

Final report

Association of liquor outlet density with domestic and non-domestic assault in New South Wales

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1 Executive summary

While a substantial body of literature has examined the correlation between alcohol outlet density (alcohol outlet density refers to the number of establishments, such as bars, restaurants, and liquor stores, that sell alcohol in a given area) and assaults or violence, associations have been found to vary across different settings. Limited studies have been conducted on this topic in New South Wales (NSW), with the most recent study by Donnelly and Mahoney (2014) utilising cross-sectional data. The existence of an association between alcohol outlet density and assaults in NSW remains unclear. This study aims to address this gap by utilising geo-spatial panel data and spatial panel econometric models to investigate the association between alcohol outlet density and rates of domestic and non-domestic assault in NSW. The analysis encompassed monthly rates of alcohol outlet density and domestic and non-domestic assaults per 100,000 population, from November 2015 to November 2019.

The study results demonstrate that an increase in alcohol outlet density was associated with a significant increase in the rate of overall assault, alcohol-related domestic assault, and non-domestic assault in NSW between November 2015 and November 2019 (see Sections 5.2 and 5.3). On average, each additional alcohol outlet in a Local Government Area (LGA) in NSW was linked to a 1.30% increase in domestic assaults and a 0.68% increase in non-domestic assaults after adjusting for the effects of socioeconomic status, the proportion of Aboriginal and Torres Strait Islander peoples and rural/urban location. Additionally, a one alcohol outlet increase in a LGA in NSW was associated with 2.19% and 1.73% increases in alcohol-related domestic and non-domestic assaults, respectively. Dividing by the type of outlet, an increase in on-sales outlets (such as bars, hotels, clubs, and *on-premises* subtypes [such as cafes, restaurants, catering services, vessels, and nightclubs]) was associated with higher rates of domestic and non-domestic assaults. Conversely, changes in off-sales outlets (where all alcohol purchased is consumed outside the selling establishment) did not lead to changes in the rates of domestic and non-domestic assaults (see Section 5.4). In a further subdivision of licence types, a higher density of hotels was found to be significantly associated with an increase in the rate of non-domestic assaults, while an increase in the density of *on-premises* licences was linked to an increase in the rate of domestic assaults (see Section 5.4).

The results of interaction analyses in spatial panel models indicate that controlling liquor licence density in disadvantaged areas may lead to greater preventive effects on both domestic and non-domestic assaults. Furthermore, controlling liquor licence density in urban areas may lead to a greater preventive effect on non-domestic assaults only (see Section 5.5).

There are potential threshold levels of alcohol outlets per 100,000 population for an LGA. Approximately, each new licence beyond 551 outlets per 100,000 population in an LGA may lead to a greater increase in the number of domestic assaults. Similarly, each new licence beyond 558 outlets per 100,000 population in an LGA may result in a greater increase in non-domestic assaults in NSW (see Section 5.6). The impact of alcohol outlet density on domestic and non-domestic assaults was more pronounced in urban areas and regions with a higher proportion of Aboriginal and Torres Strait Island peoples, compared to the comparison areas.

A series of sensitivity analyses was conducted (Sections 6.1-6.4), and consistent results were observed between the full models (Tables 2 and 3) and the adjusted models (Tables 6-8; these models considered the impact of high transient populations in the Sydney LGA and the Snowy Monaro Regional LGA). These findings suggest that our estimations are reliable and robust. Some hotels and clubs in NSW also offer take-away alcohol sales, but data regarding the number of establishments and the specifics of their take-away alcohol operations are unavailable. Establishing causal relationships in ecological study designs is notoriously difficult. A range of confounding factors, which are challenging to adjust for, along with data limitations, should be taken into consideration when interpreting the associations presented in this report.

Implementing a control on liquor licence density could reduce the rates of domestic and non-domestic assault in NSW, particularly in urban regions, areas with lower socioeconomic status, and those with higher concentrations of Aboriginal and Torres Strait Islander peoples.

2 Introduction

There is a significant body of international literature assessing the association between alcohol outlet density and a range of alcohol-related harms (Livingston et al., 2016; Popova et al., 2009). A key finding of recent reviews has been that associations vary markedly across settings and that local liquor licensing policy is likely to require local evidence (Gmel et al., 2016). There have been few studies on this topic in New South Wales (NSW), with the best analysis by Donnelly and Mahoney (2014), who found evidence that alcohol outlet density predicts rate of violence. Although this is important evidence, the study used cross-sectional data, and the key question that has not been answered is how changes in outlet density relate to changes in violence over time. Longitudinal evidence is needed to support appropriate licensing, because longitudinal data and analyses can provide greater confidence in establishing a causal relationship. Also, since Donnelly and Mahoney's study, there have been marked changes in the NSW liquor environment, including that NSW changed liquor licensing from a perpetual to an annual licence type in 2015. The decision to introduce an annual liquor licence renewal fee was made in March 2015, with the change the licensing coming into effect in November 2015.

Research evidence shows that changes in the number of liquor licences or the volume of alcohol purchases across different licence types in Australian jurisdictions have different effects on alcohol consumption and alcohol-related harms. A study in Perth by Liang and Chikritzhs (2011) revealed that alcohol purchases from off-sales outlets were significantly associated with numbers of assaults at on-premises outlets within the same LGA in Perth, while the number of on-premises outlets was a significant predictor of assaults even after controlling for the amount of alcohol sold by those types of premises. In contrast, Livingston (2008) found that in Melbourne, on-premise alcohol outlet density was significantly associated with assault, and no association was found between off-sales alcohol outlet density and assault. It remains unclear how the effects of various liquor licence types (on-sales vs off-sales, or other subtypes of liquor licence) on domestic and non-domestic assaults may vary in NSW.

Previous Australian studies from outside NSW have shown that the effects of liquor outlet density can vary across neighbourhood types (Badland et al., 2016; Foster et al., 2017). For example, several studies found that harms associated with alcohol outlets are inequitably borne by low income communities or socioeconomically disadvantaged areas (Badland et al., 2016; Brenner et al., 2015; Foster et al., 2017; Gorman et al., 2001). Previous studies also broadly support the notion that alcohol outlet density is greater in disadvantaged neighbourhoods (Foster et al., 2017; Pearce et al., 2008). A study by Livingston in 2012 suggests that alcohol outlet density followed “economic sense”, as the liquor stores that sell cheaper alcohol were more concentrated in socioeconomically disadvantaged areas, and liquor stores that sell alcohol at a higher price tended to be located in less disadvantaged areas (Livingston, 2012). Key questions for licence decision making in NSW include whether adding an outlet to an area of socioeconomic disadvantage has more or less impact on harms than in more advantaged areas, and whether adding outlets to areas with different pre-existing levels of alcohol availability will have different effects.

Donnelly and Mahoney (2014) analysed 2011 NSW data, while earlier work conducted by Livingston (2008) focused on Melbourne data. Both studies found a non-linear relationship between alcohol outlet density and alcohol-related harms, with harms increasing more steeply at higher outlet densities. In this study we also explore whether there are marked non-linearities in any relationships between alcohol outlet densities and domestic and non-domestic assaults using spatial panel data – this has the potential to identify indicative thresholds to assist with decision-making.

Impacts of changes in trading hours of liquor licences on alcohol-related harm have been examined in previous studies. For example, two systematic reviews of the international literature, including Australian studies, concluded that restricting times of alcohol trading could help to reduce injuries, alcohol-related hospitalisations, alcohol-related emergency department visits, homicides and crime (Sanchez-Ramirez & Voaklander, 2018; Wilkinson et al., 2016). A study in Perth found that increases in off-trade sales and number of on-sales outlets, particularly those with extended trading hours, predicted a higher level of alcohol-related injuries (Hobday et al., 2015). On the other hand, a study in Sweden found that extended alcohol retailers’ trading hours led to significant increases in alcohol purchases with

no corresponding increases in alcohol-related harms (Avdic & von Hinke, 2021). In NSW, a number of alcohol outlets have been granted permits to extend their trading hours, and such data were provided for this study by Liquor and Gaming NSW (L&GNSW), providing a unique opportunity to examine what are the effects of extended trading hours on domestic and non-domestic assaults in NSW.

This research aims to address five key questions:

1. Is there an association between the density of licensed liquor outlets and the rate of police-recorded incidents of domestic assault and non-domestic assault?
2. Is there an association between the density of licensed liquor outlets and the rate of police-recorded incidents of ***alcohol-related*** domestic assault and non-domestic assault?
3. Does the association between the density of licensed liquor outlets and the rate of domestic assault and non-domestic assault differ between different ***liquor licence types***?
4. Does the association between the density of licensed liquor outlets and the rate of domestic assault and non-domestic assault vary: by neighbourhood ***socioeconomic status*** (as measured by SEIFA index); between ***urban and rural/regional areas***; and between ***areas with higher, middle and lower proportions of Aboriginal and Torres Strait Islander peoples***?
5. If there are such associations (see 2 & 3), are there marked ***non-linearities in any relationships*** between alcohol outlet densities and rates of domestic assault and non-domestic assault?

3 Data: description, collection and pre-processing

3.1 Study setting

New South Wales is the most populous state in Australia with a population of 8,172,500 in 2022, the majority (65%) living in the Greater Sydney Area. In 2022, NSW was divided into 128 Local Government Areas (LGAs; administrative areas that a local government is responsible for) and one unincorporated Far West Region (which is not part of an LGA). The number of LGAs changed during the study period, with the creation of Bayside LGA in 2016

which merged the “City of Botany Bay” and “City of Rockdale” LGAs. To account for these changes in our analyses, we use the 2022 LGAs and merged data from the “City of Botany Bay” and the “City of Rockdale”.

3.2 Data

Domestic, non-domestic, and alcohol-related assault: Domestic and non-domestic assault data were acquired from the NSW Bureau of Crime Statistics and Research (BOCSAR). BOCSAR provided a list of incidents from January 2012 to November 2019, which included whether the incident was a domestic or non-domestic assault and whether the assault was alcohol-related and the location of the incident (the flag ‘alcohol-related’ is a coding of the police report on the incident by the responding police). Using this data, we calculated the number of monthly domestic, non-domestic, alcohol-related domestic, and non-domestic assaults for each LGA. To calculate the number of monthly assaults per 100,000 population, we divided the number of assaults per LGA by the LGA population in that year and multiplied by 100,000.

Incidents of assault is the default counting unit for BOCSAR's crime data, which is in terms of recorded criminal incidents rather than recorded offences (except for murder and manslaughter where the counting units are victims). A criminal incident is defined as an activity detected by or reported to police. Assaults are direct (and immediate/confrontational) *infliction* of force, injury or violence upon a person or persons or the direct (and immediate/confrontational) *threat* of force, injury or violence where there is an apprehension that the threat could be enacted (Australian Bureau of Statistics, 2011). Domestic assault may include assault incidents from a spouse/partner, ex-spouse/ex-partner, boy/girlfriend (including ex), parent/guardian (including step/foster), child (including step/foster), sibling, another member of the family (including kin), or a person who is living or has lived in the same household as the other person, is dependent on the paid or unpaid care of the other person, or is involved in a "love triangle" (e.g., a woman's ex-partner and current partner have a domestic relationship with each other for the purposes of the *Crimes (Domestic and Personal Violence) Act 2007* even if they have never met).

