

The association between alcohol outlet density and assaults on and around licensed premises

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Aim: To estimate the proportion of assaults occurring on or around licensed premises, determine whether assaults are more likely to happen around licensed premises than elsewhere and estimate the effect of additional alcohol outlets (outlet density) on the incidence of assault.

Method: Clusters of licensed premises in the Sydney Local Government Area (LGA) were identified. The proportion of recorded assault incidents within 20, 50, 100 and 200 metre buffer zones around the licensed premises was calculated and compared with the proportion of land area covered by the buffer. The incidence of recorded assaults as a function of increasing counts of alcohol outlets was also examined.

Results: Assaults were found to be highly concentrated around licensed premises. Assaults tend to cluster around George Street in the central business district (CBD), Darlinghurst Road in Kings Cross, Oxford Street in Darlinghurst, King Street in Newtown and Glebe Point Road in Glebe. The highest concentrations of assault are in Kings Cross, Oxford Street in Darlinghurst and along George Street in the CBD. More than half of the assaults recorded by police in the Sydney CBD occur within 50 metres of a liquor outlet. Only 3 per cent of the Sydney LGA is within 20 metres of a liquor outlet, yet 37 per cent of assaults in Sydney LGA occurred in this space. The results suggest that each additional alcohol outlet per hectare in the Sydney LGA will result, on average, in 4.5 additional assaults per annum.

Conclusion: Limiting the density of alcohol outlets may help limit the incidence of assault.

Keywords: GIS, assault, alcohol outlet density, alcohol-related violence, licensed premises, liquor outlets

INTRODUCTION

The NSW Bureau of Crime Statistics and Research has published a sizeable body of research documenting the relationship between licensed premises and crime in NSW (e.g., Briscoe & Donnelly, 2001a; 2001b; 2003; Donnelly, Poynton, Weatherburn, Bamford, & Nottage, 2006; Fitzgerald, Mason, & Borzycki, 2010; Jones, Kypri, Moffatt, Borzycki, & Price, 2009; Moffatt, Mason, Borzycki, & Weatherburn, 2009). The research to date, however, has been limited to incidents recorded by police as actually occurring on licensed premises. Very little research has been undertaken in NSW into the contribution licensed premises make to alcohol-related violence outside licensed premises.

The relationship between alcohol outlet density and alcohol-related violence is of critical importance to policy makers and regulators. Without good information on the relationship, it is difficult to make decisions about whether to grant new liquor licenses, whether to impose restrictions on existing licences and what sorts of restrictions might be required. Indeed, the Bureau has received several requests for advice from Local Governments wishing to know whether there is some threshold level of density of alcohol outlets where assaults become a serious problem. The study reported here had three aims. The first was to provide descriptive information about the number and proportion of assault incidents occurring *on and around* licensed premises. The second was to assess whether assaults are more likely to happen around licensed premises than elsewhere. The third was to determine the marginal effect of each additional alcohol outlet per hectare on the number of assaults.

PAST RESEARCH

CRIME ON LICENSED PREMISES

A 1988 study from New Zealand determined that 10 per cent of serious assaults (assaults resulting in hospitalisation) occurred in or around licensed premises (Langley, Chalmers, & Fanslow, 1996). Briscoe and Donnelly (2001b) showed that licensed premises were the third most frequent premises type at which reported assault incidents occurred in NSW, accounting for 9 per cent of all assaults (after residential premises and outdoor spaces with 43% and 29% respectively).¹ Fitzgerald, Mason and Boryzcki (2010) similarly found that nearly 10 per cent of reported assaults in NSW are recorded by police as occurring on licensed premises. When they examined a sample of assaults recorded as occurring on licensed premises between July 2007 and June 2008, they found that 21 per cent actually occurred outside the premises, usually on the street or footpath, and involved premises staff, patrons or people refused entry.

These and other Australian studies examining crime on or linked to individual alcohol outlets (such as Briscoe & Donnelly, 2003; Homel, Carvolth, Hauritz, McIlwain, & Teague, 2004; Homel & Clark, 1994; Homel, McIlwain & Carvolth, 2001) are valuable in highlighting the contribution of licensed premises to alcohol-related violence, but they do not tell us what proportion of assaults occur near licensed premises. Nor do they directly address the question of whether assaults are more likely to occur around licensed premises than around other types of premises. Likewise, they do not provide information on the size of the change in assault numbers that might result from each additional alcohol outlet established in an area. This last issue is important because the number of assaults may not be a simple function of the number of licensed premises in an area (Scribner, Cohen, Kaplan, & Allen, 1999). Density effects might be expected if areas with a dense number of alcohol outlets attract large crowds of drinkers who patronise several different premises in the one outing.

