

Appendix. Results of Included Studies (n=28)

Study Identification	Type of Study	Objective	Methodology	Results	Conclusion
<i>Gorman, D. M., Speer, P. W., Gruenewald, P. J., & Labowrie, E. W., 2001</i> ⁹ United States	Cross-sectional	To study the relationship between neighborhood social structure, alcohol outlet densities and violent crime in New Jersey.	Data pertaining to neighborhood social structure, violent crime and alcohol density were collected for 98 block groups, and analyzed using bivariate, multivariate and spatial analyses.	Areas with high alcohol outlet density experienced more violent crime than low-density areas, after controlling for neighborhood structural features such as poverty and age.	High alcohol outlet density is associated with high rates of violent crime in this urban community. Spatial analysis suggests that this relationship exists only within the immediate neighborhood context. Limitations: As this is a cross-sectional study, statements of cause and effect cannot be made due to other confounding factors and reverse causality.
<i>Gruenewald, P. J., Freisthler, B., Remer, L., Lascala, E. A., & Treno, A., 2006</i> ¹⁵ United States	Cross-sectional population-based ecological approach	To assess the degree to which measures of the different subpopulations contribute to violent crime.	Cross-sectional data on hospital discharges for violent assaults were obtained for residents in the 1637 zip code in California for the year 2000. Assault rates were related to measures of population and place characteristics using spatial statistical models corrected for spatial auto-correlated error.	Rates of assault were related to population and place characteristics within zip code areas.	Population and place characteristics are associated with rates of violence across spatial areas. Limitations: As this is a cross-sectional study, statements of cause and effect cannot be made due to other confounding factors and reverse causality.
<i>Lipton, R., & Gruenewald, P., 2002</i> ⁶ United States	Cross-sectional population-based ecological approach	To determine whether the association between violence and population density is moderated by the presence of alcohol outlets.	Zip code areas (N=766) in California from 1990 were examined for rates of violence, considering population characteristics and the potential effect of alcohol outlet density on violence rates.	The density of bars was strongly associated with greater rates of assault, while density of restaurants was associated with less violence.	Alcohol outlets, in the presence of socioeconomic measures, are associated with the occurrence of violence in urban areas. Limitations: As this is a cross-sectional study, statements of cause and effect cannot be made due to other confounding factors and reverse causality.
<i>Livingston, M., 2008</i> ¹⁴ Australia	Cross-sectional	To examine the spatial relationship between alcohol outlet density and alcohol-related assaultive violence in Melbourne, Australia.	Cross-sectional data on police-recorded assaults during hours of high alcohol use at liquor outlets were obtained for 223 postcodes in Melbourne. Models of the relation between alcohol outlet density and assault were made, controlling for socio-demographic factors.	The model positing non-linear relationships between outlet density and assaults was found to fit the data most effectively.	There is a positive relationship between outlet density and assault rates. The examination of non-linear effects of outlet density demonstrated a critical threshold for general licences density, after which rates of violence increase sharply. Limitations: As this is a cross-sectional study, statements of cause and effect cannot be made due to other confounding factors and reverse causality.

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<i>Livingston, M., 2008</i> ¹⁰ Australia	Longitudinal study	To examine the characteristics of regions in which changes in outlet density are most strongly associated with changes in violence rates.	Nine years (1996-2005) of alcohol outlet density (liquor licensing records) and alcohol-related violence (police recorded night-time assaults) were examined, from 186 postcodes in Melbourne, Australia.	Overall positive relationships between all types of alcohol outlets and violence were identified	Changes in the number of alcohol outlets in a community are linked to changes in the amount of violence in community experiences. Limitations: As this longitudinal study was conducted in one metropolitan area of Melbourne, Australia, the results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.