Alcohol outlets: Liquor licensing data was obtained from L&GNSW, the agency responsible for liquor licence regulation in NSW. The data provided included every active liquor licence for each month from 2012 to 2019 ($n = 15,591$ outlets). Specifically, the data included the name of the licence holder, location (address, suburb, LGA), and type of licence (club, hotel, *on premises*, packaged, small bar, producer/wholesaler, limited licence). Packaged liquor licences that are delivery only businesses were removed from our analysis, because it is unknown which LGAs these businesses deliver to. The “*on-premises*” licence category includes café, restaurant, catering company, vessel, and nightclub. The club licence category includes registered club, RSL (The Returned & Services League of Australia) or Diggers Club, and golf club. Using this data, we calculated the number of outlets and type of outlet for each month in each LGA. Additionally, we calculated estimates for the overarching categories of on- and off-sales outlets. For on-sales, we summed the number of club, hotel, *on-premise*, and small bar licences; and for off-sales, we summed the number of packaged licences. In line with previous studies, the licence types of limited licence and producer/wholesaler were excluded in the analysis (Burgess & Moffatt, 2011; Donnelly & Mahoney, 2014). Limited licences are excluded since such licensees are authorised only to provide alcohol on a small number of occasions for specific purposes and the locations were not fixed. The producer/wholesaler licence relates to alcohol production and only a few of the producers/wholesalers have a special on-premises licence; the majority of them do not directly relate to the sale of alcohol to the public for consumption. To calculate the number of outlets per 100,000 population, we divided the number of outlets per LGA by the LGA population for the corresponding year and multiplied it by 100,000.

Of the 15,591 outlets, 293 (1.88%) had some missing data concerning their LGA location for at least one timepoint. To limit the amount of missing data, we replaced any missing LGA information with the LGA of the outlet if it had been listed within 2 years of the missing data. We used this two-year cut off after discussion with the L&GNSW data team, who informed us that LGA information may be missing because 1) it is not filled in (due to an error), or 2) the licence may not be operating. After imputing LGAs, we still had 211 (1.35%) licences with some missing LGA data (12,320 cases; 0.99%). Given the relatively small number of missing cases, we removed the licences which still had missing LGA data.

Population: Annual estimated residential population for each LGA was collected from the Australian Bureau of Statistics (ABS). Annual population estimates as at 30 June are estimated for LGAs below the state level; the population estimates are final for 2001 to 2016 from the census data and preliminary rebased for 2017 to 2021 (based on the 2021 Census) (Australian Bureau of Statistics, 2022).

Aboriginal and Torres Strait Islander (%): For estimated population of Aboriginal and Torres Strait Islander peoples per LGA, we used estimates from the 2016 Census available from the ABS. We calculated the percentage of Aboriginal and Torres Strait Islander peoples by dividing the population by the overall 2016 LGA population and then created a three-category variable -- lower (Aboriginal 1, ranging from 0.20% to 3.75%), middle (Aboriginal 2 ranging from 3.76% to 7.16%), and higher (Aboriginal 3, ranging from 7.17% to 68.9%) -- representing the proportion of Aboriginal and Torres Strait Islander peoples.

Socio-Economic Indexes for Areas (SEIFA): Overall social disadvantage for each LGA was measured using the “Index of Relative Socio-Economic Disadvantage (IRSD)” as calculated by the ABS in 2016. The SEIFA index for different LGAs in NSW ranges from 757 to 1120, and lower scores reflect greater disadvantage and higher scores greater advantage (Australian Bureau of Statistics, 2016). The IRSD is one of the four indices of Socio-Economic Indexes for Areas developed by the ABS. The other three indices include:

- The Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD)
- The Index of Education and Occupation (IEO)
- The Index of Economic Resources (IER).

“The IRSD is a general socio-economic index that summarises a wide range of information about the economic and social resources of people and households within an area. Because this index focuses on disadvantage, only measures of relative disadvantage are included” (Australian Bureau of Statistics, 2006). The IRSD is thus an ideal index to examine the relationships between neighbourhood socio-economic disadvantage and various health and social outcomes (Australian Bureau of Statistics, 2006). The SEIFA index was used as a continuous variable in the following analyses.

Urban and rural/regional areas: Rural and urban regions for LGAs were as determined by the ABS. All LGAs were classified as either urban (metropolitan) or rural/regional (metropolitan fringe, regional town/city, large rural and rural areas) (NSW Government, 2020).

4 Methodology

For each of our five research questions, the outcome variable is one of a) domestic assault, b) non-domestic assault, c) alcohol-related domestic assault, or d) alcohol-related non-domestic assault, each of which were measured monthly. For the first three research questions, our primary predictor is the number of alcohol outlets per 100,000 population and the number of each type of outlet (club, hotel, *on-premises*, packaged, small bar) per 100,000 population. For our fourth research question (whether the link varies by the demographics of the region), we included SEIFA scores (lower = greater disadvantage, higher = less disadvantage), urban vs. regional/rural areas (two categories), and proportion of the population which is Indigenous (coded to lower = 1, middle = 2 and higher proportions = 3). In this report, we used data from November 2015 to November 2019 in our main models and descriptive tables.

4.1 Statistical models

A spatial autocorrelation test (Moran's I test) was used to examine whether the licence density in one geographical area influences the rates of the relevant criminal incidents in an adjacent geographical area. If there is spatial autocorrelation between adjacent geographical areas, this effect needs to be adjusted for in the panel model. A number of spatial panel models have been used to examine the association between alcohol outlet density and related harms, such as spatial autoregressive models, spatial error models and spatial seemingly unrelated regression models (Cameron et al., 2012; Donnelly & Mahoney, 2014). More recently, a geographically spatial-weighted panel (GSWP) model has been used to examine such a relationship (Cameron et al., 2016), and we adopted the GSWP model in our analysis. This method has some advantages in that it accounts for spatial interdependency between locations (if there is a spatial autocorrelation), and it allows for the estimation of effects at

each locality. Another advantage of the GSWP model is the use of a distance-weighted subsample of observations to produce locally linear estimates for every point in space. Essentially, this means that a separate regression equation is fitted for every location in the dataset, with the data used being weighted to reflect the separation between locations.

Our analyses primarily focused on the period between November 2015 and November 2019 because of changes in the liquor licence system. In March 2015, there was a shift from a perpetual type to an annual liquor licence scheme, and the full effects of this change were observed on 1st November 2015 (please see Sensitivity analysis 4 for more information). To analyse the data, we first present the descriptive data and heat maps for our main outcomes. Next, we report scatterplots and the correlations between outlet density and incidents. Finally, we present preliminary panel models for each of our research questions. Given that positive spatial dependencies were present (2015 domestic assault Moran's $I = 0.41$, $p < 0.001$; 2015 non-domestic assault Moran's $I = 0.39$, $p < 0.001$), we used GSWP models with the SPLM package (Millo & Piras, 2012) in R (version 4.1.1) to examine associations of alcohol outlet density with overall and alcohol-related domestic and non-domestic assaults, using LGA-level data. SPLM (spatial-weighted panel maximum likelihood model with spatial error correlation) allows us to account for the fact that both space and time are being modelled. For space, we calculated a spatial weight matrix using a Queen contiguity matrix (Fingleton, 2008).

The spatial structure is specified by combining the spatial autoregressive (the dependent variable at each location is regressed on both its own lagged value [autoregressive term] and the lagged values of the variable at neighbouring locations [spatial lag term]) and spatial error. Spatial error refers to the presence of spatial autocorrelation or spatial dependence in the error term of a regression model. By considering spatial error, we can better understand and account for the spatial dependence in the data, leading to more accurate and reliable analysis in spatial panel econometrics. In this report, we present results of random effects models of the spatial panel regression. Our initial analyses found that the correlations between alcohol outlet density and domestic and non-domestic assault are quite consistent over time (see Figure 2a & 2b). Random effects models are more efficient estimators

compared with fixed effects models, and more sensitive to finding significant effects based on cross-sectional differences rather than changes over time. Furthermore, we performed Hausman tests (Hausman, 1978) for spatial panel models with random effects. The Hausman test results ($\text{chisq} = 1.4572$, $\text{df} = 1$, $p = 0.2274$) accepted the null hypothesis of an absence of correlation between individual effects and explanatory variables, which suggested use of the random effects model. Random effects were incorporated in statistical models to capture variability in the data that affects the response variable. They allow for the estimation of group-specific effects or deviations from the overall population mean. By including random effects, the model can account for the unique characteristics and differences among the groups or clusters in the data, providing a more accurate and comprehensive understanding of the relationships between variables (Gelman & Hill, 2006).

Donnelly and Mahoney (2014) have indicated that the Sydney LGA has a high transient population (visitors and/or tourists) and the Snowy Monaro Regional LGA has a high visitor population during the winter months. We therefore also ran two sensitivity analyses: sensitivity analysis 1 that excludes the Sydney LGA and the Snowy Monaro Regional LGA in our model to avoid any under- or overestimation due to the high transient populations; sensitivity analysis 2 that included the estimated overnight stay tourist population for these two LGAs in the local estimated resident population. Monthly data on the international and national tourists (visitors that had overnight travel) in Sydney LGA and the Snowy Monaro Regional LGA were collected from the NSW Government's Destination NSW. These high transient populations were added to the estimated residential population in these two LGAs to compute the outlet density in our analysis. Visitors who had a return trip in the same day in NSW were not included in our analysis, as they were presumed to be less likely to attend alcohol outlets and cause alcohol-related assaults.

Following Donnelly and Mahoney (2014) and our earlier work on Melbourne data (Livingston, 2008), we also explored whether there are marked non-linearities in any relationships between alcohol outlet densities and domestic and non-domestic assaults. We asked whether there are points at which domestic or non-domestic assaults increase more steeply with extra outlets. Therefore, multiple regression models with cubic polynomial terms

(of degree 3) for the significant outlet density variables were employed to address this question.

The data provided by L&GNSW also include the indicator, “yes” or “no”, on whether it has extended trading hours for each liquor outlet. Although the intensity and magnitude of the extended trading hours were not specified, the indicator provides an opportunity to estimate the effects of extended trading hours among alcohol outlets on domestic and non-domestic assaults in LGAs. Extended trading hours among various alcohol outlet categories were aggregated as the number of alcohol outlets with extended trading hours per 100,000 population in each LGA, and were used as a predicting variable to predict the rate of domestic and non-domestic assaults.

4.2 Computing the effect

We used the following formula to compute the effect of one alcohol outlet increase on domestic and non-domestic assaults in LGAs in NSW

$$Y = ((\beta/MP) * 100,000)/MA * 100\%$$

where β is the coefficient value of the outlet density rate per 100,000 population in a spatial panel regression model, MP is median population in LGAs, and MA is the median assault rate per 100,000 population.

5 Results

5.1 Descriptive statistics

Table 1 shows the average monthly assaults and outlets for the average LGA per 100,000 population. As seen in Table 1, there were on average 44.9 domestic, 39.9 non-domestic, 18.3 alcohol-related domestic, and 15.6 alcohol-related non-domestic assaults per LGA per month between November 2015 and November 2019. Additionally, as seen in Table 1, there were 291 overall outlets on average per LGA.

Table 1. Descriptive statistics. Mean monthly assault and outlet rates per 100,000 population for LGAs in NSW during November 2015 and November 2019

Variable	Mean (SD)	Median [Min, Max]
Outlet number (monthly per 100,000 population)		
Club	39.8 (33.4)	28.9 [0, 160]
Hotel	68.5 (64.7)	47.1 [2.36, 390]
On premise	88.2 (75.8)	78.4 [0, 585]
Packaged	35.0 (17.6)	30.7 [10.7, 101]
Small bar	0.40 (1.73)	0 [0, 23.6]
All outlets	291 (168)	258 [38.8, 1070]
Incidents (monthly per 100,000 population)		
Non-Domestic	39.9 (38.8)	31.1 [0, 638]
Domestic	44.9 (62.4)	31.5 [0, 926]
Non-domestic (alcohol-related)	15.6 (24.5)	9.11 [0, 585]
Domestic (alcohol-related)	18.3 (42.8)	9.20 [0, 797]
Population	61300 (80300)	23500 [1030, 378000]
Aboriginal and Torres Strait Islander peoples (%)	7.79 (9.70)	4.94 [0.202, 68.9]
Socioeconomic status (SEIFA index)	978 (62.6)	971 [757, 1120]

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower the number the greater the socioeconomic disadvantage) (Australian Bureau of Statistics, 2016).