CRIME AND DENSITY OF ALCOHOL OUTLETS

The application of Geographic Information Systems (GIS) in crime analysis has enabled spatial investigations into the relationship between licensed premises and crime. The majority of such spatial research has involved an investigation into the density of alcohol outlets and rates of crime using different administrative boundaries (e.g., postcode areas) as the geographic units of analysis. In these studies, density traditionally refers to the number of licensed premises per 100, 1,000 or 10,000 residents, depending on the geographic unit being examined (Britt, Carlin, Toomey, & Wagenaar, 2005;

Freisthler, 2004; Gorman, Speer, & Gruenewald 2001; Nielsen & Martinez, 2003; Norstrom, 2000; Reid, Hughey, & Peterson, 2003; Tatlow, Clapp, & Hohman, 2000; Zhu, Gorman, & Horel, 2004).

Some of the first research studied the effects of taverns and cocktail lounges on crime at the city block level in Cleveland (Roncek & Bell, 1981; Roncek & Maier, 1991; Roncek & Pravatiner, 1989). Roncek and Maier (1991) found that the number of licensed premises had a positive and significant statistical effect on crime levels. In particular, the risk of assault on a city block rose by 19 per cent with every additional tavern or lounge. However, most of the early research analysed this relationship at a broad level, using city municipalities as their units of analysis. Early Australian-based research, under the Measurement of Alcohol for Public Policy (MAPP) Consortium of Western Australia from 1995, used Local Government Areas (LGAs) to examine the relationship between alcohol outlet density and harm (Chikritzhs, Catalano, Henrickson, & Pascal, 2007).² MAPP studies found a strong and positive association between licensed premises and assault when calculating outlet-density as number of outlets per LGA, number of outlets by land area or number of beverages purchased (by beverage or outlet type) per LGA. The strength of association between assaults and outlet-density was dependent upon the type of alcohol outlet, the location of the assault incidents and socio-economic factors (Chikritzhs et al., 2007).

Internationally, Scribner, Mackinnon, and Dwyer (1995) observed a significant geographic association between alcohol outlet density (per capita) and violent assault in 74 cities of Los Angeles County.³ They also found that each additional alcohol outlet was associated with 3.4 assaultive violence incidents. Gorman, Speer, Labouvie, and Subaiya (1998) replicated this study in New Jersey and did not find a geographic association between alcohol outlet density and rates of violent assault. They therefore concluded that alcohol outlet density might influence violence only in certain environments, for example when there is a dense population or when alcohol outlet density exceeds a certain threshold.⁴

Postcodes have since been used as the geographic unit of analysis in three more recent California-based studies. Each found bar density was strongly associated with rates of assault (Gruenewald, et al., 2006; Gruenewald & Remer, 2006; Lipton & Gruenewald, 2002).⁵ Lipton and Gruenewald (2002) found that alcohol outlet density exerted small effects on rates of hospitalisation for assault-related injury: for every additional bar per roadway mile there was an increase of between 0.068 and 0.095 self-reported hospitalisations (per 100 persons). The strongest evidence linking outlet density to assault comes from

longitudinal studies because they are capable of identifying the temporal order of cause and effect. In their six-year longitudinal study, Gruenewald and Remer (2006) looked at how changes in alcohol outlet densities affect violence rates. They found that each 10 per cent increase in the number of off-premises outlets and bars resulted in a 2 per cent increase in violence. Put another way, every six additional outlets accounted for one additional violent assault per year. Livingston (2008a) also found that changes in outlet density at the postcode level were linked with changes in rates of alcohol-related night time assaults.⁶ Both of these studies found that the relationship between licensed premises and violence differed between neighbourhoods with different socio-economic profiles.

The literature suggests that small area unit studies using census tracts and blocks are more useful in examining the link between alcohol outlet density and crime than the larger units of analysis employed in the studies mentioned earlier (Speer, Gorman, Labouvie, & Ontkush, 1998; Zhu et al., 2004). This is because the spatial distribution of alcohol outlets (and other relevant factors) across large geographic units can be very uneven and small area units allow for a greater degree of variance to be examined. Smaller census tracts or blocks are now the most commonly used administrative boundaries in assessing the relationship between alcohol outlet density and crime.

