative and more cost-effective methods such as the one presented here may play a crucial role in the prevention of alcohol-related fatalities in Brazil and elsewhere.

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Table 1

Comparison between the registered number of fatal injuries in Sao Paulo (2013) and this study's population sample (n=365) according to the type of injury.

	Annual statistic (2013)[a] N (%)	Final study sample N (%)	p[b]
Homicides	1,354 (26.0)	104 (28.5)	
Traffic-related	1,054 (20.3)	56 (15.3)	
Self-inflicted	524 (10.1)	44 (12.1)	
All others	2,267 (43.6)	161 (44.1)	
Total	5,199	365	0.08

[a]Excluding minors and those who died due to complications of medical and surgical care (Y40–Y84) or sequelae of external causes of morbidity and mortality (Y85–Y89). Type of injuries and codes were defined according to the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) (14).

[b]Chi-square goodness of fit test.

Table 2

Proportion alcohol-positive, mean blood alcohol concentration and logistic regression results (alcohol-negative=0; alcohol-positive=1) according to victims' socio-demographic characteristics, injury context data and past criminal record data from fatally injured victims in the city of Sao Paulo (N=365).

	All n (%)	Alcohol-Positive % (95%CI)	Mean[a] (95%CI)	p[b]	OR adj.[c]	p	Missing Data (%)
Total	365	30.1 (25.6–35.1)	0.11 (0.09–0.13)	-	-	-	0%
Gender							
Women	65 (17.8)	16.9 (9.6–28.2)	0.11 (0.09–0.13)		1.0		
Men	300 (82.2)	33.0 (27.9–38.5)	0.12 (0.06–0.18)	0.60	2.4 (1.2–4.8)	**0.01**	0%
Age							
30 or less	120 (37.0)	29.2 (21.7–37.9)	0.09 (0.07–0.11)		1.0		
More than 30	204 (63.0)	29.4 (23.5–36.1)	0.12 (0.09–0.14)	**0.04**	1.0 (0.6–1.7)	0.96	11.2%
Ethnicity							
White	172 (50.3)	25.6 (19.6–32.7)	0.09 (0.07–0.11)		1.0		
Non-white	170 (49.7)	34.7 (27.9–42.2)	0.12 (0.10–0.14)	**0.03**	1.4 (0.9–2.4)	0.16	6.3%
Educational status							
Primary or none	157 (61.1)	30.6 (23.8–38.3)	0.09 (0.06–0.11)		1.0		
Secondary	74 (28.8)	35.1 (25.1–46.7)	0.09 (0.06–0.12)		1.3 (0.7–2.3)	0.40	
Some College	26 (10.1)	7.7 (1.9–26.8)	0.04 (−0.02–0.10)	0.30	0.2 (0.1–0.9)	**0.04**	29.6%
Victim origin							
Same city	154 (51.7)	27.9 (21.4–35.6)	0.08 (0.06–0.10)		1.0		
Same State	50 (16.8)	32.0 (20.5–46.2)	0.07 (0.03–0.10)		1.2 (0.6–2.4)	0.49	
Outside State	94 (31.5)	29.8 (21.4–39.9)	0.10 (0.07–0.13)	0.43	1.1 (0.6–2.0)	0.31	18.4%
Injury type							
Self-inflicted	44 (12.1)	13.6 (6.2–27.4)	0.07 (0.02–0.12)		1.0		
Traffic-related	56 (15.3)	42.9 (30.5–56.2)	0.12 (0.09–0.15)		4.2 (1.5–11.7)	**<0.01**	
Homicides	104 (28.5)	34.6 (26.1–44.3)	0.09 (0.06–0.11)		2.8 (1.1–7.5)	**0.04**	
All others	161 (44.1)	27.3 (21.0–34.8)	0.08 (0.05–0.11)	**0.03**	2.1 (0.8–5.3)	0.13	0%
Method of death							
Firearms	83 (22.7)	32.5 (23.3–43.4)	0.07 (0.05–0.09)		1.0		
Vehicle-pedestrian	31 (8.5)	22.6 (11.0–40.8)	0.15 (0.07–0.24)		0.6 (0.2–2.0)	0.45	

	All n (%)	Alcohol-Positive % (95%CI)	Mean[a] (95%CI)	p[b]	OR adj.[c]	p	Missing Data (%)
Vehicle crash	27 (7.4)	59.2 (39.9–76.1)	0.11 (0.08–0.13)		3.7 (1.5–9.5)	**<0.01**	
Sharp weapons	23 (6.3)	34.8 (18.1–56.3)	0.16 (0.10–0.23)		1.7 (0.6–4.9)	0.31	
Fall	34 (9.3)	29.4 (16.4–46.9)	0.15 (0.09–0.21)		1.1 (0.4–2.8)	0.82	
Hanging	14 (3.8)	35.7 (15.1–63.4)	0.08 (0.02–0.15)		1.5 (0.4–5.2)	0.50	
Intoxication	25 (6.9)	16.0 (6.0–36.3)	0.03 (0.01–0.05)		0.6 (0.2–1.8)	0.33	
All others	128 (35.1)	25.8 (18.9–34.1)	0.07 (0.04–0.10)	**<0.01**	0.9 (0.5–1.8)	0.80	0%
Injury place							
Public	207 (64.9)	33.8 (27.7–40.6)	0.12 (0.10–0.14)		1.0		
Private	112 (35.1)	28.6 (20.9–37.7)	0.10 (0.07–0.13)	0.20	0.9 (0.5–1.5)	0.58	12.6%
Substance at the event							
Yes	48 (14.5)	25.0 (14.7–39.3)	0.05 (0.03–0.07)		1.0		
No	283 (85.5)	31.8 (26.6–37.5)	0.12 (0.10–0.14)	**<0.01**	0.8 (0.4–1.7)	0.56	9.3%
Aggressor presence							
Yes	45 (13.6)	35.6 (22.9–50.6)	0.15 (0.11–0.19)		1.0		
No	286 (86.4)	30.1 (25.0–35.7)	0.10 (0.09–0.12)	**0.03**	1.3 (0.6–2.7)	0.75	9.3%
Death time							
Morning	64 (17.6)	18.8 (10.9–30.3)	0.10 (0.05–0.15)		1.0		
Afternoon	80 (21.9)	20.0 (12.6–30.3)	0.08 (0.03–0.12)		1.1 (0.4–2.8)	0.92	0%
Evening	137 (37.5)	32.8 (25.5–41.2)	0.09 (0.07–0.11)		2.5 (1.1–5.8)	**0.04**	
Night	84 (23.0)	44.0 (33.8–54.9)	0.10 (0.07–0.12)	**0.02**	5.2 (2.1–12.9)	**<0.01**	
Death day							
Weekday	270 (74.0)	27.0 (22.1–32.7)	0.10 (0.09–0.12)		1.0		
Weekend	95 (26.0)	38.9 (29.6–49.2)	0.12 (0.08–0.16)	0.81	1.7 (1.0–2.8)	**0.05**	0%
Criminal background							
Yes	50 (15.9)	34.0 (22.2–48.3)	0.08 (0.04–0.11)		1.0		
No	264 (84.1)	29.2 (24.0–35.0)	0.11 (0.09–0.13)	**0.05**	1.3 (0.6–2.5)	0.51	14.0%

[a] Mean values for alcohol-positive victims only (% w/v).

[b] Student's t-test was applied for mean comparisons between groups based on independent dichotomous variables, while one-way ANOVA was used for groups classified according to variables with three or more categories.

[c] For gender and age, only crude ORs are presented. All other regressions included gender and age as covariates.