Figure 1 shows a heat map of average monthly domestic and non-domestic, assault and alcohol outlet density per 100,000 population by year for LGAs in New South Wales (though results for LGAs in the Sydney area are not visible on the map). The figure illustrates that rates of overall and alcohol-related domestic and non-domestic assault and alcohol outlet density changed over time in different LGAs in NSW during 2012, 2015, and 2019.

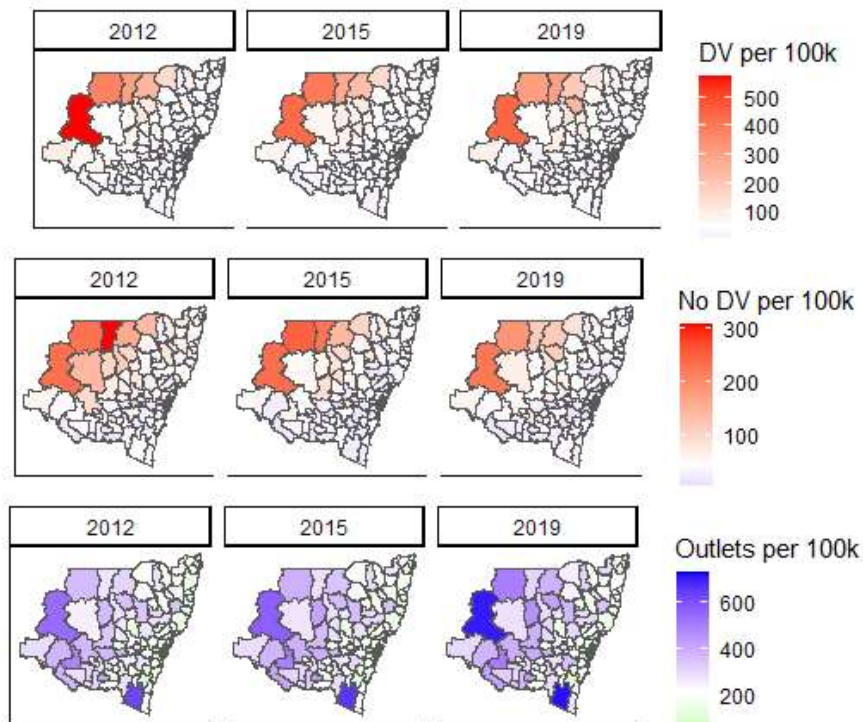


Figure 1. Heat map showing highest rates of average monthly domestic (DV), non-domestic assault (No DV), and outlets per 100,000 population for 2012, 2015, and 2019.

5.2 Is there an association between the density of licensed liquor outlets and the rate of police recorded incidents of domestic assault and non-domestic assault?

Figure 2 presents the scatterplots and correlations between overall outlets and domestic (Figure 2a) and non-domestic incidents (Figure 2b). Spearman rank correlation is a non-parametric test that measures the degree of association between two variables. The correlation coefficients (“R” in the figures below) between 0.10 and 0.29 represent a small association, coefficients between 0.30 and 0.49 represent a medium association, and coefficients of 0.50 and above represent a large association. As seen in the figures, there are small- to medium-level positive correlations between outlet density and domestic and non-domestic assaults.

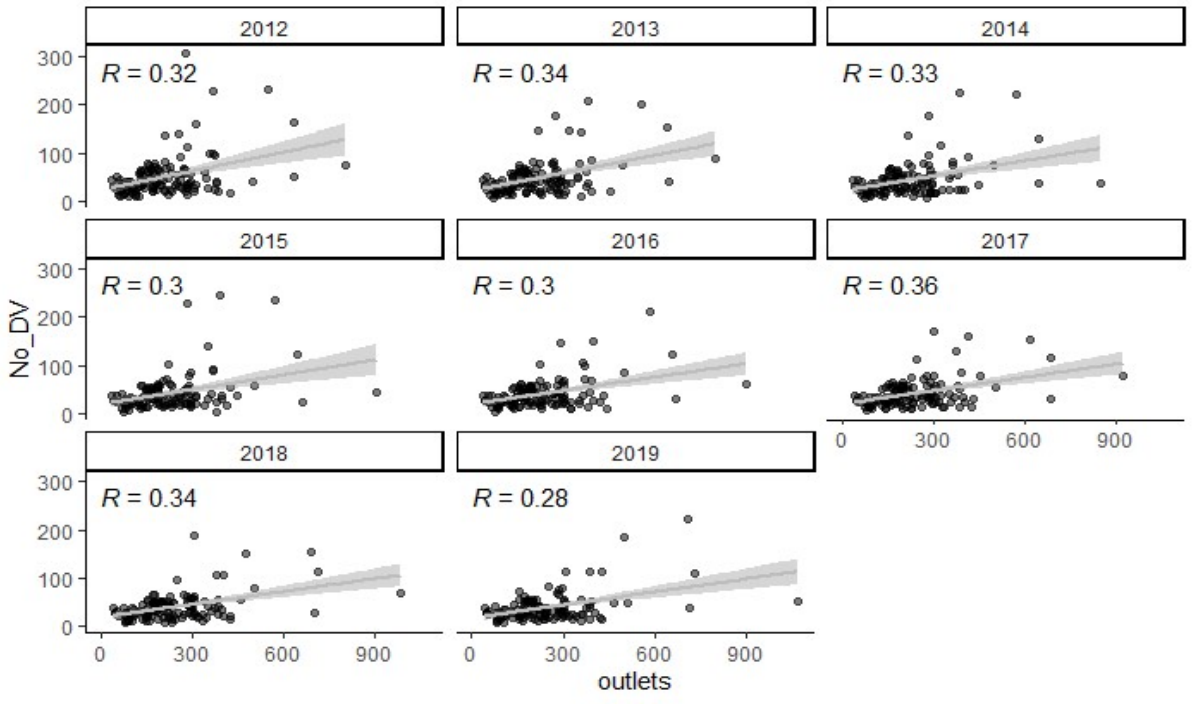


Figure 2a. Scatterplots of the yearly number of non-domestic assaults per 100,000 population by the mean number of monthly outlets per year per 100,000 population.

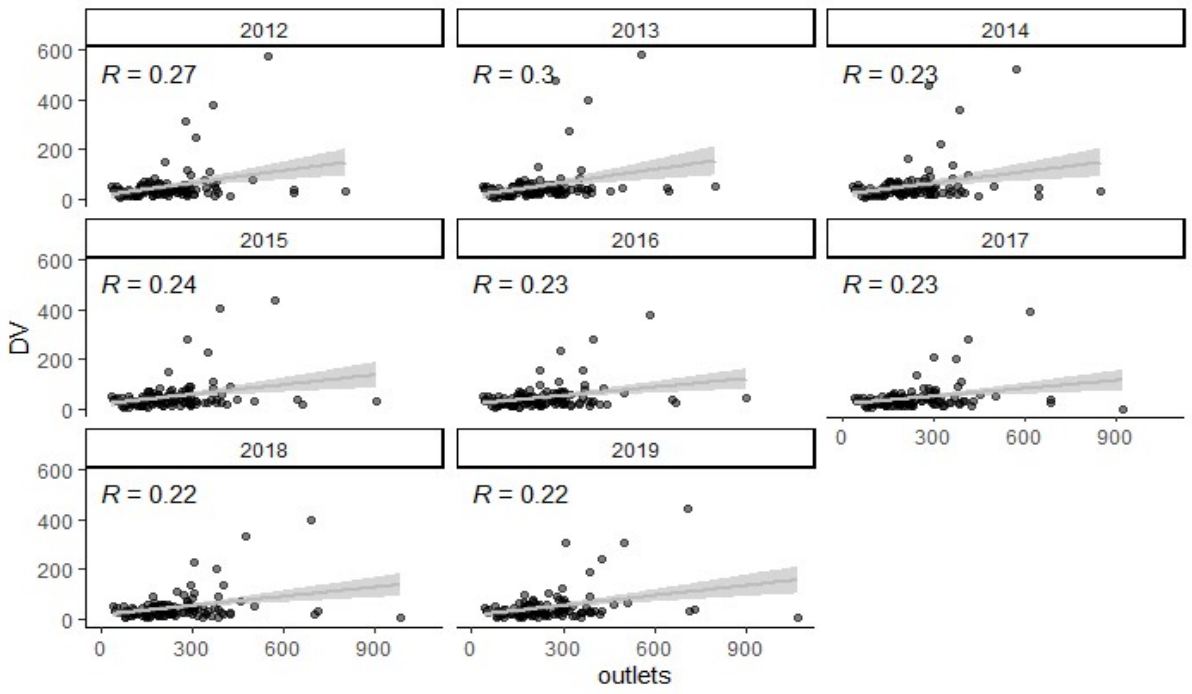


Figure 2b. Scatterplots of the yearly number of domestic assaults per 100,000 population by the mean number of monthly outlets per year per 100,000 population.

To answer the first research question, we conducted two spatial panel regression models with random effects predicting domestic and non-domestic assault from the number of outlets and time. As seen in Table 2, outlets per 100,000 population significantly predicted both domestic and non-domestic assault. Compared with a higher neighbourhood socioeconomic status group, lower neighbourhood socioeconomic status was associated with risk for both domestic and non-domestic assault in NSW. Compared with LGAs with a lower proportion of Aboriginal and Torres Strait Islander peoples, a higher proportion of Aboriginal and Torres Strait Islander peoples was associated with greater risk for non-domestic assault, while it was not associated with risk for domestic assault. LGAs in urban areas had higher non-domestic assaults per 100,000 population compared with LGAs in rural areas. Whether the neighbourhood was urban or regional/rural was not associated with the risk for domestic assault in NSW.

Table 2. Results of maximum likelihood spatial panel models with random effects for the overall number of outlets predicting domestic and non-domestic assault, using monthly data between November 2015 and November 2019, for the whole of NSW and for demography-defined subgroups.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Outlets per 100,000 population	0.050	0.012	4.209	<0.001	0.096	0.022	4.402	0.001
SEIFA index	-0.220	0.038	-5.807	<0.001	-0.425	0.076	-5.615	<0.001
Aboriginal 2	2.223	5.643	0.394	<0.001	-0.708	11.292	-0.063	0.950
Aboriginal 3	16.194	6.434	2.517	0.012	17.783	12.878	1.381	0.167
Urban	12.112	6.146	1.971	0.049	19.426	12.262	1.584	0.113

Note: Socio-Economic Indexes for Areas (SEIFA) index (the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower proportion of Aboriginal and Torres Strait Islander peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

The results of spatial panel regression models reveal that there was a positive association between the density of licensed liquor outlets and the rate of police recorded incidents of

domestic assault and non-domestic assault. Using the formula of computing effects described in the method ($((\beta/MP) * 100,000)/MA * 100\%$), we can compute that on average, one alcohol outlet increase in an LGA was associated with 1.30% and 0.68% increases in domestic and non-domestic assaults in NSW.

5.3 Is there an association between the density of licensed liquor outlets and the rate of police recorded incidents of alcohol-related domestic assault and non-domestic assault?

Figure 3 presents the scatterplots and correlations between overall outlets and alcohol-related non-domestic (Figure 3a) and alcohol-related domestic assaults (Figure 3b). As seen in the figures, there is a medium positive correlation between outlet density and non-domestic assault (ranging from a Spearman correlation “R” of 0.48 to 0.56) and outlet density and domestic assault (ranging from a Spearman correlation of 0.37 to 0.46).