Studies at these levels based in NSW, California, Florida, Texas, New Jersey, Missouri and New Orleans have all found positive, often significant, bi-variate relationships between alcohol outlet density and alcohol consumption, neighbourhood problems, child abuse, robbery, assault and homicide (Britt et al., 2005; Connor, Kypri, Bell, & Cousins, In press; Donnelly et al. 2006; Freisthler, 2004; Gorman et al., 2001; Gorman, Zhu, & Horel, 2005; Nielsen & Martinez, 2003; Reid et al., 2003; Scribner, et al., 1999; Stevenson, Lind, & Weatherburn, 1999a; Stevenson, Lind, & Weatherburn, 1999b; Zhu et al., 2004). Some of these studies also found that the link between alcohol outlet density and crime remained significant while controlling for other variables. Donnelly et al., (2006), for example, found that after controlling for socio-demographic factors, residents who lived in areas of NSW with a high density of alcohol outlets were more likely to report problems arising from drunkenness in their neighbourhoods (e.g., property damage and assault victimisation in the home).

Reid et al., (2003) found that alcohol outlet density was the strongest predictor of crime controlling for income, unemployment, racial/ethnic structure and age structure. Gorman et al., (2001) found a strong relationship between alcohol outlet densities and violent crime after controlling for structural features such as poverty, residential stability and age

composition. Likewise, Zhu et al., (2004) found that alcohol outlet density was a significant predictor of violent crime after controlling for disadvantage, residential instability and various socio-demographic measures.

While more appropriate than large unit area studies in analysing spatial distributions and associations, small area unit studies are particularly prone to the effects of spatial autocorrelation. Spatial autocorrelation can be described as the spill-over effects of measures in one geographic unit on outcomes observed in adjacent units (Gorman et al., 2001; Gorman et al., 2005; Zhu et al., 2004). That is, the effect of a high alcohol outlet density in one census tract may influence assault rates in neighbouring census tracts, for example, arising from the movement of intoxicated patrons leaving an entertainment precinct. Analytic methods that fail to account for spatial autocorrelation are likely to overstate the degree of association between alcohol outlet density and crime (Britt et al., 2005).

Some studies have ignored the potential for such unobserved correlations between geographic units and assumed that the association between alcohol outlet densities on crime in neighbouring units is constant and independent of location (Waller, Zhu, Gotway, Gorman, & Gruenewald, 2007). For example, Reid et al., (2003) comment that the effect of alcohol outlet densities spilling over into adjacent geographical units would likely be negligible and therefore did not account for this potential problem. In contrast, Gyimah-Brempong and Racine (2003) found that density was a predictor of violent crime in neighbouring census tracts. Studies are increasingly using geostatistical software to control for spatial autocorrelation, thereby reducing bias (Freisthler, 2004; Gruenewald et al., 2006; Gruenewald & Remer, 2006; Nielsen & Martinez, 2003; Zhu et al., 2004). These analyses provide more accurate estimations of the effect of alcohol outlet density on crime (the degree of association between alcohol outlet density and crime is lower than otherwise, however is still positive and often statistically significant) (Britt et al., 2005).

Also of note is that all analyses involving administrative boundaries are subject to the Modifiable Areal Unit Problem (MAUP) (Openshaw, 1984). MAUP occurs when relationships between geographically continuous variables change with the imposition of arbitrary artificial boundaries. It can lead to misleading research findings because crime and alcohol outlet density is a function of the size, shape and orientation of the administrative boundaries being used. Small geographic units, like census blocks, are less prone to MAUP than the large units, however census blocks are often irregular in shape and have varying geographic areas, meaning care must also be taken when interpreting research results. One noteworthy study by

Connor et al., in press, developed alternative spatial methods to investigate the association between alcohol outlet density with patterns of alcohol consumption and harm in New Zealand that did not use administrative boundaries. Outlet density was calculated as the number of alcohol outlets within 1 km of a person's home. Adjusting for individual and neighbourhood socio-economic variables⁷, they found that the density of alcohol outlets was associated (although not significantly) with alcohol-related harm.⁸

As noted earlier, the present study had three aims. The first was to provide descriptive information about the number and proportion of assault incidents occurring *on and around* licensed premises. The second was to assess whether assaults are more likely to happen around licensed premises than elsewhere. The third was to determine the marginal effect of each additional liquor license granted on the number of assaults.

METHOD

STUDY AREA

The analyses were conducted on data from the Sydney LGA. This area was chosen because it has a large number of assault incidents, alcohol-related assault incidents and licensed premises relative to other LGAs in NSW. Sydney LGA contains the CBD of the city of Sydney, high-rise offices, large retail areas, entertainment areas including cinemas, restaurants and licensed premises and high and medium density residential areas.