<i>Nielsen, A. L., & Martinez, R., 2003</i> ⁵ United States	Cross-sectional	To examine the relationship between alcohol availability (outlet density rate) and non-lethal violence in Miami.	Effects of alcohol (total outlet rate) are considered from the perspectives of social disorganization and routine activities theories. The analysis includes corrections for spatial auto-correlation.	Alcohol availability has strong positive effects on rates of nonlethal violence. The percentage of recent immigrants is also a positive predictor.	Reducing the availability of alcohol through various means (e.g., limiting the number of outlets or increasing taxes) may help to reduce violence. Limitations: As this is a cross-sectional study, statements of cause and effect cannot be made due to other confounding factors and reverse causality.
<i>Norstrom, T., 2000</i> ⁸ Sweden	Longitudinal study (time-series)	To test whether changes in the number of bars over time is associated with changes in violence.	The data comprise aggregate time series method for Norway for the period 1960-95.	A statistically significant relationship ($p=0.03$) was found between outlet density and crimes of violence investigated by the police.	The findings suggest that increases in the number of public drinking places are associated with increases in criminal violence. Limitations: As this longitudinal study was conducted in one area of Norway, the results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.
<i>Reid, R. J., Hughey, J., & Peterson, N. A., 2003</i> ¹¹ United States	Cross-sectional	To assess the geographic association between rates of assaultive violence and alcohol-outlet density in Kansas City, Missouri.	A hierarchical multiple regression analysis strategy was employed to test whether alcohol availability, as measured by outlet density, contributed to assaultive violence in 89 inner-city census tracts in Kansas City, Missouri, accounting for socio-demographic variables	Alcohol outlet density was predictive of assaultive violence. Controlling for socio-demographic factors, 9% ($R^2=0.09$) of the variability in assaultive violence was explained by the density of alcohol outlets.	Alcohol-outlet density contributed significantly to the explained variance of the regression model and was associated with higher rates of assaultive violence in this Midwestern city. Limitations: As this is a cross-sectional study, statements of cause and effect cannot be made due to other confounding factors and reverse causality.

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<i>Sivarajasingam, V., Matthews, K., & Shepherd, J., 2006</i> ¹⁸ United Kingdom	Retrospective study	To investigate relationships between violence-related injury and potential risk factors in England and Wales from 1995-2000.	Records from ten economic regions relating to price of alcohol, youth income, wealth, ethnic density, dates of major sporting events and seasonality were studied with reference to violent injury data derived from 58 Emergency Departments (EDs).	Overall, 353,443 violence-related ED visits occurred. High rates of regional violence-related injury correlated with low price of alcohol. Rates of violence were higher during summer months and on days of major sporting events.	Risk of violent injury was closely linked to alcohol price. Injury reduction efforts should be intensified during the summer and on days of major sports events. Limitations: As this study was conducted only in England and Wales, the results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.
<i>Vingilis, E., Mcleod, A. I., Mann, R. E., & Seeley, J., 2008</i> ²⁶ Canada	Quasi-experimental design using interrupted time series	To identify any differences in impaired driving and assault charges in London and Windsor, Ontario, concomitant with the Liquor License Act, amended in 1996 (extending hours of alcohol sales in licensed venues from 1 to 2 a.m.).	Analyzed data sets included monthly impaired driving and assault charges data for Ontario, for hourly windows between 11 p.m. and 4 a.m., for four years prior to and three years after the policy change.	London and Windsor had significant reductions in impaired driving charges but no changes for assault charges aggregated over the 11 p.m.–4 a.m. time period after the drinking hours were extended. A significant decrease in assault charges was found in London for Thursday-Saturday 1-2 a.m. and significant increases for Sunday-Wednesday 2-3 a.m. and Thursday-Saturday 3-4 a.m.	These findings suggest no overall effect on charges aggregated over the 11 p.m. to 4 a.m. time window, although some differences were observed for the different hours after 2 a.m., possibly an effect of the one-hour alcohol sales extension. Limitations: As this is a quasi-experimental study, there may be contaminations across the conditions of the study.