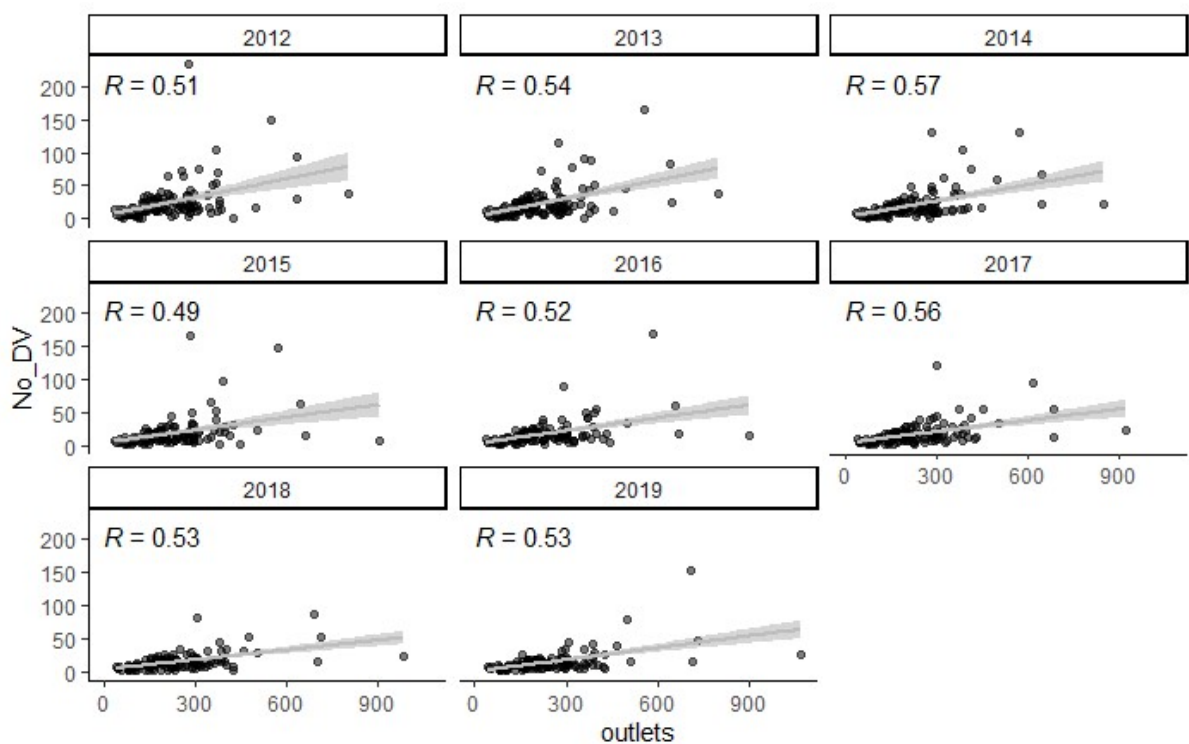


Figure 3a. Scatterplots of the yearly number of alcohol-related non-domestic assault per 100,000 population by the mean number of monthly outlets per year per 100,000 population.

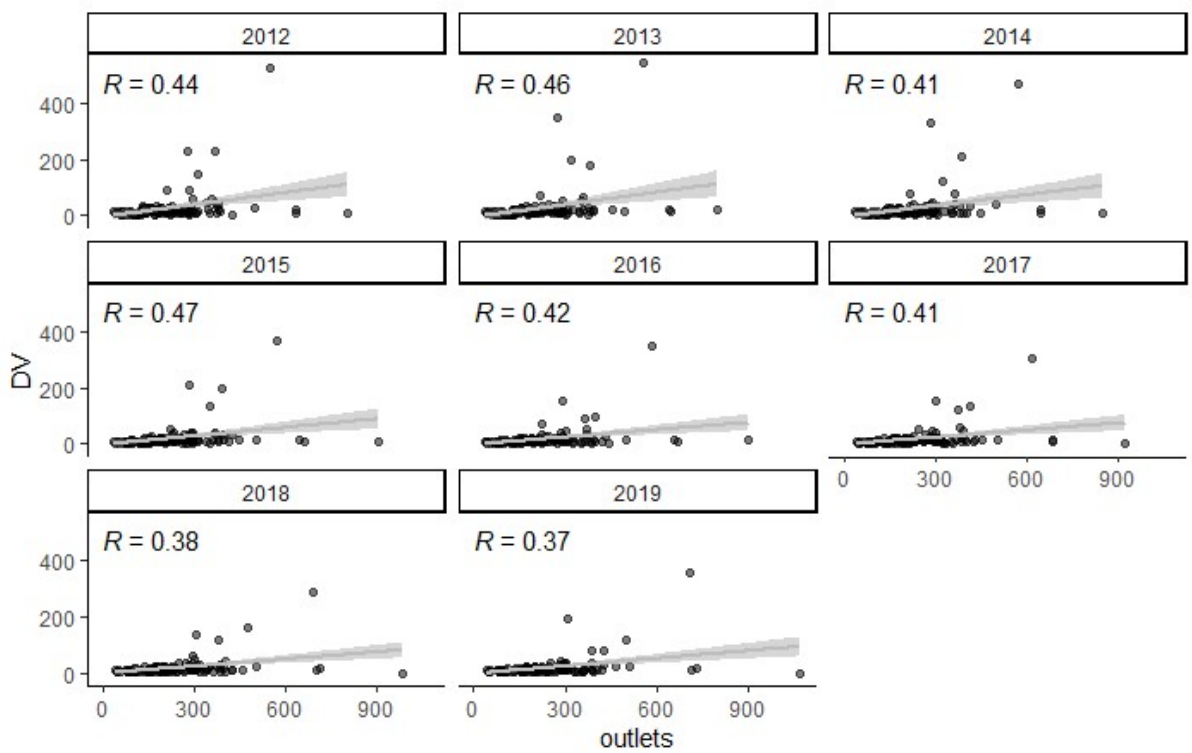


Figure 3b. Scatter plots of the yearly number of alcohol-related domestic assaults per 100,000 population by the mean number of monthly outlets per year per 100,000 population.

To answer the second research question, we conducted two spatial panel regression models with random effects predicting alcohol-related domestic and non-domestic assault from the density rate of outlets over time. As seen in Table 3, outlet density per 100,000 population predicted both alcohol-related domestic and non-domestic assaults. On average, one alcohol outlet increase in LGAs was associated with 2.19% and 1.73% increases in alcohol-related domestic and non-domestic assaults in NSW respectively. The effects of a one alcohol outlet increase in LGAs on alcohol-related domestic and non-domestic assaults are about two times greater than the effects on overall domestic and non-domestic assaults.

Table 3. Results of the maximum likelihood spatial panel model with random effects estimates for the overall number of outlets in the LGA predicting alcohol-related domestic and non-domestic assault, using monthly data between November 2015 and November 2019, for the whole of NSW and for demography-defined subgroups.

<i>Predictors</i>	Alcohol-related non-domestic assault				Alcohol-related domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Outlets per 100,000 population	0.037	0.007	5.369	<0.001	0.047	0.016	3.027	0.002

Note: As in previous models, these models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Islander peoples and rural/urban. Please see full models in Appendix Table A2.

5.4 Does the association between the density of licensed liquor outlets and the rate of domestic assault and non-domestic assault differ between different liquor licence types?

Figure 4a shows trends in different types of alcohol outlet density per 100,000 population from 2012 to 2019. Increasing trends were observed in density rates of nearly all subtypes of alcohol outlets between 2012 and 2019, except for clubs. Figure 4b shows trends in alcohol outlet density for on- and off-sales outlets per 100,000 population. Rates per head of population increased steadily for all except club licences from 2012 to 2019.

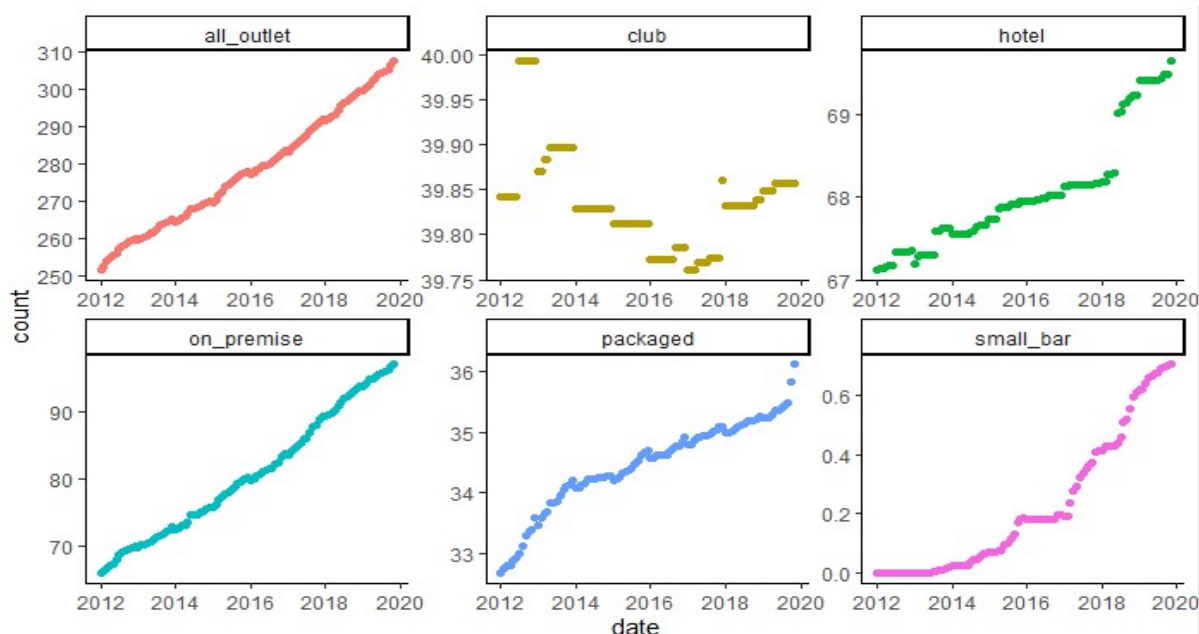


Figure 4a. Trends in alcohol outlet density per 100,000 population from 2012 to 2019 (*on-premises* includes café, restaurant, catering company, vessel and nightclub).