LICENSED PREMISES DATA

Spatial analysis techniques were used to identify assault incidents occurring on and around licensed premises. The first step in doing this was to identify the location of licensed premises. Alcohol outlet data for 2007 were obtained from the NSW Office of Liquor, Gaming and Racing. There are 27 liquor licence types in NSW, some of which were excluded from the analyses. Several licence types, such as vigneron, brewer, wholesale and auction licenses, were excluded because they do not relate to the sale of alcohol direct to the public for consumption. Alcohol outlets with licenses for premises without a fixed geographic position were also removed from the data. These included vessel, aircraft, catering and special event licenses. All premises with an unknown certificate of registration were also removed from the data. Multiple bars located at the same venue and registered under the same licence were counted and geocoded as one premise. One hundred per cent of the premises were geocoded using MapInfo's MapMarker v14 software and StreetPro v12.5 digital street network database. Geocodes were derived from the street address

and premises name information. This allowed us to identify all relevant licensed premises occurring in and within 10 metres of the Sydney LGA boundary. Street centrelines often form the boundary for LGAs and if these borders were strictly applied then licensed premises situated on one side of the boundary road would be excluded from the analyses. Licensed premises located up to 10 metres beyond the study area boundaries were included in the analyses to ensure this did not occur.

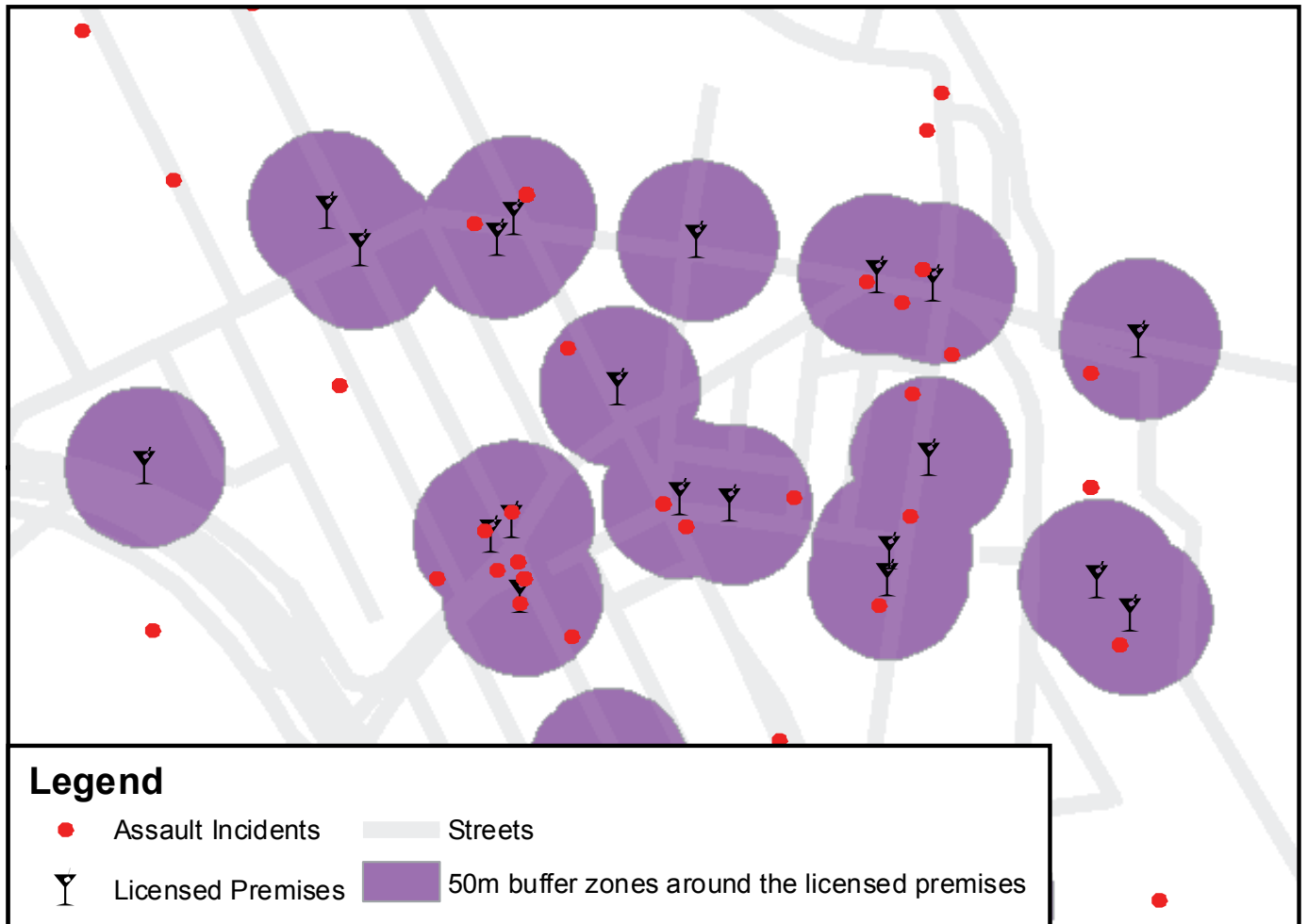
COMMERCIAL PREMISES DATA

Commercial premises were also used in the study as a comparison with licensed premises. Commercial premises data for 2007 were obtained from several online search engines, including Yellow Pages, UBD street directory, City Search and Google. Premises were excluded from the study if there was uncertainty about whether alcohol was served. The types of commercial premises included in the study were retail stores, executive offices, unlicensed cafes and restaurants, accommodation, hairdressers, solicitors, government offices, cinemas, theatres, financial institutions, doctors' surgeries, art studios, dry cleaners, tailors, travel agents and convenience stores. Premises were geocoded using Mapinfo's MapMaker v14 software according to the street address and premises name information. A sample of 864 commercial premises from the Sydney LGA was randomly selected, which is an equivalent number to the number of licensed premises in the area.

