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# Relating Off-Premises Alcohol Outlet Density to Intentional and Unintentional Injuries

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## Abstract

**Aims—**This study investigated the hypotheses that (i) intentional and unintentional injuries occur more frequently in areas with greater density of off-premises alcohol outlets; and (ii) larger and chain outlets selling cheaper alcohol contribute more substantially to injury risk than smaller and independent outlets.

**Design—**Ecological cross-sectional.

**Setting—**From the 256 Statistical Area level 2 (SA2) Census units in Melbourne, Australia, we selected a random sample of 62 units. There were 2,119 Statistical Area level 1 (SA1) units nested within the selected SA2 units.

**Participants—**The selected units contained 295 off-premises outlets.

**Measurements—**Two independent observers conducted premises assessments in all off-premises outlets, assessing the volume of alcohol available for sale (paces of shelf space), price (least wine price), and other operating characteristics (chain vs. independent, drive-through). Outlet counts, assessed outlet characteristics, and other area characteristics (population density, median age, median income, retail zoning) were aggregated within SA1 units. Dependent variables were counts of ambulance attended intentional injuries (assaults, stabbings, shootings) and unintentional injuries (falls, crush injuries, and object strikes).

**Findings—**In univariable analyses, chain outlets were larger ($r = 0.383$; $p < 0.001$) and sold cheaper alcohol ($r = -0.484$; $p < 0.001$) compared with independent outlets. In Bayesian spatial Poisson models, off-premises outlet density was positively related to both intentional (Incidence Rate Ratio = 1.38; 95% Credible Interval: 1.19, 1.60) and unintentional injuries (IRR = 1.18; 95% CI: 1.06, 1.30). After disaggregation by outlet characteristics, chain outlet density was also related

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to both intentional (IRR = 1.35; 95% CI: 1.11, 1.64) and unintentional injuries (IRR = 1.20; 95% CI: 1.08, 1.38).

**Conclusions—**Greater off-premises outlet density is related to greater incidence of traumatic injury, and chain outlets appear to contribute most substantially to traumatic injury risk.

### Keywords

Alcohol outlets; outlet density; trauma; injury; availability

## Introduction

Suggestions that on-premises alcohol outlets (e.g., bars) are related to traumatic injury and other problems are supported by nine empirical and theoretical observations. At the population level, (i) numbers of outlets correlate with numbers of problems across geographic areas (e.g., zip codes; 1-4); (ii) these relationships continue to be observed at relatively fine spatial scales (e.g., Census block groups; 5, 6); (iii) effects continue to be observed after accounting for many theoretically predicted covariates (7), (iv) when relationships are examined over time (7, 8), and (v) assessed relative to sudden changes in availability (9, 10). At the individual level, (vi) there is evidence that at-risk drinkers use these establishments for drinking and, when at these establishments, drink in risky ways (11-13); (vii) problem risks are an increasing function of levels of use in these contexts (14, 15) and (viii) appear to be related to certain operating characteristics of these places (16, 17). Finally, (ix) theoretical models and empirical analyses support the appearance of assortative social mechanisms that link the existence of populations of risky drinkers to use of these places and subsequent drinking risks (18).

Some 50 years of study have gone into establishing the social mechanisms by which problems may be tied to alcohol use in on-premises outlets (19). More recent literature relating problems to off-premises outlets (e.g., liquor stores) has shown some similar relationships. Greater densities of off-premises outlets appear related to greater incidence of assaults (7, 8, 20, 21), intimate partner violence (22-26), youth violence (5), and child abuse (27, 28), and all-cause hospital admissions (29). However some studies present inconclusive findings (3, 30), others conflate off- with on-premises effects (e.g., 1, 31), and most locate incidents by victims’ places of residence (e.g., hospital discharge data; 29) rather than event locations. The few studies that use event locations aggregate these data within large spatial units (e.g., postcodes; 8, 22), so parameter estimates are potentially attenuated due to aggregation bias. Thus, evidence at the population level linking traumatic injury to off-premises outlets is comparatively weak and subject to criticism from several perspectives, and there is very little complementary evidence at the individual level.