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<p><i>Ray, J. G., Moineddin, R., Bell, C. M., Thiruchelvam, D., Creatore, M. I., Gozdyra, P., et al., 2008</i>²¹</p> <p>Canada</p>	Retrospective population-based cross-over study	To determine the risk of being hospitalized due to assault in association with retail alcohol sales across Ontario.	On the day prior to each assault case's hospitalization, the volume of alcohol sold at the store in closest proximity to the victim's home was compared to the volume of alcohol sold at the same store one week earlier. Conditional logistic regression analysis was used to determine the associated relative risk (RR) of assault per 1,000L higher daily sales of alcohol.	Of the 3,212 persons admitted to hospital for assault, nearly 25% were between the ages of 13-20, and 83% were male. For every 1,000L of alcohol sold per store per day, the relative risk of being hospitalized for assault was 1.13 (95% CI: 1.02-1.26). The risk was accentuated for males (1.18, 95% CI: 1.05-1.33), youth aged 13-20 (1.21, 95% CI: 0.99-1.46), and those in urban areas (1.19, 95% CI: 1.06-1.35).	<p>The risk of being a victim of serious assault increases with alcohol sales, especially among young urban males.</p> <p>Limitations: As this is a cross-over study, transient factors such as fluctuations in the severity of assaults may confound results.</p>
<p><i>Stevenson, R. J., Lind, B., & Weatherburn, D., 1999</i>²⁰</p> <p>Australia</p>	Cross-sectional analysis	To explore the relationship between alcohol sales and assault in New South Wales (NSW), Australia.	Multiple regression analyses of the relationship between alcohol sales and assault were performed, taking into account spatial auto-correlation.	A significant relationship existed between overall alcohol sales and incidence of assault in all areas in NSW, particularly from hotels and off-licenses.	<p>Although the current research cannot exclude an opportunity account of the role of alcohol in assault, the results are consistent with alcohol consumption as a causal agent.</p> <p>Limitations: As this is a cross-sectional study, statements of cause and effect cannot be made due to other confounding factors and reverse causality.</p>
<p><i>Duailibi, S., Ponicki, W., Grube, J., Pinsky, I., Laranjeira, R., & Raw, M., 2007</i>²⁷</p> <p>Brazil</p>	Retrospective study	To determine if limiting hours of alcohol sales in bars had an effect on homicides and violence against women in Diadema Brazil.	Data on homicides (1995-2005) and violence against women (2000-2005) from the Diadema (population 360,000) police archives was analyzed using log-linear regression analyses.	Restriction on drinking hours led to a decrease of almost nine murders a month. Assaults against women also decreased, but this effect was not significant in models in controlling for underlying trends.	<p>The results of this study confirmed what we know from the literature: restricting access to alcohol can reduce alcohol-related problems.</p> <p>Limitations: As this study was conducted only in Diadema, Brazil, the results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.</p>

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<i>Norstrom, T., & Skog, O. J., 2005</i> ²⁵ Sweden	Longitudinal study	To assess the impact of Saturday opening of alcohol retail shops in Sweden in 2001—during a trial period (phase I) and its application to the entire country (phase II).	Outcome measures included alcohol sales and indicators of assaults and drunk driving. The pre-intervention period was 1995-2000, and the post-intervention period was 17 months (phase I), and 13 months (phase II). Evolution of sales and harm rates were estimated with autoregressive integrated moving-average modeling (ARIMA).	A statistically significant increase in alcohol sales was found (3.7% in phase I, 3.6% in phase II). There were no significant changes in any of the assault indicators during either phase.	Increased accessibility to alcohol rendered by Saturday opening also seems to have increased consumption. However, the authors were not able to detect any increase in alcohol-related harm (such as assault). Limitations: As this longitudinal study was conducted only in Sweden, the results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.
<i>Chikritzhs, T., & Stockwell, T., 2002</i> ²³ Australia	Retrospective study	To examine the impact of later trading hours for licensed public houses in Perth, Western Australia, on levels of violent assault on or near the premises.	Data on assault offenses reported to police between 1991-1997 were examined. A time-series analysis employing linear regression was used to test whether there was a relationship between the introduction of extended trading and monthly rates of assaults.	There was a significant increase in monthly assault rates for public houses following the introduction of extended trading permits. This relationship was largely accounted for by the purchase of increased volumes of high-alcohol content drinks.	Late trading was associated with both increased violence in and around Perth public houses and increased levels of alcohol consumption during the study period. Limitations: As this study was conducted only in Perth, results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.