CRIME DATA

The dependent variable in the study was the number of assault incidents⁹ recorded by NSW Police Force on the Computerised Operational Policing System (COPS) in Sydney LGA in 2008. Incidents reported by police as occurring on all premises types were included in the analyses. Geocodes were assigned to incidents using the street address, place name or landmark information recorded in COPS, as detailed above.¹⁰ The same data extraction and geocoding process was also conducted for assault incidents occurring in the LGAs adjacent to the study area (Woollahra, Randwick, Botany Bay, Marrickville and Leichhardt). This was to protect against the 'edge effect' problem which can occur when a liquor outlet is located near the edge of the Sydney LGA boundary, affecting assault rates just outside that boundary. Assault incidents in the immediate vicinity of such an outlet could therefore be located outside the study area. Excluding these incidents from the analyses would assume that there were no assaults in these edge areas. Therefore to overcome the possibility of such bias, assault data located up to 210 metres¹¹ into the neighbouring LGAs were included in the analyses.

Figure 1. Sample of the study area showing 50 metre buffer zones around 21 licensed premises, forming 10 licensed premises clusters



CALCULATING THE PROPORTION OF ASSAULT INCIDENTS THAT OCCUR ON AND AROUND LICENSED PREMISES

The first set of analyses was designed to estimate the number and proportion of assault incidents occurring *on and around* licensed premises. The number of assaults on licensed premises can be directly obtained from COPS. To determine the distribution of assaults around licensed premises a GIS was used to create buffer zones around each alcohol outlet. The buffers were placed at 20, 50, 100 and 200 metre intervals and became the geographic unit of analysis. Figure 1 shows an example of the geographic units created by applying the 50 metre buffers in a section of the LGA.¹² Licensed premises with overlapping buffers were grouped together as one geographic unit, or cluster (see Figure 1). The number of assault incidents occurring within each cluster and all clusters within the study area as a whole, were then calculated.