In addition to this limited empirical support, few theoretical mechanisms have been proposed linking off-premises outlets to problems. Unlike bars, where drinkers purchase and consume alcohol in one place, drinkers purchase alcohol from off-premises outlets for use elsewhere (e.g., at home). Thus, there are many possible causal linkages between the purchase of alcohol from an off-premises outlet and an injury incident that may occur someplace else. Not surprisingly, theoretical models and empirical methods for conducting detailed studies of these relationships have only been recently developed. For example, recent studies have examined context-specific drinking risks related to violence in the home (22-26, 32), child abuse and neglect (27, 28), and underage drinking (33, 34).

The aim of this study was to investigate relationships between off-premises outlet density and the incidence of intentional and unintentional injuries using highly resolved spatial units and detailed data on outlet characteristics. Standardised premises assessments were used to characterise off-premises outlets located within randomly sampled Census areas of Melbourne, Australia (35-38). Densities and premises characteristics were then related to counts of trauma cases aggregated within Census units using Bayesian spatial Poisson models. Availability theory suggests that greater outlet density will be related to reduced convenience costs for obtaining alcohol (39). Economies of scale related to alcohol distribution and sales will lead to the opening of larger outlets and corporate chains/ franchises that sell alcohol in greater volumes at lower prices, thereby reducing financial costs (40). Reduced convenience and financial costs are theorised to lead to greater use among local populations, leading to more instances of traumatic injury (39, 41). Thus, we hypothesised that (i) the overall density of off-premises outlets would be related to trauma, and (ii) larger outlets and chains selling cheaper alcohol would contribute more substantially to risk than smaller outlets and independent operations selling more expensive alcohol.

# Method

## Sample Frame

This study used data from two nested geographic units provided by the Australian Bureau of Statistics (ABS) 2011 Census: Statistical Area level 2 (SA2) regions which have an average of 9,414.4 residents (SD = 6,548.6) and Statistical Area level 1 (SA1) regions, which are wholly nested within SA2 regions and have an average of 392.4 residents (SD = 195.7). We selected all SA2 regions with an internal centroid inside the city of Melbourne as defined by the ABS. Including one region wholly surrounded by selected SA2 regions and the waterfront and excluding another region not connected to any other selected SA2 region produced a study area with 256 SA2 regions on a contiguous surface (known as a convex hull). We selected a sample of SA2 regions, then used the SA1 regions nested within them as the unit of analysis for the spatial component of this study. Assuming an average of 34.8 SA1 regions in each SA2 region, and moderate spatial autocorrelation between SA1 regions (Moran’s I = 0.30), a sample of 78 SA2 regions would contain 2,716 SA1 regions with an effective sample size of 1,412 SA1 regions (42). We calculated that this sample would provide 80% power to detect a small effect size ($\delta$=0.132) for comparison between independent means in a two-tailed test ($\alpha$ = 0.05).

In practice, we were able to collect field data from 62 SA2 regions, selected as follows. Having acquired geocoded data for all alcohol outlets in the state from the Victorian Commission for Gambling and Liquor Regulation (43), we calculated counts of outlets within SA2 regions according to licence type. Two licences types permit the sale of alcohol for off-premises consumption in Victoria, packaged licences (for dedicated off-premises outlets) and general licences (for bars and restaurants that may also sell take-away alcohol). Defining outlet density as a count of licenced addresses denominated by land area (km$^2$), we stratified the 256 SA2 regions by income and the density of packaged licences (dichotomised at the study area medians). Concerned that outlets in dense urban areas with higher outlet density would predominate, we oversampled areas with lower densities of outlets. The 62 SA2 regions contained 2,119 SA1 regions and a total resident population of 869,095 (23.5% of the population of Melbourne). In preliminary univariate analyses, the selected SA2 units did not systematically differ from non-selected units on key area characteristics (population density, proportion retail, median household income, median age, proportion Australian born; all $p > 0.05$). This suggests that findings from this study may be generalizable to metropolitan Melbourne.