<i>Briscoe, S., & Donnelly, N., 2003</i> ²⁸ Australia	Retrospective study	To examine the distribution of violent crime across licensed premises in three inner-urban areas of NSW, Australia.	Police-recorded assault incidents on licensed premises in inner Sydney, Newcastle and Wollongong over a two-year period were analyzed. Characteristics such as the time of day and day of week that assaults typically occur, the severity of recorded assaults, as well as the license type of the venue were also considered.	In Sydney 12% of hotels and nightclubs accounted for ~60% of assaults, in Newcastle 8% of licensed premises accounted for ~80% of assaults and in Wollongong 6% of licensed premises accounted for ~67% of assaults. Incidents were more often late at night or early in the day and on weekends, particularly in hotels with extended hours and nightclubs.	The implications of these findings for crime prevention and law enforcement strategies are discussed. Limitations: As this study was conducted only in urban areas of New South Wales, the results may be reflective of selection bias and cohort effects., and thus may be difficult to generalize.

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Graham, K., Osgood, D. W., Wells, S., & Stockwell, T., 2006 ²⁹ Canada	Naturalistic observation study	To assess the relationship between level of intoxication and the frequency and severity of aggressive incidents observed in bars or clubs.	Hierarchical Linear Modeling (HLM) analysis of 1,025 incidents of aggression documented by trained observers during 1,334 nights of observation in 118 bars and clubs in Toronto, Canada, was conducted.	Both level of intoxication of the crowd during the visit as well as mean level of intoxication at the bar level significantly predicted frequency of aggression. There was a positive association between level of intoxication and severity of aggression.	Prevention efforts should focus on both identifying bars that typically have more intoxicated patrons and reducing intoxication levels of patrons across all bars. Limitations: As this is a naturalistic observation study, statements regarding the causes of aggression may not be made, since outside variables cannot be controlled for and recordings of severity of aggression may be a result of observer bias.
Graham, K., Wells, S., & Jelley, J., 2002 ³² Canada	Survey study	To understand the social context of physical aggression.	A survey was designed to collect data that would provide ecologically valid descriptions of aggression using a representative sample of adults 18-60 years of age in Ontario, Canada in 1999. The survey included both open and closed-ended questions. Content coding was used to quantitatively measure open-ended responses.	Of 1,753 adults screened for involvement in physical aggression, males and younger respondents more often reported being involved in an incident in the past 12 months. Of the social context categories, licensed premises were the most common social context (30%) for aggression, followed by a public place such as a street or park (21%).	The study identified clearly distinguishable, mutually exclusive social contexts. The distinctiveness of the different contexts of aggression indicates that a contextual approach would be useful for future research. Limitations: As this is a survey study, cause-and-effect relationships should not be inferred. Self-reported data collected from this study may have introduced recall bias into the results.
Hamel, R., Carvolth, R., Hauritz, M., McIlwain, G., & Teague, R., 2004 ³⁰ Australia	Observational study	To improve interventions designed to increase safety in licensed venues by examining key changes related to observed reductions in violence.	Analysis of observational data collected in 1994 and 1996 in licensed venues in three northern Queensland cities. Data commented on violence, drinking and serving practices, and characteristics of the physical and social environments pre- and post-intervention.	Reductions in aggression were observed, with improvements in venue environment and management. Four predictors were identified for reduced physical violence: improved comfort, availability of public transport, less overt sexual activity and fewer intoxicated males.	Control of the drinking environment is necessary but not sufficient to reduce aggression and violence. Limitations: As this is an observational study, statements regarding the causes of aggression cannot be made since outside variables cannot be controlled for, and recordings of the severity of aggression may be a result of observer bias.