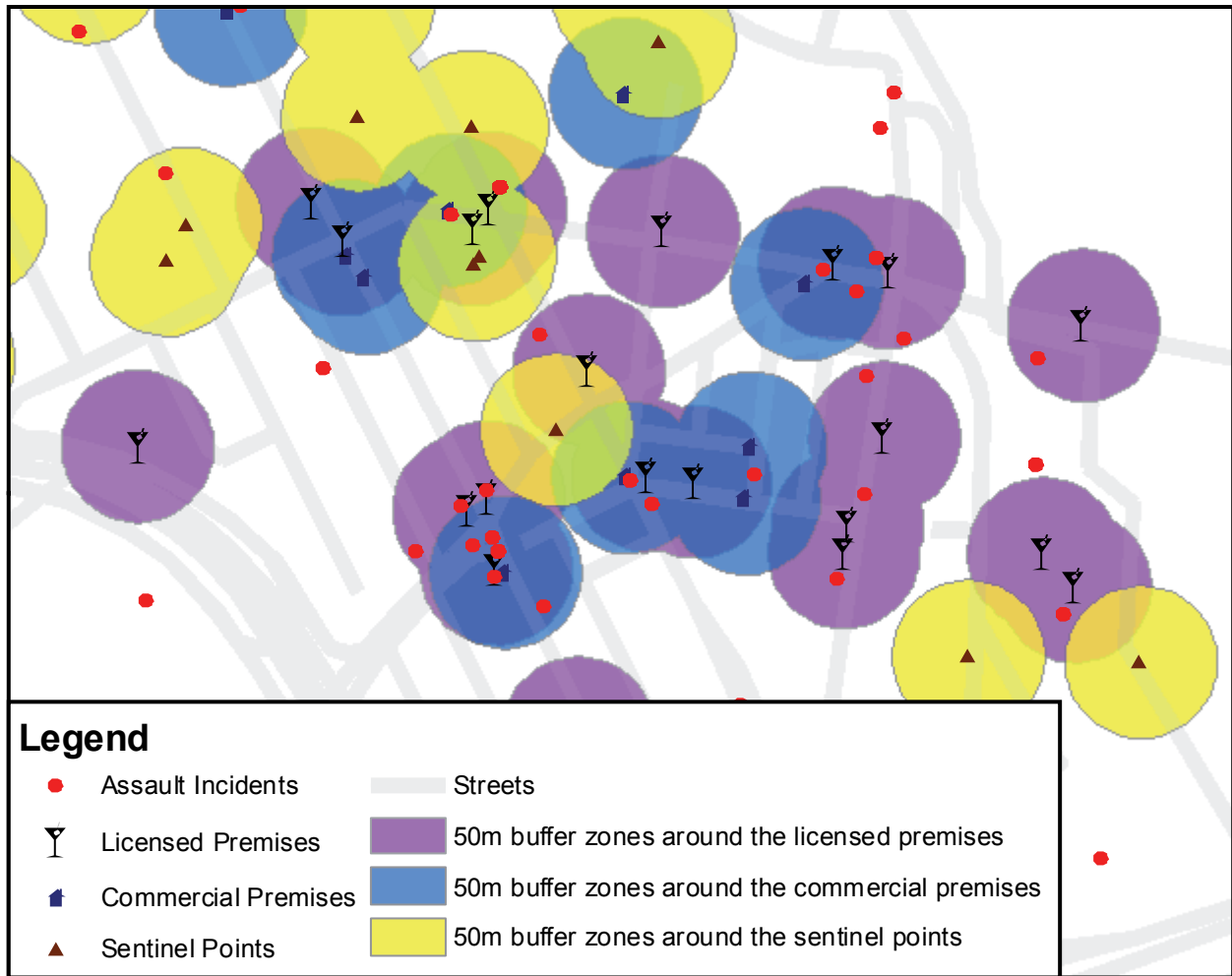
The decision to define areas by licensed premises clusters, rather than by administrative boundaries was taken partly

to overcome the effects of MAUP and partly to avoid spatial autocorrelation. Census collection districts and other administrative boundaries in Australia follow road centerlines and frequently split regions where licensed premises could be in close proximity, for example on opposite sides of a road or in entertainment districts. Using the area around groups of licensed premises as the geographic unit of analyses ensured that no clusters of licensed premises (including those in large entertainment districts) were disaggregated. Separate analyses were conducted to examine the effects of cluster number (number of alcohol outlets in a cluster) and cluster density (number of alcohol outlets per unit area).

DETERMINING WHETHER ASSAULTS ARE MORE LIKELY TO OCCUR IN THE VICINITY OF LICENSED PREMISES THAN IN OTHER LOCATIONS

The second analysis considered whether assaults were more concentrated on and around licensed premises than elsewhere. Three methods were employed to answer this question. The first

Figure 2. Example of the buffer zones forming 10 licensed premises clusters, six commercial premises clusters and eight sentinel point clusters



considered whether the land on and around licensed premises had more assaults than the land on and around a series of randomly selected (sentinel) points also located in the study region. A set of computer generated sentinel points, of equal number to the premises, were randomly distributed across the study region. As with the licensed and commercial premises, 20, 50, 100 and 200 metre buffer zones were drawn around each sentinel point. The calculations described above were repeated to determine the number and density of assault incidents located within the buffer zones around these sentinel points. If there was no relationship between the licensed premises and assault incidents, it would be expected that the proportion of incidents around the licensed premises would be similar to the proportion of incidents around these sentinel points.