Outlets with packaged licences were eligible for inclusion if they were located within the selected SA2 regions and were open for business at the time our field staff attended ($n = 260$). Outlets with general licences were eligible if they met these same criteria, and if they had drive-through facilities or a separate room dedicated to take-away sales. Of the 197 general licenced outlets in the study region, we used Google streetview to exclude 112 that were clearly ineligible (e.g., restaurants in shopping strips; 44, 45). Field staff attended the other 85, identifying 35 that were currently open for business and met the inclusion criteria. Thus, the 62 selected SA2 regions contained 295 off-premises outlets, including 260 outlets with packaged licences and 35 with general licences.

## Data Collection

The two staff members each underwent 29 hours training, including assessments in 39 outlets outside the selected SA2 areas. Premises assessments were conducted between April and August 2014 and took approximately five minutes per outlet. Although the field staff travelled together, they recorded data from their assessments separately and independently. Each field staff member completed an electronic form as soon as possible after exiting each outlet. Using measures established by Bluthenthal et al. (38), *price* was the cheapest available item within beverage categories (i.e., a 750ml bottle of wine, a 750ml bottle of sparkling wine, and a six-pack of 375ml cans or bottles of beer) and *volume* was the number of paces of shelf space dedicated to alcohol sales (i.e., measured by walking along every shelf in the store) and an estimate of the floor area (i.e., length by width). We identified *drive-throughs* as outlets with facilities for customers to be served while remaining in their vehicles, and differentiated *business type* (chain vs. independent) by classifying chains as outlets for which the licencee held more than one licence in the state as indicated in the licensing data. In cases where outlets had a different operating name than licence name, outlets were cross-checked against other business names in the state, supplemented by web searches.

## Variables

At the outlet level, interrater reliability of price (least wine price, least sparkling wine price), volume (shelf-paces, estimated floor area), and drive-through facilities was high ($r$ or $\kappa \geq 0.80$). Reliability of the least beer price measure was poor ($r = 0.48$), and 39 outlets (13.2%) did not sell any beer. Parallel forms reliability comparing measures of similar features was high ($r \geq 0.85$) for least price (wine compared to sparkling wine) and volume (shelf-paces compared to estimated floor area; 46). We selected the least wine price as the best price measure because only two outlets did not sell that beverage type and available evidence suggests that least prices are substantively related to use (41). To maintain consistency with the extant literature, the measure of shelf-paces was selected to represent volume (38).

At the SA1 level, we separately calculated the number of chain and independent outlets, average least wine prices, and shelf-paces across outlets. Since both chain and independent outlets had drive-throughs, we calculated the proportion of all off-premises outlets in each SA1 with these facilities. The 1,911 (90.2%) areas with no outlets were assigned the mean least wine price and mean proportion of outlets with drive-throughs among all areas with outlets. Other area characteristics potentially related to traumatic injury included measures of population demographics (population, gender, age, median household income), acquired from the 2011 census. Visitors to an area potentially contribute substantially to the background incidence of traumatic injuries, so we also calculated the proportion of land area zoned for retail use within each SA1. Using planning and zoning data from VicMap, the state mapping authority, we denominated the combined business (B1Z, B2Z, B3Z, B4Z, B5Z) and capital city use (CCZ1, CCZ2) areas by the total land area within SA1 units. Additionally, on-premises outlets were assessed using counts of general licences (bars) and restaurant and café licences (restaurants)

Ambulance Victoria, the sole emergency medical service for Melbourne, provided data for the outcome measures (47). Paramedics record patient data in the field using VACIS, an electronic clinical information system. We received georeferenced records for 100% of trauma cases attended between 1 July 2011 and 30 June 2014, spatially masked to the SA1 level. Within each SA1 unit we calculated counts of *intentional injuries* (assaults, stabbings, or shootings) and *unintentional injuries* (falls, crush injuries, or where patients were accidentally struck by an object). Although indicators of recent alcohol use were available in the ambulance data, we included all intentional and unintentional injury cases because unstructured field assessments of intoxication are known to be inaccurate (48).

## Statistical Analysis

We assessed univariate relationships between the outlet-level measures by constructing a Pearson correlation matrix of least wine price, shelf-paces, and business type. We then assessed univariate relationships for the spatially aggregated data, constructing a Spearman correlation matrix of counts of traumatic injuries and measured characteristics of off-premises outlets.