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<i>Quigley, B. M., Leonard, K. E., & Collins, R. L., 2003</i> ¹⁹ United States	Survey study	To examine the characteristics of bars in which violence occurs while accounting for the personalities of the clientele that frequent the bar.	Interviews were conducted with frequent bar patrons (n =327), assessing participants on a number of individual differences related to aggression and drinking behaviour as well as on characteristics of the usual bar that they attend.	Participants' age, alcohol dependence and anger expression differentiated those who frequented violent versus nonviolent bars. This relationship was mediated by characteristics of the bar itself, including noise, temperature, the presence of bouncers, gender of the workers, presence of billiards and illegal activity in the bar.	Individuals having certain personality characteristics are attracted to bar environments that promote anti-normative behaviours such as violence, yet bar characteristics are stronger predictors of violence. Limitations: As this is a survey study, cause-and-effect relationships cannot be inferred. Self-reported data may have introduced recall bias into the results.
<i>Borges, G., Cherpitel, C. J., Medina-Mora, M. E., & Mondragon, L., 2004</i> ³⁷ Mexico	Population based case-control Study	To measure the association between alcohol consumption and ER visits due to violence in Pachuca, Mexico, from 1996-1997.	Data consisted of an interviewer-administered questionnaire, collected on a 24-hour basis, during the entire week.	Patients who reported drinking within the previous six hours were more likely to suffer a violence-related injury compared to non-drinkers, and alcohol-dependent patients were more likely to be involved in a violence-related injury compared to non-drinkers.	In the city of Pachuca, Mexico, a large relationship between drinking prior to the event and violence-related injury, regardless of alcohol dependence, was found. Limitations: As this study employed interviewer-administered questionnaires, reliance on recall to determine exposure status (e.g. alcohol consumption) represents a potential for recall bias.
<i>Borges, G., Orozco, R., Cremonte, M., Buzi-Figlie, N., Cherpitel, C., & Poznyak, V., 2008</i> ³⁴ Mexico	Pair-matched case crossover study	To determine the relative risk of unintentional and violence-related injury associated with alcohol consumption in three EDs in Latin America (2001-2002).	Pair-matched case-crossover was used to obtain RR estimates for alcohol in non-fatal injuries among 447 patients in Argentina 489 in Brazil and 455 in Mexico. Intentional (violence) or unintentional (non-violence) injury status were the main outcomes.	About 46% of violence-related cases involved alcohol (versus 11.5% for non-violence related cases). The risk of violence-related injury increased with drinking.	Increasing amounts of drinking may have pronounced consequences on the risk of triggering an injury, especially for a violence-related injury. Limitations: As this is a crossover study, transient factors, such as fluctuations in the severity of injuries, may confound the results.

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<i>Humphrey, G., Casswell, S., & Han, D. Y., 2003</i> ³⁵ Australia	Case-crossover study	To investigate the role of alcohol in injuries among patients attending an ED in Auckland during December 2000.	A random sample of patients was interviewed and breath tested in the ED. Interviewing took place continuously for a three-week period. Using a case-crossover design the causal role of alcohol was assessed.	35% of injured patients reported having consumed alcohol prior to sustaining their injury. Violence was found to be the cause of 17% of the injury cases and alcohol was reported as involved (victim and/or perpetrator) in 79% of these cases.	Findings indicate that a relatively high proportion of injury cases requiring ED treatment were alcohol-related and that the risk of an injury occurring was significantly increased by consumption of alcohol. Limitations: As this is a cross over study, transient factors, such as fluctuations in the severity of injury, may confound the results.
<i>Macdonald, S., Cherpitel, C. J., Borges, G., Desouza, A., Giesbrecht, N., & Stockwell, T., 2005</i> ³⁶ Canada	Retrospective study	To determine whether alcohol is a likely cause of violence through an application of criteria outlined by Bradford Hill to ED data collected from six countries.	The paper is based on data using similar methods collected from 30 EDs in six countries. Analyses were conducted by comparing various measures of alcohol involvement in violent versus accidental injuries.	The results supported temporal sequence of events and specificity. The odds ratios of violent versus accidental injury for a blood alcohol concentration (BAC) >0.08% were significant for each country, ranging from 2.77 for Mexico to 9.45 for Canada.	A significant dose-response relationship between BAC level and violence was found. All analyses point to a causal role of alcohol in injuries related to violence. Limitations: As this is a retrospective study, selection bias and cohort effects may make it difficult to generalize the findings to other populations.