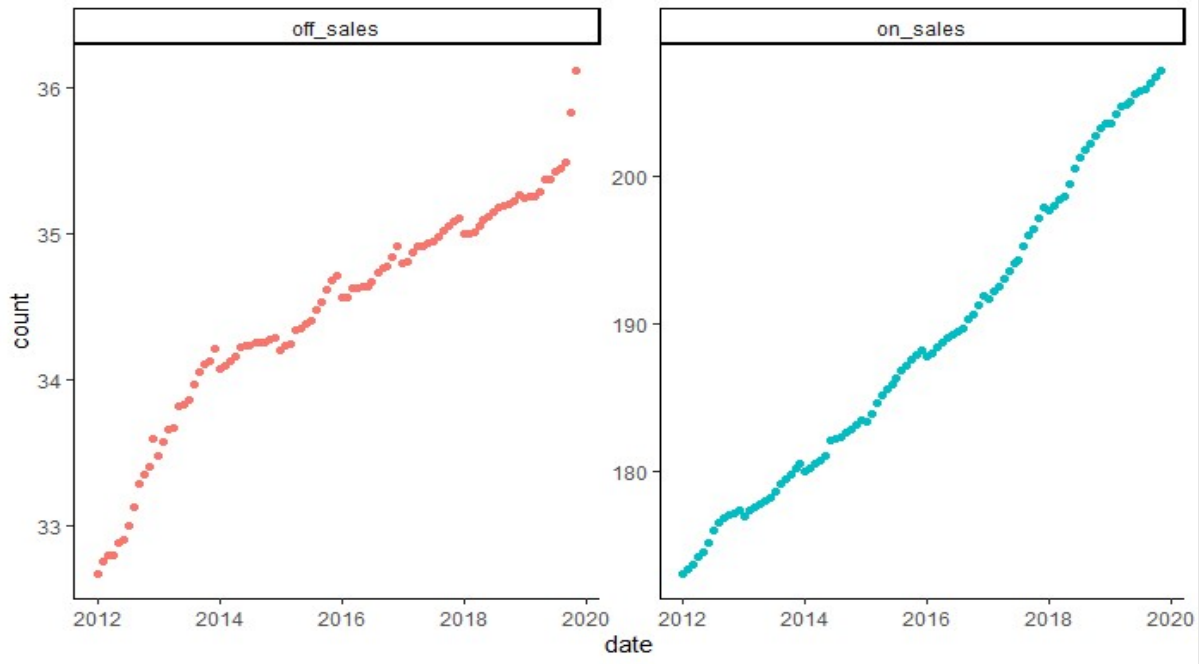


Figure 4b. Trends in alcohol outlet density for on- and off- sales outlets per 100,000 population from 2012 to 2019.

To answer the third research question, we conducted four spatial panel regression models (with random effects) predicting domestic and non-domestic assault from the density of on- and off-sales outlets and various outlet subtypes. As seen in Table 4a, on-sales outlets per 100,000 population predicted both domestic and non-domestic assault. However, off-sales premises were not associated with either domestic or non-domestic assault.

Table 4a. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of on- and off-sales outlets per 100,000 population between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
On-sales outlets	0.055	0.015	3.710	<0.001	0.093	0.026	3.543	<0.001
Off-sales outlets	-0.009	0.116	-0.078	0.938	0.141	0.214	0.658	0.511

Note: The spatial panel models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Islander peoples and rural/urban. Please see full models in Appendix Table A3a.

The associations of non-domestic and domestic assaults with density of various liquor licence subtypes were examined (Table 4b). The results of spatial panel regression models show that hotel density rate was positively associated with non-domestic assault rate per 100,000 population, while density of *on-premises* (café, restaurant, catering company, vessel and nightclub) was positively associated with domestic assault rate per 100,000 population in NSW. In contrast, density of club was negatively associated with non-domestic assault rate per 100,000 population.

Table 4b. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by density of alcohol outlet subtypes per 100,000 population between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Club ^a	-0.306	0.066	-4.666	< 0.001	-0.122	0.140	-0.875	0.382
Hotel	0.181	0.034	5.360	< 0.001	0.084	0.064	1.313	0.189
On-premise ^b	0.030	0.023	1.317	0.188	0.138	0.041	3.373	0.001
Packaged liquor	0.075	0.106	0.712	0.476	0.200	0.218	0.921	0.357
Small bar	0.088	0.491	0.180	0.857	-0.877	0.702	-1.249	0.212

Note: ^a Club includes registered club, RSL (The Returned & Services League of Australia) or Diggers Club, golf club. ^b On-premises outlet includes café, restaurant, catering company, vessel and nightclub. The spatial panel models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Islander peoples and rural/urban. Please see full models in Appendix Table A3b.

5.5 Does the association between the density of licensed liquor outlets and the rate of domestic assault and non-domestic assault vary by neighbourhood income level, between urban and rural/regional areas, and in areas with higher, middle and lower proportions of Aboriginal and Torres Strait Islander peoples?

To answer the fourth research question, we conducted six spatial panel regression models with three key interaction terms, examining whether the associations of alcohol outlet density with rates of domestic and non-domestic assault differ in urban and rural areas (dummy coded with rural as the reference group), in different socioeconomic groups (with an index derived from the Socio-Economic Indexes for Areas [SEIFA]: the Index of Relative Socio-Economic Disadvantage [IRSD], with the lower number for the greater socioeconomic

disadvantage), and in proportion of Aboriginal and Torres Strait Island peoples (dummy coded as low [Aboriginal 1], medium [Aboriginal 2], high [Aboriginal 3] with low as the reference group).

As seen in Table 5, the associations between alcohol outlet density and rate of non-domestic assault differed significantly between urban and rural areas in NSW, with a stronger association found in urban compared with rural regions. The results of the random effects models with the interaction between outlet density and SEIFA index show that the associations between alcohol outlet density and rate of both domestic and non-domestic assaults significantly differed among NSW LGAs by their socioeconomic status: a stronger association was found in the lower socioeconomic status LGAs compared with LGAs with a higher socioeconomic status. We examined such associations in LGAs with different proportions of Aboriginal and Torres Strait Island peoples, and the results show that the association between alcohol outlet density and rate of both domestic and non-domestic assaults were stronger in LGAs with a higher proportion of Aboriginal and Torres Strait Island peoples population compared with LGAs with a lower proportion of Aboriginal and Torres Strait Island peoples.

Table 5. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of overall outlets per 100,000 population, considering the interaction between rurality and outlet density; socioeconomic status and outlet density; levels of Aboriginal and Torres Strait Island peoples and outlet density between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Overall outlets * Urban (vs. rural)	0.086	0.031	2.823	0.005	-0.072	0.058	-1.241	0.214
Overall outlets * socioeconomic status (vs. the most socioeconomic disadvantaged group)	-0.001	0.000	-3.906	<0.001	-0.003	0.000	-13.111	<0.001
Overall outlets * Aboriginal 2(vs. Aboriginal 1)	-0.034	0.026	-1.275	0.202	-0.014	0.045	-0.303	0.762

Overall outlets *									
Aboriginal 3 (vs. Aboriginal 1)	0.063	0.030	2.088	0.037	0.423	0.050	8.452	<0.001	

Note: Separate fully adjusted models (adjusted for alcohol outlet density, the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Island peoples and rural/urban) were used to examine whether the association between the density of licensed liquor outlets and the rate of domestic assault and non-domestic assault vary among different SEIFA groups, urban and rural/regional areas, and in areas with higher, middle and lower proportions of Aboriginal and Torres Strait Islander people. Please see full models in Appendix Tables A4a-c.

5.6 If there is such an association, whether there are marked non-linearities in any relationships between alcohol outlet densities and rates of domestic assault and non-domestic assault?

The linear model of alcohol outlet and non-domestic assault using data from 2015 to 2019 (Figure 5) shows that as the number of alcohol outlets per 100,000 population increases from 42 to 750, the predicted monthly number of non-domestic assaults per 100,000 population increases gradually from 25 to 160. The non-linear model (cubic polynomial model), on the other hand, shows a different result in the number of non-domestic assaults expected per 100,000 population in the range between 558 and 740 outlets per 100,000 population, with a sharp increase in non-domestic assault from 60 to 160.

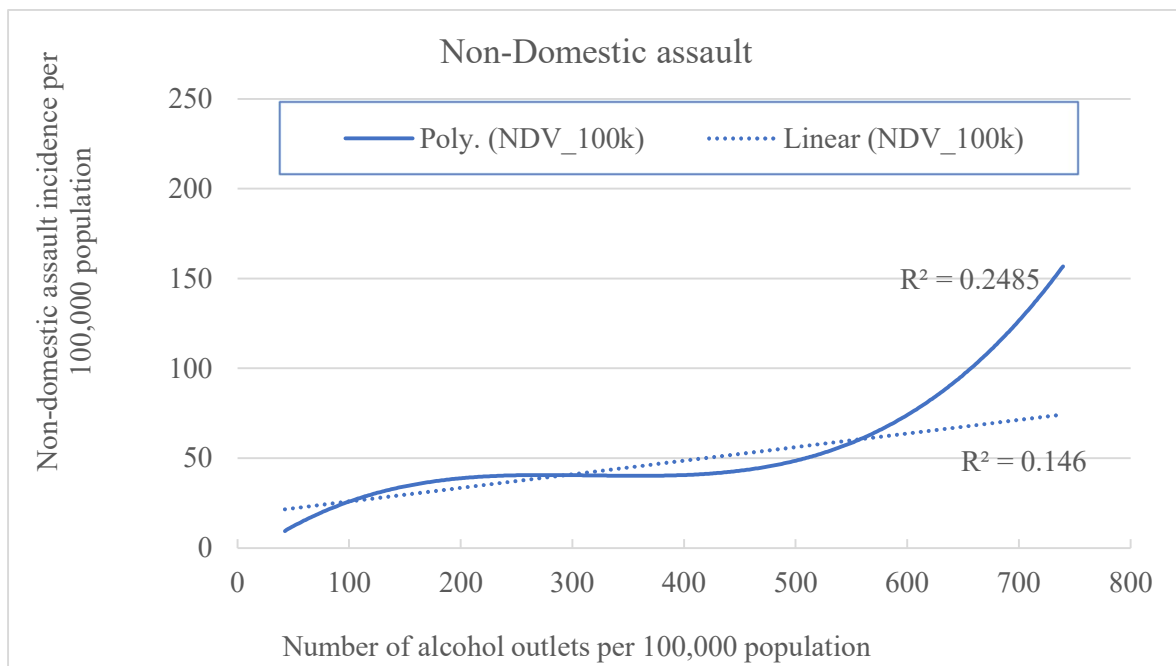


Figure 5. Linear and non-linear relationships between alcohol outlet density and non-domestic assaults per 100,000 population in a hypothetical LGA in NSW between November 2015 and November 2019.

The linear and non-linear relationships found between the number of alcohol outlets per 100,000 population and domestic assaults rate per 100,000 population in NSW (Figure 6) were similar to the relationships found between alcohol outlets and non-domestic assaults. Along with the number of alcohol outlets per 100,000 population increasing from 42 to 740, the predicted monthly number of non-domestic assaults per 100,000 population increased gradually from 5 to 410. These complex relationships provide some indication of a potential threshold level of alcohol outlets per 100,000 population at the LGA level (approximately 551 per 100,000 population in a LGA), above which each new licence results in a marked increase in the expected number of both domestic and non-domestic assaults. The R-squared value is a statistical measure that indicates the goodness-of-fit of a regression model and the higher the value the better the model fit. The R-squared values in Figures 5 and 6 both show that the polynomial regression models achieved a better model fit than the linear regression models.