We used hierarchical Bayesian conditional autoregressive Poisson models to assess statistical relationships between counts of intentional (Model 1) and unintentional injuries (Model 2) and characteristics of SA1. For each injury type, an initial model (a) assessed relationships between counts of all off-premises outlets and injuries, then a second model (b) separated the density measure into its theoretically relevant dimensions: counts of independent outlets, counts of chain outlets, the proportion of outlets with drive-throughs, and the average least wine price. Average shelf-paces was collinear with overall outlet counts and was examined in separate sensitivity analyses. Analysis models accounted for other area features that may be related to the incidence of intentional and unintentional injuries: counts of on-premises outlets (bars and restaurants), demographic characteristics, and retail land use. Recognizing that spatial lag effects are often observed in spatial models of this type (49), we also included spatial lags of the independent variables, calculated as average values of adjacent spatial units. Because spatial units were not of uniform size, SA1 land area was used for the model expectancies with the effect that count variables (injuries, outlets, population) can be interpreted as density measures (50).

Hierarchical Bayesian conditional autoregressive Poisson models are well suited to analyses of this kind. The hierarchical structure nested SA1 units within SA2 units to account for the possibility that SA1 units within the same SA2 unit were more alike than SA1 units from different SA2 units. The Bayesian approach provided a closed form solution for expressing the likelihood (whereas a frequentist approach provides an asymptotic estimate). The conditional autoregressive (CAR) random effect partitioned model residuals into spatially structured and spatially unstructured error, controlling for the loss of unit independence due to spatial autocorrelation (51). The CAR term also accounts for the small area problem and controls for over-dispersion of the outcome measures (52). Using WinBUGS v14 (53), models were allowed to burn-in for 50,000 iterations, before sampling from 50,000 iterations to produce estimates. The median estimate and 95% credible interval from this sample can be interpreted similar to a coefficient and 95% confidence interval in regular regressions.

## Results

The natural log (ln) of the least wine price was inversely related to the natural log of shelf-paces across most of the 295 outlets (i.e., higher prices were found in smaller establishments). However, 19 outlets had very low shelf-paces and identical very low least wine prices (labelled “Retailer Type A” in Figure 1). Field staff noted in debriefing discussions that these low-cost supermarkets stocked predominantly “store brand” goods (i.e., low-cost items labelled with the supermarket name), and dedicated very small sections of their otherwise large stores to alcohol sales. We excluded these outlets from subsequent analyses, reserving them for sensitivity tests noted below. In the remaining 276 outlets, logged least wine price had a substantial negative correlation with both chains ($r = -0.484$) and logged shelf-paces ($r = -0.524$). Chains had a moderate positive correlation with logged shelf-paces ($r = 0.383$).

At the SA1 level, the 2,119 selected spatial units contained a mean of 0.130 (SD = 0.447) off-premises outlets, comprised of 0.092 (SD = 0.362) chain outlets and 0.038 (SD = 0.216) independent outlets (Table 1). Ambulance Victoria paramedics attended 3,089 intentional injuries (mean = 1.46; SD = 4.41) and 19,129 unintentional injuries (mean = 9.03; SD = 11.80) in the study area during the three years. Other SA1 level characteristics are presented in Table 1, and the Spearman correlations assessing univariate relationships between areas are presented in Table 2. The shelf-pace measure was very highly correlated with the number of chain stores across areas ($\rho = 0.858$), precluding the inclusion of both items as independent variables in a single model.