<i>Macdonald, S., Cherpitel, C. J., DeSouza, A., Stockwell, T., Borges, G., & Giesbrecht, N., 2006</i> ³³ Canada	Retrospective study	To document alcohol impairment BAC of at least 0.08% for different types, causes and location contexts of injuries	Data from 45 studies of alcohol involvement with 11,536 injury patients from 16 countries were merged to determine variations in the percent of alcohol impairment among injury patients. In each study, ED-injury patients were given a short interview on the circumstances of their injury and BAC was measured.	Injury severity was significantly associated with BAC >0.08%. The injury type most commonly involving alcohol was head injury. Patients with alcohol impairment were more likely to be involved in violence than any other cause of injury.	The results demonstrate considerable variation in the circumstances where alcohol is involved in injuries. These results may be useful for the development of prevention initiatives. Limitations: As this is a retrospective study, selection bias and cohort effects may make it difficult to generalize the findings to other populations.

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<i>Bye, K.E., 2007</i> ¹⁷ Norway	Retrospective time series analysis	To assess the aggregate association between alcohol consumption and violence, while controlling for potential confounders.	The data comprise aggregate time-series for Norway from 1880–2003 and 1911–2003 on criminal violence rates and per capita alcohol consumption. Possible confounders include rates of unemployment, divorce, gross national product, public assistance and proportion of the population aged 15-25.	An increase in alcohol consumption of 1 litre per year per inhabitant predicted a change of approximately 8% in the violence rate. Of the seven covariates included in the models, only divorce was associated significantly with violence rate.	Alcohol consumption has an independent effect on violence rates when controlling for other factors. Limitations: As this is a time series analysis, other potential confounders may not have been considered.
<i>Gruenewald, P. J., & Remer, L., 2006</i> ¹² United States	Longitudinal study (population-based ecological approach)	To observe longitudinal relationships between alcohol outlets and violence, and to establish whether these longitudinal effects are context-specific.	Six years of data from 581 zip code areas in California were collected along with features of local populations (e.g. household size) and places (e.g. retail markets) thought to be related to one measure of violence.	Ten percent increases in numbers of off-premise outlets and bars were related to 1.67% and 2.06% increases in violence rates across local and lagged spatial areas, respectively. Every six outlets accounted for one additional violent assault that resulted in at least a one-night stay in hospital.	After controlling for measures in household income and ethnic background, greater numbers of licensed alcohol retail establishments, especially bars and off-premise outlets, were related to rates of assault. Limitations: As this longitudinal study was conducted only in California, United States, the results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.
<i>Warburton, A. L., & Shepherd, J. P., 2006</i> ¹³ United Kingdom	Longitudinal study	To identify correlates of alcohol-related assault injury in the centre of a European capital city, with reference to ED and police interventions, and number and capacity of licensed premises.	Assaults resulting in ED treatment were studied using a longitudinal controlled intervention during a three-year period of rapid expansion in the night-time economy, when ED-initiated targeted police interventions were delivered. A controlled ED intervention targeted at high risk night-clubs was carried out. Main outcome measure was ED treatment after assault in licensed premises and the street.	Targeted police intervention was associated with substantial reductions in assaults in licensed premises, but increases in street assault were also observed (34% overall, 105% in the main entertainment area). Street assault correlated with number and capacity of premises. Risk of assault was 50% greater near licensed premises in the city centre compared with the suburbs.	Marked decreases in licensed premises assaults resulting from targeted policing were enhanced by ED intervention. Capacity of licensed premises was a major predictor of assaults in the city centre street in which they are clustered. City centre assault injury prevention can be achieved through police/ED interventions targeted at high-risk licensed premises. Limitations: As this longitudinal study was conducted only in a city centre of a European capital city, the results may be reflective of selection bias and cohort effects, and thus may be difficult to generalize.