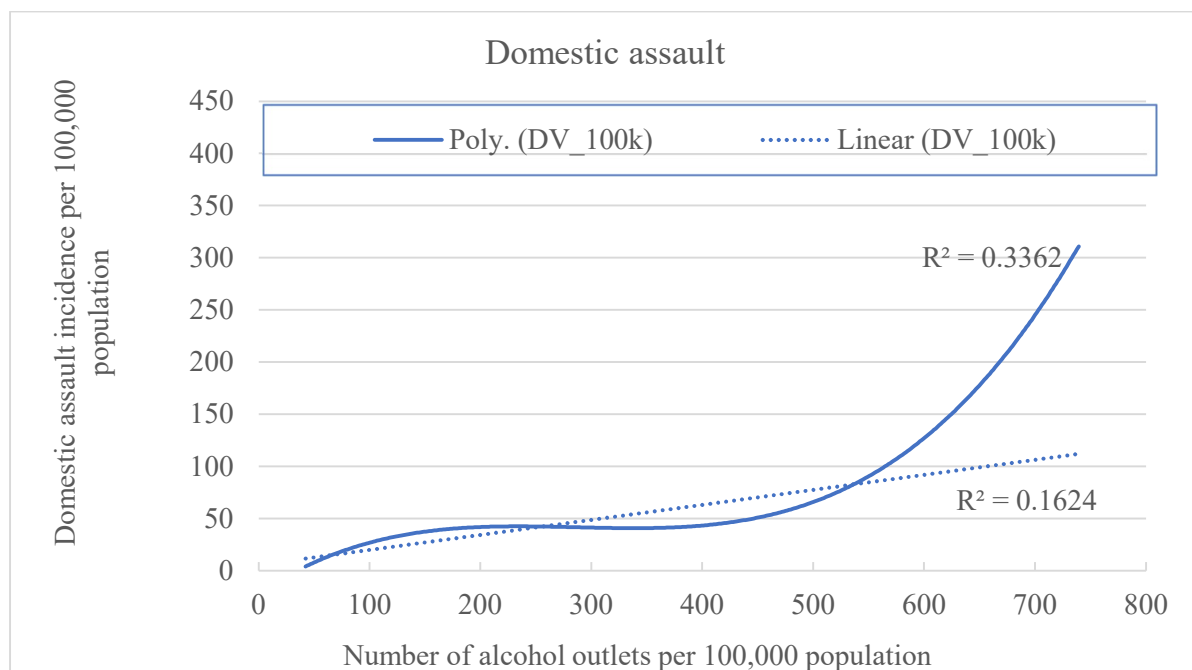


Figure 6. Linear and non-linear relationships between alcohol outlets density and domestic assaults per 100,000 population in a hypothetical LGA in NSW.

The linear and non-linear relationships between the number of alcohol outlets per 100,000 population and the rates of alcohol-related domestic and non-domestic assaults per 100,000 population in NSW were presented in Figures 7 and 8. Similar patterns were observed in the cubic polynomial regression models, indicating that above approximately 550 per 100,000 population in an LGA, each new liquor licence results in a greater increase in the expected number of both alcohol-related domestic and non-domestic assaults. The R-squared values in Figures 7 and 8 demonstrate that the polynomial regression models outperform the linear regression models.

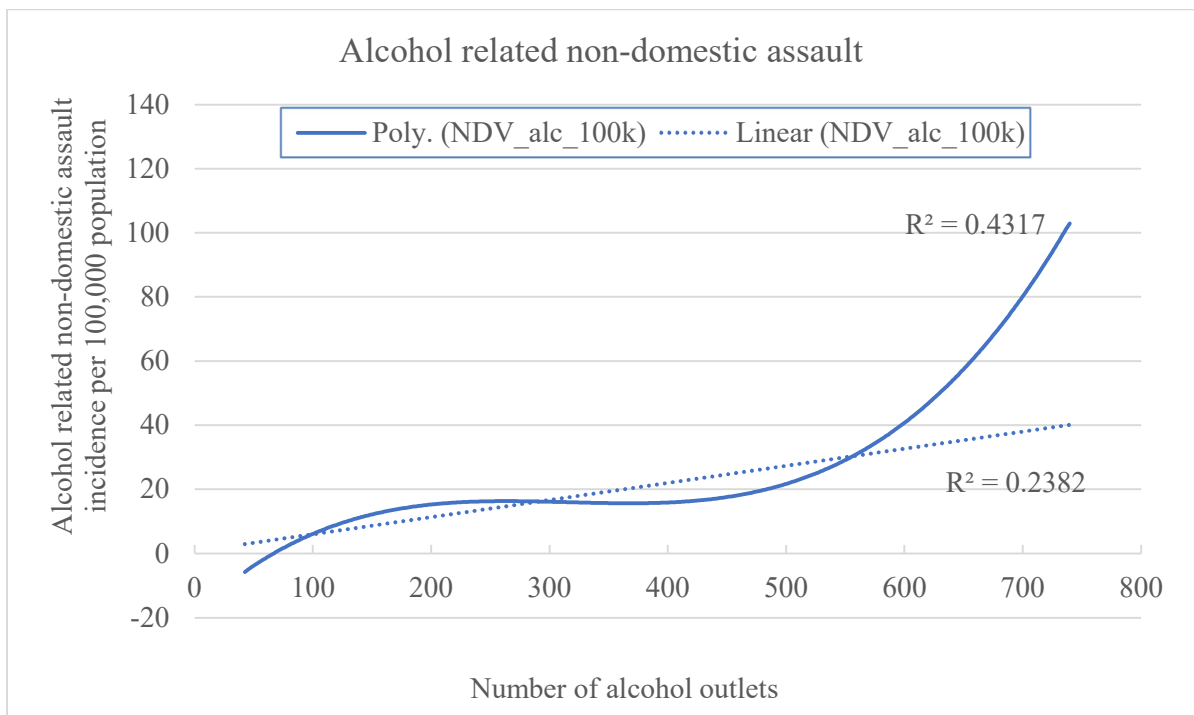


Figure 7. Linear and non-linear relationships between alcohol outlet density and alcohol-related non-domestic assaults per 100,000 population in a hypothetical LGA in NSW.

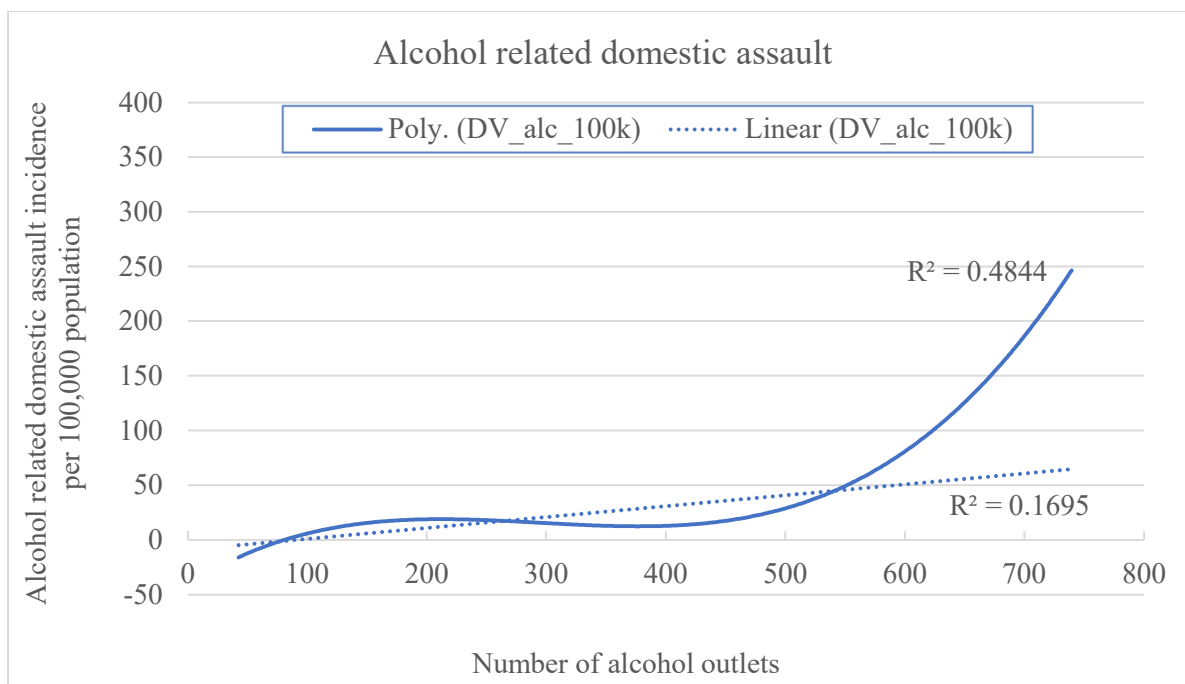


Figure 8. Linear and non-linear relationships between alcohol outlets density and alcohol-related domestic assaults per 100,000 population in a hypothetical LGA in NSW.

6 Sensitivity analyses

6.1 Sensitivity analysis 1 – Excluding Sydney LGA and Snowy Monaro Regional LGA in the analysis on data from November 2015 to November 2019

A previous study Donnelly and Mahoney (2014) has indicated that the Sydney LGA has a high transient population (visitors and/or tourists) and the Snowy Monaro Regional LGA has a high visitor population during the winter months. Therefore, we conducted a sensitivity analysis that excludes the Sydney LGA and the Snowy Monaro Regional LGA in our model to avoid any under - or overestimation of assault rate due to the high transient populations in these two LGAs. Table 6 below presents a sensitivity analysis on associations between alcohol outlet density and non-domestic and domestic assaults per 100,000 population using a sample excluding Sydney LGA and Snowy Monaro Regional LGA. The outlet density per 100,000 population positively and significantly predicted both domestic assault and non-domestic assault in NSW. Comparing the result in Table 6 with the first row in Table 2, excluding the two LGAs makes little difference in the results.

Table 6. The maximum likelihood spatial panel regression models with random effect predicting domestic and non-domestic assaults by alcohol outlet density, excluding Sydney LGA and Snowy Monaro Regional LGA for the period November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Outlets per 100,000 population	0.041	0.013	3.101	0.002	0.114	0.024	4.719	<0.001

Note: these two models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Island peoples and rural/urban. See Appendix Table A5 for full model outputs.

Similar results were found in the alcohol-related assault model (Table 7), showing that the outlet density per 100,000 population positively predicted alcohol-related non-domestic assault and alcohol-related domestic assault. Comparing the results in Table 7 with Table 3, we found the results for alcohol-related domestic assaults strengthen and become more significant.

Table 7. The maximum likelihood spatial panel regression models with random effect predicting alcohol-related domestic and non-domestic assaults by alcohol outlet density excluding Sydney LGA and Snowy Monaro Regional LGA for the period November 2015 and November 2019.

<i>Predictors</i>	Alcohol-related non-domestic assault				Alcohol-related domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Outlets per 100,000 population	0.034	0.008	4.499	<0.001	0.083	0.004	19.714	<0.001

Note: these two models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Island peoples and rural/urban. See Appendix Table A6 or full model outputs.

6.2 Sensitivity analysis 2 – Including tourist population in Sydney LGA and Snowy Monaro Regional LGA in the analysis on data from November 2015 to November 2019

The impact of highly transient populations on the estimated residential populations in the Sydney LGA and the Snowy Monaro Regional LGA were considered in this sensitivity analysis and the tourist population was added to the estimated resident population in these two LGAs. The model results on overall and alcohol-related domestic and non-domestic assaults were presented in Tables 8 and 9. These models show that the outlet density per 100,000 population positively predicted overall and alcohol-related domestic and non-domestic assaults. The results are similar with the results in Tables 2 and 3 and Tables 6 and 7, showing that our estimation on the association between alcohol outlet density, and overall and alcohol-related domestic and non-domestic assaults are reliable and robust, though the effect size may vary in different models and the significance of the domestic assault relationship in Table 9 decreases slightly.

Table 8. The maximum likelihood spatial panel regression models with random effect predicting domestic and non-domestic assaults by alcohol outlet density, including tourist population of Sydney LGA and Snowy Monaro Regional LGA for the period November 2015 - November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Outlets per 100,000 population	0.033	0.010	3.203	0.001	0.072	0.018	3.949	<0.001

Note: these two models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Island peoples and rural/urban. See Appendix Table A7 for full model outputs.

Table 9. The maximum likelihood spatial panel regression models with random effect predicting alcohol-related domestic and non-domestic assaults by alcohol outlet density, including tourist population of Sydney LGA and Snowy Monaro Regional LGA for the period Nov 2015 - Nov 2019.

<i>Predictors</i>	Alcohol-related non-domestic assault				Alcohol-related domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Outlets per 100,000 population	0.028	0.006	4.676	<0.001	0.032	0.013	2.401	0.016

Note: these two models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Island peoples and rural/urban. See Appendix Table A8 for full model outputs.