Results of the Bayesian spatial models predicting counts of intentional (Model 1) and unintentional injuries (Model 2) across SA1 areas are presented in Table 3. In Model 1a, an increase of one off-premises outlet within local SA1 units was associated with a 38.0% increase in the incidence of intentional injuries (IRR = 1.38; 95% CI: 1.19, 1.60), and one additional outlet in lagged units was associated with an 8.4% increase (IRR = 1.08; 95% CI: 1.00, 1.17). After separating off-premises outlets into the assessed outlet operating characteristics, in Model 1b an increase of one chain outlet within local SA1 unit was associated with a 35.3% increase in intentional injuries (IRR = 1.35; 95% CI: 1.11, 1.64); a lagged effect for chains was not supported, though the median estimate was positive. Models 2a and 2b show similar relationships between unintentional injuries and off-premises outlets. Relationships for the covariates differed slightly between injury types (e.g., younger median age was associated with more intentional injuries, but older median age was associated with more unintentional injuries). Global Moran's I values for the two spatial models were large and positive ($\geq 0.82$).

Sensitivity analyses showed that including the shelf-paces measure and Retailer Type A outlets did not substantively change the effects reported here. Although sampled and unsampled units were generally similar on all area characteristics, effect estimates from the Bayesian spatial analysis were compared to those provided by parallel weighted Poisson regression models. Results again were much the same as those reported here although with evident Type I errors due to spatial autocorrelation. Additional specification tests included population measures of gender, ethnic group composition, and social disadvantage. All were either collinear with other independent measures or their effects were not supported.

## Discussion

Supporting our first hypothesis, we found intentional and unintentional injuries were more common in areas with greater concentrations of off-premises outlets. Supporting our second hypothesis, we found chain outlets appeared to contribute most substantially to injury risk. Chain outlets were larger and appeared to sell alcohol at cheaper prices than independent outlets. Thus, these results support the theory that reduced convenience and financial costs associated with greater densities of outlets (particularly chain outlets) in neighbourhoods lead to more problems.

Previous studies have identified spatial relationships between densities of off-premises outlets and incidence of intentional injuries (5, 7, 8, 20-26). Our results within local SA1 regions were congruent with these prior findings, and parameter estimates within lagged SA1 regions were consistently positive (though the credible interval for some estimates in lagged regions included the possibility of no relationship). Results for the other independent variables were also consistent with previous spatial and person-level analyses. Areas with more retail land use and a younger resident population had more intentional injuries, and areas with an older resident population had more unintentional injuries (7, 49, 54). Importantly, because our analyses adjusted for these area features, relationships between outlets and traumatic injuries are less likely to be confounded by increased background rates of ambulance attendance due to population demographics and the presence of visitors to an area for retail purposes. Thus, our study contributes to a growing literature suggesting that off-premises outlet density is related to intentional injuries.

We make two important further additions. First, our field data collection enabled us to disaggregate outlets based on theoretically relevant characteristics. Identifying that chain outlets contribute most substantially to injury risk, and that these outlets are larger and sell cheaper alcohol, strengthens the claim that observed relationships with traumatic injuries are due to reduced financial and convenience costs of purchasing alcohol. This assertion is also supported by a previous observation that chain outlets have more sales promotions than independent outlets (55). Second, ours is the first study to identify that off-premises outlets are related to unintentional injuries. Indeed, off-premises outlets may place a greater overall burden on public health through unintentional injury than intentional injury due to substantially greater cumulative incidence of the former. In absolute terms, each additional chain was associated with 0.28 additional intentional injuries in local areas compared to 1.09 additional unintentional injuries per year. A greater focus on unintentional injuries in this literature may be warranted.

Availability theory suggests the observed relationships between off-premises outlets and traumatic injury are mediated by greater alcohol consumption among local residents. That is, greater access to alcohol leads to greater consumption, producing greater incidence of alcohol-related problems. Future studies could test this hypothesis by coupling ecological data (e.g., outlet density) with person-level observations of alcohol consumption and injury risk. Alternate theoretical mechanisms should also be tested. For example, off-premises outlets may attract people at increased risk for involvement with violent crime (56, 57). Relationships may also be confounded by the tendency of outlets to be located in disorganised neighbourhoods, and for disorganised neighbourhoods to have greater incidence of traumatic injury (where disorganisation refers to the “inability of a community structure to realise the common values of its residents and maintain effective social controls”; 58, 59).