The second method considered whether the area encompassing and surrounding licensed premises had a higher concentration of assaults than other parts of the LGA not in the vicinity of a liquor outlet. This was done by determining whether the number and density of assault incidents was higher or lower than

expected given the area of land in the immediate vicinity of a liquor outlet. If there was no relationship between the licensed premises and assault incidents, it would be expected that the proportion of assaults on and around the licensed premises (both in number and density) would be similar to the proportion of the total land area that falls around the licensed premises. To make this comparison, the land area falling within the buffer zone of all licensed premises was calculated as a per cent of the total land area of the study region. Buffers zones were created at 20, 50, 100 and 200 metres around each premise. A 'cluster' was created where there was overlap between the buffers surrounding two or more premises.

The third method considered whether the area on and around licensed premises had more assaults than the area on and around an equal number of unlicensed commercial premises located in the Sydney LGA. Buffer zones were also generated at 20, 50, 100 and 200 metres around each commercial premises (see Figure 2). The commercial premises were chosen without taking into account the nearby licensed premises and thus some

contained licensed premises within their buffer zone and some did not.¹³ This is illustrated in Figure 2. The number and density of assault incidents located within the buffer zones around the commercial premises was then calculated. If there was no relationship between licensed or commercial premises and assaults it would be expected that the proportion of incidents around the licensed premises (both in number and density) would be similar to the proportion of incidents around the commercial premises.

THE EFFECT OF ADDITIONAL LICENSED PREMISES IN AN AREA

When new licensed premises are added to an area, the corresponding influence on assaults may take the form of additional linear or non-linear increments. That is, there may be either constant, increasing or decreasing ‘returns to scale’. ‘Returns to scale’ is an economics concept that examines changes in output subsequent to a proportional change in input. If outputs increase by the same proportional change as the inputs then it is said that there are constant returns to scale. If output increases by less than the proportional change, there are decreasing returns to scale. If output increases by more than that proportion, there are increasing returns to scale.

The unit of analysis (buffer zone) used for this investigation comprised the land area 100 metres around each alcohol outlet. The size of the unit of analysis is somewhat arbitrary but analyses using larger and smaller units of analysis produced similar results. Where two alcohol outlets were located within 100 metres of each other, the buffers were joined forming a cluster of two or more licensed premises (see Figure 1). Only licensed premises buffers that contained an assault incident were included. The independent variable in the analysis was the number of licensed premises in the cluster area. The dependent variable was the number of assault incidents in the cluster area. Of interest was whether increasing the number of licensed premises within 100 metres of each other disproportionately affected the number of assault incidents in the buffer. This question was examined by regressing licensed premises collection unit (buffer) size on the number of assaults using a regression model expressed in log-log form. The expected number of assaults will equal some constant (α) times the licensed premises collection unit size to the power of β (return to scale). That is;

$$\begin{aligned} &\text{Expected number of assaults} \\ &= \alpha (\text{number of licensed premises})^\beta \end{aligned}$$

If β is greater than one, increasing returns to scale are present, if β is less than one, decreasing returns to scale are present and if β equals one then constant returns to scale are present. This

analysis also indicates the number of additional assaults that can be expected to be reported to police for each additional alcohol outlet in a cluster of premises located within 100 metres of one another.

RESULTS

WHAT PROPORTION OF ASSAULT INCIDENTS OCCUR ON AND AROUND LICENSED PREMISES?

Figure 3 shows the location of licensed premises, the 50, 100 and 200 metre buffers around the licensed premises and the parts of Sydney with high concentrations of assault.¹⁴ The figure shows that, while licensed premises occur throughout the LGA, their distribution is not evenly spread and there are dense clusters throughout the Sydney CBD around Darlinghurst Road in Kings Cross, along Oxford Street in Darlinghurst, along King Street in Newtown and along Glebe Point Road in Glebe. Figure 3 also shows that the parts of the LGA with the highest concentration of assault are in Kings Cross, Oxford Street in Darlinghurst and along George Street in the CBD.

Nineteen per cent of assault incidents in the Sydney LGA, 2008, were recorded by police as occurring on a liquor outlet. This is almost double the 9 to 10 per cent of assault incidents that were recorded by police as occurring on licensed premises across NSW in the Briscoe and Donnelly, (2001b), and Fitzgerald et.al., (2010) studies. In Sydney LGA in 2008, licensed premises were the third most frequent premises type at which reported assault incidents occurred, following outdoor public/space with 42 per cent of incidents and residential premises with 20 per cent of incidents.