6.3 Sensitivity analysis 3 – The effects of extended trading hours

The data provided by L&GNSW also include a “yes” or “no” indicator of extended trading hours for each liquor outlet. Although the intensity and magnitude of the extended trading hours were not specified, it provides an opportunity to estimate the effects of extended trading hours among alcohol outlets on domestic and non-domestic assaults in LGAs. Status of extended trading hours among various alcohol outlets were aggregated as number of alcohol outlets with extended trading hours per 100,000 population in each LGA.

After including both overall alcohol outlet density and alcohol outlets with extended trading hours per 100,000 population in the same model, we found that there is strong collinearity between alcohol outlet density rate per 100,000 population and alcohol outlets with extended trading hours per 100,000 population in LGAs. A possible reason could be that overall alcohol outlet density and alcohol outlets with extended trading hours per 100,000 population share the same characteristics. That is, the more alcohol outlets, the greater the number of outlets there are that apply for and are granted permits for extending trading hours. Thus, we could only run models predicting domestic and non-domestic assaults using number of alcohol outlets with extended trading hours per 100,000 population in LGAs, and control for the effects of other covariates, such as the proportion of Aboriginal and Torres Strait Island peoples, rurality and SEIFA index.

The results of spatial panel models (Table 10) show that an increase in density of alcohol outlets with extended trading hours per 100,000 population would lead to greater risk for non-domestic assaults in LGAs in NSW. No significant association was found between number of alcohol outlets with extended trading hours and domestic assault in LGAs.

Table 10. The maximum likelihood spatial panel regression models with random effect predicting domestic and non-domestic assaults by alcohol outlet density with extended trading hours between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
Outlets with extended trading hours per 100,000 population	0.153	0.042	3.608	< 0.001	0.034	0.083	0.408	0.683

Note: these two models adjusted for the effects of socioeconomic status (using SEIFA index), proportion of Aboriginal and Torres Strait Island peoples and rural/urban. See Appendix Table A9 for full model outputs.

6.4 Sensitivity analysis 4 – Using full dataset from Jan 2012 to Nov 2019

Chow breakpoint test

The Chow breakpoint test was employed to test whether the change to the liquor licensing system in November 2015 had a significant impact on the associations between alcohol outlet density and domestic and non-domestic assault. The results of the Chow breakpoint test (see Table 11) show that there was a significant break point in the associations between alcohol outlet density and domestic and non-domestic assaults in November 2015, when NSW changed the licence process from being perpetual to an annual licence type. As advised by L&GNSW, the decision to change the liquor licensing system was made in March 2015, however the change did not come into effect until November 2015. The associations were found to differ significantly between the periods before November 2015 and from November 2015 onward.

Table 11. Chow breakpoint test on the impact of liquor licence system change in November 2015.

Chow Breakpoint Test: 2015M11			
Null Hypothesis: No breaks at specified breakpoints			
Varying regressors: All equation variables			
Equation Sample: 2012M01 2019M11			
Test name	Results		P-value
F-statistic	5.140184	Prob. F(2,91)	0.0077
Log likelihood ratio	10.16814	Prob. Chi-Square(2)	0.0062
Wald Statistic	10.28037	Prob. Chi-Square(2)	0.0059

Because there was a significant impact of the liquor licence system change in November 2015, examining the associations between alcohol outlet density and domestic and non-domestic assaults rates using data between January 2012 and November 2019 is not recommended. Our final model used spatial panel data between November 2015 and November 2019.

7 Discussion

Our study has presented the first comprehensive spatial panel (both spatial and temporal) model analysis on the association between alcohol outlet density and domestic and non-domestic assaults in LGAs in NSW. The study results revealed that alcohol outlet density per 100,000 population was significantly associated with both domestic and non-domestic assaults. On average between November 2015 and November 2019, when there was an increase of one alcohol outlet per LGA, this was associated with 1.30% and 0.68% increases in domestic and non-domestic assaults respectively. Moreover, an increase of one alcohol outlet per LGA was also associated with a 2.19% increase in alcohol-related domestic assaults and a 1.73% increase in alcohol-related non-domestic assaults, respectively, between 2015 and 2019. These results are consistent with existing studies (Badland et al., 2016; Donnelly & Mahoney, 2014; Livingston, 2011) and suggest that controlling alcohol outlet density could reduce domestic and non-domestic assaults in NSW.

Positive associations between on-sales alcohol outlet density and both domestic and non-domestic assaults in LGAs in NSW were found in the spatial panel regression models. A previous study in the District of Columbia, in the US, found that off-sales outlets were associated with an increase in domestic violence, but another study found restaurants and nightclubs (on-sales outlets) were associated with a decrease in domestic violence (Roman & Reid, 2012). However, our study found there was no significant association between off-sales alcohol outlet density and domestic and non-domestic assaults in NSW in the spatial panel models. Our result is in line with a study on associations between on-sales and off-sales alcohol outlet density rates and assault in Melbourne (Livingston, 2008). Consistent with Donnelly and Mahoney (2014) subtype liquor licence analysis in NSW using one year cross-

sectional data, our study found that the hotel density rate was positively associated with non-domestic assault and that the density rate of clubs was negatively associated with non-domestic assault, while the density of *on-premises* alcohol outlets (café, restaurant, catering company, vessel and nightclub licences) was positively associated with domestic assault in NSW. These findings suggest that a targeted liquor licensing control on the density of hotel and *on-premises* outlets may effectively reduce non-domestic and domestic assaults in NSW. The reason for the negative effects from club density on non-domestic assault is unknown and future studies are needed to investigate the possible mechanism behind this.

The interaction analyses in spatial panel models show that the associations between alcohol outlet density and domestic and non-domestic assaults were found to be stronger in socioeconomically disadvantaged areas and regions with a higher proportion of Aboriginal and Torres Strait Island peoples, compared with comparison areas. These results indicate that controlling liquor licence density in socioeconomically disadvantaged areas and regions with a higher proportion of Aboriginal and Torres Strait Island peoples may lead to greater preventive effects on both domestic and non-domestic assaults. Furthermore, controlling liquor licence density in urban areas may lead to greater preventive effect on non-domestic assaults only.

The results of linear and cubic polynomial regression models suggest that there were positive associations between alcohol outlet density and both domestic and non-domestic assaults in NSW, suggesting that there is a potential threshold level of alcohol outlets per 100,000 population at the LGA level. The results suggest that each new licence above 551 outlets per 100,000 population in a LGA may result in a greater increase in the number of domestic. While each new licence above 558 outlets per 100,000 population in a LGA may result in a greater increase in non-domestic assaults in NSW (predicting results were summarised in Appendix Table A10). There are eight LGAs with alcohol outlets exceeding 551 per 100,000 population in NSW, including Murray River, Mid-Western Regional, Cabonne, Cessnock, Bogan, Sydney, Central Darling, Snowy Monaro Regional.

Two sensitivity analyses were conducted to control for the impact of the high transient populations in the Sydney LGA and Snowy Monaro Regional LGA. The results were similar with the full model presented in Tables 2 and 3, confirming that there were significant associations between alcohol outlet density and domestic and non-domestic assaults, regardless of whether the effects of the high transient populations in Sydney LGA and Snowy Monaro Regional LGA in the sample were controlled for or not.

The results of a third sensitivity analysis suggest that the number of outlets with extended trading hours positively predicts non-domestic assault, but not domestic assault. This result suggests that an increase in trading hours for alcohol outlets will lead to greater non-domestic assaults in NSW. Nevertheless, this finding needs to be treated cautiously as we only captured information about whether the outlets have extended trading hours permits or not.

The Chow Breakpoint test results indicate that the associations between alcohol outlet density and domestic and non-domestic assaults were significantly different before and after the licence system change in 2015. Thus, using the data from November 2015 to November 2019 to examine such associations is more reliable, given that the data is more accurate in reflecting which liquor licences are truly active.

While this study provides good evidence of a spatial and temporal association between overall and alcohol-related domestic and non-domestic assaults and alcohol outlet density, it has a number of limitations. First, the changes in trading hours of licensed venues were dichotomised in our model, as the liquor licensing data only capture information on extended trading hours for licences when those are granted, and not reductions in trading hours (for example, on-trade alcohol sales restriction have been implemented after 3.30 am in Newcastle, and after 3 am in Kings Cross and the Sydney central business districts in NSW, July 2016). How the extended trading hours were applied and the intensity and magnitude of the extended trading hours among those outlets were not clear. Second, outlet size, patron capacity and the volume of alcohol sales of licensed venues were unknown, so it is not possible to measure whether large bottle shops, hotels or on-premises venues may be associated with greater effects on assault rates compared with smaller liquor venues. Third,

the mix of restaurants, cafes, karaoke venues, catering companies, vessels and nightclubs in the *on-premises* type may vary substantially across LGAs in NSW. The effects of these different venue subtypes on domestic and non-domestic assaults cannot be measured separately due to the data limitation. They have different primary operation models, venue and patron size, and operating hours, types of alcohol consumed and ease of access to food, which could influence the risk assessment and treatment of all *on-premises* venue types and therefore our analysis of *on-premises* alcohol outlets should be treated cautiously. Fourth, some hotels and clubs in NSW also sell takeaway alcohol, but the data on how many of them do so and in which way they sell takeaway alcohol is unavailable. However, the impact of this data limitation on the analyses is likely to be minimal, as the primary focus of hotels and clubs is on providing on-premises alcohol sales. Fifth, alcohol-related domestic and non-domestic assaults include an alcohol "flag" which is recorded and assessed by personnel in the NSW police system. There is a possibility of underreporting in alcohol-attributable assaults. The effects of underestimation in alcohol-related assaults were not accounted for in our models. Additionally, other confounding factors, such as ethnicity, mental health status, accessibility to family and community services, and the resources available to the person, and other factors, which may predict domestic and non-domestic assaults in NSW, were unable to be controlled in this study. Due to these limitations, the results of this study need to be treated with caution.

Nevertheless, this study is the first study of NSW data in nearly 10 years that provides temporal and geographically relevant information linking alcohol outlet density and domestic and non-domestic assaults. Compared with previous studies that used cross-sectional data (Donnelly & Mahoney, 2014; Livingston, 2008; Prodemore & Grubestic, 2012), this study estimated both temporal and spatial associations using longitudinal spatial panel data with a series of robust sensitivity analyses, demonstrating clearly that alcohol outlet density was associated with increased domestic and non-domestic assaults in NSW.

8 Conclusions

Overall, this study has provided clear research evidence that alcohol outlet density is positively associated with both domestic and non-domestic assaults in NSW. A potential

threshold for the number of outlets per 100,000 population in an LGA has been identified to inform future policy formulation. The rates of domestic and non-domestic assault per 100,000 population rise faster above somewhere around 550 outlets per 100,000 populations, but this is not the beginning of the rise. Controlling liquor licence density could effectively reduce domestic and non-domestic assaults in NSW, particularly in urban regions, and areas with lower socioeconomic status and higher levels of Aboriginal and Torres Strait Island peoples.

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10 Appendix.

Table A1. Descriptive statistics. Mean monthly assault and outlet counts for LGAs in NSW between 2012 and 2019.

Variable	Mean (SD)	Median [Min, Max]
Outlet (per 100,000 population)		
Club	39.8 (33.1)	29.1 [0, 162]
Hotel	68.0 (63.0)	47.3 [1.72, 390]
On premise	80.7 (71.7)	70.2 [0, 585]
Packaged	34.5 (17.3)	30.7 [10.7, 101]
Small bar	0.222 (1.28)	0 [0, 23.6]
All outlets	278 (163)	247 [375, 1072]
Incidents (per 100,000 population)		
Non-domestic assault	42.6 (43.2)	32.8 [0, 638]
Domestic assault	46.3 (69.7)	31.9 [0, 1090]
Non-domestic assault (alcohol-related)	18.2 (28.2)	10.8 [0, 585]
Domestic assault (alcohol-related)	20.7 (52.2)	9.93 [0, 982]
Population	59600 (77700)	23500 [1030, 378000]
Aboriginal Australians percent	7.79 (9.70)	4.94 [0.202, 68.9]
Socioeconomic status (SEIFA Index)	978 (62.6)	971 [757, 1120]

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016).