A key limitation of our study is the use of least wine price and shelf-pace to represent the price and volume of alcohol sold within outlets. Real sales data are rarely available for all outlets within an area (60); however future studies could validate these proxy measures within a sample of outlets. It is also unknown whether the ambulance patients (or the perpetrators of intentional injuries) had consumed alcohol or accessed the alcohol outlets in their local or lagged SA1 areas. This limitation could be addressed by the study design suggested above, linking ecological data with person-level observations. Finally, our cross-sectional design did not allow us to assess temporality.

Despite these limitations, this study contributes important theoretical and empirical advances. Results provide support for the local policies aimed at reducing concentrations of off-premises outlets within neighbourhoods as a strategy to reduce the incidence of traumatic injury. Reducing concentrations of chain outlets, possibly representing larger outlets selling cheaper alcohol, may yield the greatest public health benefit.

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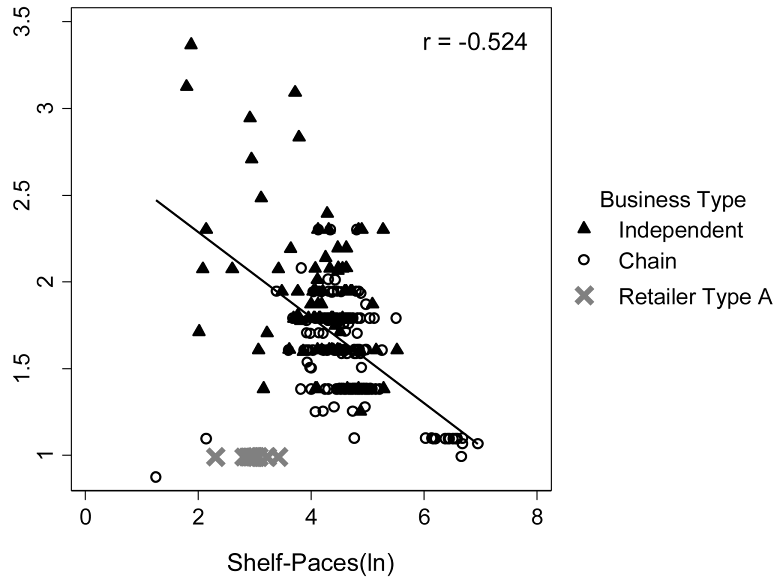


**Figure 1.**

Least wine price (ln), paces of alcohol-shelves (ln) and business type of off-premises outlets (n = 295). The fitted line shows predicted values for wine price and shelf-paces, excluding Retailer Type A.

**TABLE 1**

SA1 Characteristics (n = 2119)

| | Mean | SD | Min | Max |
|---|---|---|---|---|
| **Local SA1 Characteristics** | | | | |
| **Outcomes** | | | | |
| Intentional Injuries | 1.46 | 4.41 | 0.00 | 135.00 |
| Unintentional Injuries | 9.03 | 11.80 | 0.00 | 169.00 |
| **Off Premises** | | | | |
| Total Outlets | 0.13 | 0.45 | 0.00 | 4.00 |
| Independent Outlets | 0.04 | 0.22 | 0.00 | 3.00 |
| Chain Outlets | 0.09 | 0.36 | 0.00 | 3.00 |
| Drive Through (Proportion) | 0.13 | 0.10 | 0.00 | 1.00 |
| Average Least Wine Price (A$) | 5.73 | 0.71 | 2.70 | 19.50 |
| Shelf-Paces | 11.84 | 54.31 | 0.00 | 1047.50 |
| **On Premises** | | | | |
| Bars | 0.11 | 0.57 | 0.00 | 11.00 |
| Restaurants | 0.25 | 1.08 | 0.00 | 18.00 |
| **SA1 Characteristics** | | | | |
| Age (Median) | 37.47 | 6.72 | 12.00 | 82.00 |
| Australian Born (%) | 66.92 | 15.52 | 0.00 | 100.00 |
| Median Household Income | 73827.15 | 27222.02 | 0.00 | 260715.00 |
| Retail Zone (%) | 2.74 | 8.95 | 0.00 | 97.00 |
| Population | 410.22 | 202.82 | 3.00 | 3042.00 |
| **Lagged SA1 Characteristics** | | | | |
| **Off Premises** | | | | |
| Total Outlets | 0.79 | 1.14 | 0.00 | 7.00 |
| Independent Outlets | 0.21 | 0.56 | 0.00 | 6.00 |
| Chain Outlets | 0.58 | 0.92 | 0.00 | 5.00 |
| Drive Through (Proportion) | 0.14 | 0.20 | 0.00 | 1.00 |
| Average Least Wine Price (A$) | 5.34 | 0.72 | 2.70 | 5.73 |
| Shelf-Paces | 53.87 | 98.79 | 0.00 | 791.00 |
| **On Premises** | | | | |
| Bars | 0.64 | 2.06 | 0.00 | 28.00 |
| Restaurants | 1.53 | 3.41 | 0.00 | 42.00 |
| **SA1 Characteristics** | | | | |
| Age (Median) | 37.23 | 4.78 | 22.20 | 66.42 |
| Australian Born (%) | 63.35 | 14.16 | 0.00 | 100.00 |
| Median Household Income | 75503.60 | 19932.10 | 24831.34 | 137366.10 |
| Population Density | 2.17 | 1.63 | 0.00 | 12.06 |

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## TABLE 2

Spearman's rho assessing correlations between counts of traumatic injuries and off-premises outlet characteristics within SA1 areas (n = 2119)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Intentional Injuries | 1.000 | | | | | | | |
| 2. Unintentional Injuries | 0.367 | 1.000 | | | | | | |
| 3. Total Off-Premises Outlets | 0.205 | 0.241 | 1.000 | | | | | |
| 4. Independent Outlets | 0.136 | 0.147 | 0.567 | 1.000 | | | | |
| 5. Chain Outlets | 0.183 | 0.210 | 0.852 | 0.115 | 1.000 | | | |
| 6. Drive Through (Proportion) | −0.101 | −0.131 | −0.655 | −0.469 | −0.475 | 1.000 | | |
| 7. Average Least Wine Price (ln) | −0.100 | −0.072 | −0.082 | 0.198 | −0.216 | −0.010 | 1.000 | |
| 8. Average Shelf-Paces | 0.202 | 0.239 | 0.998 | 0.543 | 0.858 | −0.661 | −0.098 | 1.000 |

## TABLE 3

Bayesian hierarchical Poisson models predicting injury events in SA1 units (n = 2119)

| | Intentional Injuries | | | | Unintentional Injuries | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1a | | Model 1b | | Model 2a | | Model 2b | |
| | Median | (Lower, Upper) | Median | (Lower, Upper) | Median | (Lower, Upper) | Median | (Lower, Upper) |
| **Local SA1 Characteristics** | | | | | | | | |
| ***Off Premises*** | | | | | | | | |
| Total Outlets | **1.380** | **(1.189 , 1.597)** | | | **1.178** | **(1.063 , 1.303)** | | |
| Independent Outlets | | | 1.209 | (0.866 , 1.684) | | | 0.984 | (0.793 , 1.221) |
| Chain Outlets | | | **1.353** | **(1.112 , 1.638)** | | | **1.220** | **(1.077 , 1.382)** |
| Drive Through (Proportion) | | | 1.015 | (0.520 , 1.895) | | | 0.890 | (0.596 , 1.345) |
| Average Price (ln) | | | 0.524 | (0.252 , 1.012) | | | 0.885 | (0.632 , 1.257) |
| ***On Premises*** | | | | | | | | |
| Bars | 1.134 | (0.997 , 1.285) | **1.160** | **(1.020 , 1.325)** | 1.001 | (0.913 , 1.102) | 1.008 | (0.919 , 1.108) |
| Restaurants | **1.012** | **(0.939 , 1.092)** | **1.021** | **(0.948 , 1.101)** | 1.031 | (0.981 , 1.080) | 1.038 | (0.989 , 1.092) |
| ***SA1 Characteristics*** | | | | | | | | |
| Area (expectancy) | 1.000 | | 1.000 | | 1.000 | | 1.000 | |
| Age (Median, 10 years) | **0.807** | **(0.703 , 0.919)** | **0.817** | **(0.715 , 0.926)** | **1.482** | **(1.378 , 1.596)** | **1.471** | **(1.364 , 1.589)** |
| Australian Born (10%) | **0.805** | **(0.738 , 0.878)** | **0.806** | **(0.744 , 0.887)** | **0.909** | **(0.859 , 0.955)** | **0.909** | **(0.862 , 0.962)** |