Table A2. Results of the maximum likelihood spatial panel model with pooled estimates for the overall number of outlets in the LGA predicting alcohol-related domestic and non-domestic assault, using monthly data between November 2015 and November 2019, for the whole of NSW and for demography-defined subgroups.

<i>Predictors</i>	Alcohol non-domestic assault				Alcohol domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	113.219	21.618	5.237	< 0.001	278.702	56.306	4.950	< 0.001
Outlets per 100,000 population	0.037	0.007	5.369	< 0.001	0.047	0.016	3.027	0.002
SEIFA index	-0.111	0.021	-5.274	< 0.001	-0.278	0.055	-5.089	< 0.001
Aboriginal 2	-1.557	3.126	-0.498	0.618	-5.553	8.158	-0.681	0.496
Aboriginal 3	4.751	3.565	1.333	0.183	1.910	9.304	0.205	0.837
Urban	4.044	3.410	1.186	0.236	9.415	8.856	1.063	0.288

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower

Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A3a. The maximum likelihood spatial panel model with random effects predicting alcohol-related domestic and non-domestic assault by number of on- and off-sales outlets per 100,000 population between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	236.094	39.091	6.040	< 0.001	427.373	78.113	5.471	< 0.001
On-sales outlets	0.055	0.015	3.710	< 0.001	0.093	0.026	3.543	< 0.001
Off-sales outlets	-0.009	0.116	-0.078	0.938	0.141	0.214	0.658	0.511
SEIFA index	-0.220	0.038	-5.828	< 0.001	-0.424	0.076	-5.611	< 0.001
Aboriginal 2	2.592	5.683	0.456	0.648	-0.977	11.348	-0.086	0.931
Aboriginal 3	16.692	6.501	2.568	0.010	17.404	12.986	1.340	0.180
Urban	11.997	6.144	1.953	0.051	19.539	12.258	1.594	0.111

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A3b. The maximum likelihood spatial panel model with random effects predicting alcohol-related domestic and non-domestic assault by density of alcohol outlet subtypes per 100,000 population between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	257.840	35.899	7.183	< 0.001	473.136	80.975	5.843	< 0.001
Club ^a	-0.306	0.066	-4.666	< 0.001	-0.122	0.140	-0.875	0.382
Hotel	0.181	0.034	5.360	< 0.001	0.084	0.064	1.313	0.189
On-premise ^b	0.030	0.023	1.317	0.188	0.138	0.041	3.373	0.001
Packaged liquor	0.075	0.106	0.712	0.476	0.200	0.218	0.921	0.357
Small bar	0.088	0.491	0.180	0.857	-0.877	0.702	-1.249	0.212
SEIFA index	-0.235	0.035	-6.759	< 0.001	-0.467	0.078	-5.962	< 0.001
Aboriginal 2	0.304	5.017	0.061	0.952	-2.636	11.354	-0.232	0.816
Aboriginal 3	14.146	5.777	2.449	0.014	18.366	13.028	1.410	0.159
Urban	7.729	5.501	1.405	0.160	15.431	12.452	1.239	0.215

Note: ^a On-premise outlet includes café, restaurant, catering company, vessel and nightclub. Club includes registered club, RSL or Diggers Club, golf club. Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD])

from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A4a. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of overall outlets per 100,000 population considering the interaction between rurality and outlet density between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	260.447	38.617	6.744	<0.001	406.731	80.103	5.078	<0.001
Outlets per 100,000 population	0.035	0.013	2.737	0.006	0.109	0.024	4.506	<0.001
SEIFA index	-0.241	0.037	-6.498	<0.001	-0.407	0.077	-5.260	<0.001
Aboriginal 2	0.915	5.442	0.168	0.867	0.404	11.353	0.036	0.972
Aboriginal 3	14.639	6.205	2.359	0.018	19.084	12.950	1.474	0.141
Urban	-1.740	7.702	-0.226	0.821	31.099	15.470	2.010	0.044
Overall outlets * Urban	0.086	0.031	2.823	0.005	-0.072	0.058	-1.241	0.214

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A4b. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of overall outlets per 100,000 population considering the interaction between socioeconomic status and outlet density between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	99.375	49.933	1.990	0.047	-239.500	76.065	-3.149	0.002
Outlets per 100,000 population	0.630	0.148	4.247	<0.001	2.977	0.221	13.465	<0.001
SEIFA index	-0.085	0.049	-1.734	0.083	0.245	0.075	3.280	0.001
Aboriginal 2	4.653	5.273	0.882	0.378	10.754	8.185	1.314	0.189
Aboriginal 3	15.347	5.977	2.568	0.010	13.890	9.282	1.496	0.135

Urban	13.053	5.711	2.286	0.022	22.038	8.861	2.487	0.013
Overall outlets *	-0.001	0.000	-3.906	<0.001	-0.003	0.000	-13.111	<0.001
SEIFA index								

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A4c. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of overall outlets per 100,000 population considering the interaction between levels of Aboriginal and Torres Strait Island population and outlet density between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	215.302	37.837	5.690	<0.001	369.739	67.027	5.516	<0.001
Outlets per 100,000 population	0.050	0.019	2.619	0.009	-0.012	0.033	-0.354	0.724
SEIFA index	-0.201	0.037	-5.492	<0.001	-0.340	0.065	-5.255	<0.001
Aboriginal 2	10.475	8.334	1.257	0.209	2.710	14.425	0.188	0.851
Aboriginal 3	0.153	9.934	0.015	0.988	-90.333	16.903	-5.344	<0.001
Urban	11.629	6.072	1.915	0.055	6.448	10.745	0.600	0.548
Overall outlets * Aboriginal 2	-0.034	0.026	-1.275	0.202	-0.014	0.045	-0.303	0.762
Overall outlets * Aboriginal 3	0.063	0.030	2.088	0.037	0.423	0.050	8.452	<0.001

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A5. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of overall outlets per 100,000 population excluding the Sydney LGA and Snowy Monaro Regional LGA for the period of November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	236.073	37.770	6.250	<0.001	429.072	77.978	5.502	<0.001

Outlets per 100,000 population	0.041	0.013	3.101	0.002	0.114	0.024	4.719	<0.001
SEIFA index	-0.218	0.037	-5.954	<0.001	-0.427	0.076	-5.640	<0.001
Aboriginal 2	1.236	5.559	0.222	0.824	-3.229	11.494	-0.281	0.779
Aboriginal 3	15.848	6.358	2.493	0.013	14.104	13.133	1.074	0.283
Urban	7.602	6.118	1.243	0.214	20.561	12.593	1.633	0.103

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A6. The maximum likelihood spatial panel model with random effects predicting alcohol-related domestic and non-domestic assault by number of overall outlets per 100,000 population excluding the Sydney LGA and Snowy Monaro Regional LGA for the period between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	113.945	21.256	5.361	<0.001	271.105	10.996	24.654	<0.001
Outlets per 100,000 population	0.034	0.008	4.499	<0.001	0.083	0.004	19.714	<0.001
SEIFA index	-0.110	0.021	-5.337	<0.001	-0.277	0.011	-26.043	<0.001
Aboriginal 2	-2.299	3.126	-0.736	0.462	-6.509	1.617	-4.027	<0.001
Aboriginal 3	4.178	3.577	1.168	0.243	-1.116	1.848	-0.604	0.546
Urban	2.032	3.447	0.590	0.556	12.284	1.785	6.880	<0.001

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A7. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of overall outlets per 100,000 population including the tourist population of Sydney LGA and Snowy Monaro Regional LGA in the sample for the period between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	118.529	20.146	5.884	<0.001	214.410	39.090	5.485	<0.001

Outlets per 100,000 population	0.033	0.010	3.203	0.001	0.072	0.018	3.949	<0.001
SEIFA index	-0.110	0.020	-5.641	<0.001	-0.212	0.038	-5.592	<0.001
Aboriginal 2	0.862	2.909	0.296	0.767	-0.665	5.652	-0.118	0.906
Aboriginal 3	8.268	3.317	2.492	0.013	9.151	6.448	1.419	0.156
Urban	6.075	3.207	1.894	0.058	10.437	6.201	1.683	0.092

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A8. The maximum likelihood spatial panel model with random effects predicting alcohol-related domestic and non-domestic assault by number of overall outlets per 100,000 population including the tourist population of Sydney LGA and Snowy Monaro Regional LGA in the sample for the period between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	56.621	11.113	5.095	<0.001	140.459	28.430	4.941	<0.001
Outlets per 100,000 population	0.028	0.006	4.676	<0.001	0.032	0.013	2.401	0.016
SEIFA index	-0.055	0.011	-5.119	<0.001	-0.139	0.028	-5.052	<0.001
Aboriginal 2	-0.897	1.603	-0.559	0.576	-3.005	4.112	-0.731	0.465
Aboriginal 3	2.477	1.828	1.355	0.176	1.111	4.690	0.237	0.813
Urban	2.302	1.772	1.299	0.194	4.760	4.508	1.056	0.291

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A9. The maximum likelihood spatial panel model with random effects predicting domestic and non-domestic assault by number of outlets with extended trading hours per 100,000 population for the period between November 2015 and November 2019.

<i>Predictors</i>	Non-domestic assault				Domestic assault			
	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>Estimate</i>	<i>SE</i>	<i>t</i>	<i>p</i>
(Intercept)	257.710	40.040	6.436	<0.001	468.238	79.400	5.897	<0.001
Outlets with extended trading	0.153	0.042	3.608	<0.001	0.034	0.083	0.408	0.683

hours per 100,000
population

SEIFA index	-0.236	0.039	-6.032	<0.001	-0.442	0.078	-5.686	<0.001
Aboriginal 2	0.202	5.823	0.035	0.972	-4.057	11.550	-0.351	0.725
Aboriginal 3	15.258	6.672	2.287	0.022	18.936	13.229	1.431	0.152
Urban	9.265	6.268	1.478	0.139	10.429	12.427	0.839	0.401

Note: Socio-Economic Indexes for Areas (SEIFA) scores (SEIFA - the Index of Relative Socio-Economic Disadvantage [IRSD] from 757 to 1120, the lower number the greater socioeconomic disadvantage) (Australian Bureau of Statistics, 2016). Aboriginal 1 – lower Aboriginal and Torres Strait Island peoples was used as the reference group in the model. Rural/regional areas was used as the reference group to compare with Urban.

Table A10. Linear regression and cubic polynomial regression models predicting domestic and non-domestic assaults using number of alcohol outlet per 100,000 population in LGAs.

Number of alcohol outlet per 100,000 population in a LGA	Domestic assault per 100,000 population		Non-domestic assault per 100,000 population	
	Linear regression model prediction	Cubic polynomial regression model prediction	Linear regression model prediction	Cubic polynomial regression model prediction
550	84.78	83.95	59.96	58.48
551	84.92	84.52	60.03	58.72
552	85.06	85.11	60.11	58.96
553	85.21	85.70	60.18	59.21
...		
558	85.93	88.72	60.56	60.47
559	86.07	89.34	60.64	60.72
560	86.21	89.96	60.71	60.98
561	86.36	90.59	60.79	61.25

Note: bolded numbers indicate the thresholds that domestic and non-domestic violence increases more steeply with extra outlets.