| Median Household Income ($10,000) | **0.928** | **(0.895 , 0.962)** | **0.934** | **(0.902 , 0.969)** | **0.975** | **(0.955 , 0.996)** | **0.977** | **(0.956 , 0.997)** |
| Retail Zone (%) | **1.103** | **(1.010 , 1.203)** | **1.102** | **(1.010 , 1.200)** | 1.053 | (0.996 , 1.114) | 1.050 | (0.994 , 1.111) |
| Population (1,000) | **2.118** | **(1.521 , 2.921)** | **2.024** | **(1.482 , 2.795)** | **3.093** | **(2.514 , 3.819)** | **3.034** | **(2.446 , 3.740)** |
| **Lagged SA1 Characteristics** | | | | | | | | |
| ***Off Premises*** | | | | | | | | |
| Total Outlets | **1.084** | **(1.001 , 1.176)** | | | 1.053 | (0.999 , 1.108) | | |
| Independent Outlets | | | 1.040 | (0.874 , 1.239) | | | 0.965 | (0.866 , 1.075) |
| Chain Outlets | | | 1.070 | (0.970 , 1.182) | | | **1.064** | **(1.002 , 1.130)** |
| Drive Through (Proportion) | | | 0.742 | (0.494 , 1.113) | | | 0.809 | (0.634 , 1.033) |
| Average Price (ln) | | | 0.712 | (0.390 , 1.241) | | | 0.869 | (0.652 , 1.261) |
| ***On Premises*** | | | | | | | | |
| Bars | **1.103** | **(1.038 , 1.170)** | **1.112** | **(1.042 , 1.182)** | 0.984 | (0.944 , 1.027) | 0.991 | (0.951 , 1.032) |

| | Intentional Injuries | | | | Unintentional Injuries | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1a | | Model 1b | | Model 2a | | Model 2b | |
| | **Median** | **(Lower, Upper)** | **Median** | **(Lower, Upper)** | **Median** | **(Lower, Upper)** | **Median** | **(Lower, Upper)** |
| Restaurants | 0.977 | (0.942 , 1.015) | 0.974 | (0.938 , 1.011) | 1.010 | (0.986 , 1.034) | 1.012 | (0.989 , 1.035) |
| ***SA1 Characteristics*** | | | | | | | | |
| Age (Median, 10 years) | 0.802 | (0.610 , 1.011) | 0.801 | (0.630 , 1.045) | 0.888 | (0.750 , 1.092) | 0.880 | (0.751 , 1.021) |
| Australian Born (10%) | **1.188** | **(1.019 , 1.413)** | 1.194 | (0.998 , 1.377) | 1.092 | (0.974 , 1.249) | 1.092 | (0.964 , 1.189) |
| Median Household Income ($10,000) | **0.732** | **(0.671 , 0.797)** | **0.728** | **(0.670 , 0.794)** | **0.832** | **(0.787 , 0.877)** | **0.829** | **(0.790 , 0.874)** |
| Population | **1.140** | **(1.054 , 1.228)** | **1.145** | **(1.061 , 1.230)** | **1.159** | **(1.105 , 1.216)** | **1.162** | **(1.108 , 1.221)** |
| *Global Moran's I for CAR* | 0.842 | | 0.838 | | 0.828 | | 0.831 | |
| *Proportion of variance explained by:* | | | | | | | | |
| *SA2 random effect* | 0.001 | (0.000 , 0.063) | 0.001 | (0.000 , 0.064) | 0.008 | (0.000 , 0.099) | 0.006 | (0.000 , 0.082) |
| *CAR random effect* | 0.592 | (0.379 , 0.770) | 0.566 | (0.339 , 0.756) | 0.553 | (0.385 , 0.682) | 0.539 | (0.401 , 0.658) |