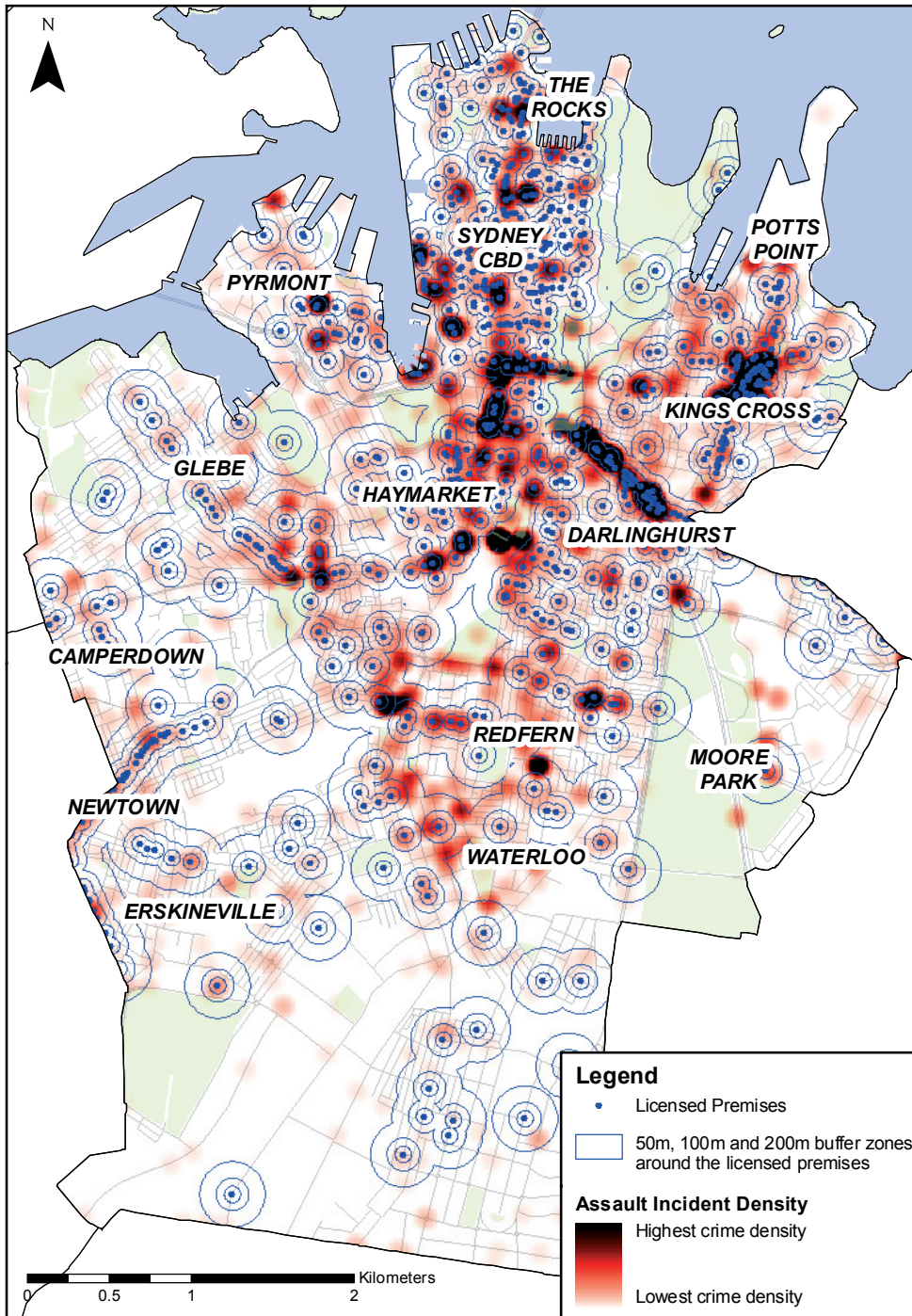
Table 1 shows the number and proportion of assaults occurring on or around licensed premises in the Sydney LGA in 2008. Virtually all the assaults recorded by police in the Sydney LGA in 2008 occurred within 200 metres of a liquor outlet. This may be

Table 1. Number and proportion of assault incidents occurring on and around licensed premises compared with land area, Sydney Local Government Area

Buffer distance around the licensed premises	Assault incidents around licensed premises	Assault incidents around licensed premises
	n	%
20m	2,047	37.0
50m	3,157	56.8
100m	4,200	74.9
200m	5,265	92.8

Note: Geocoded incidents and licensed premises only.

Figure 3. The distribution of assault incidents and licensed premises clusters in Sydney LGA



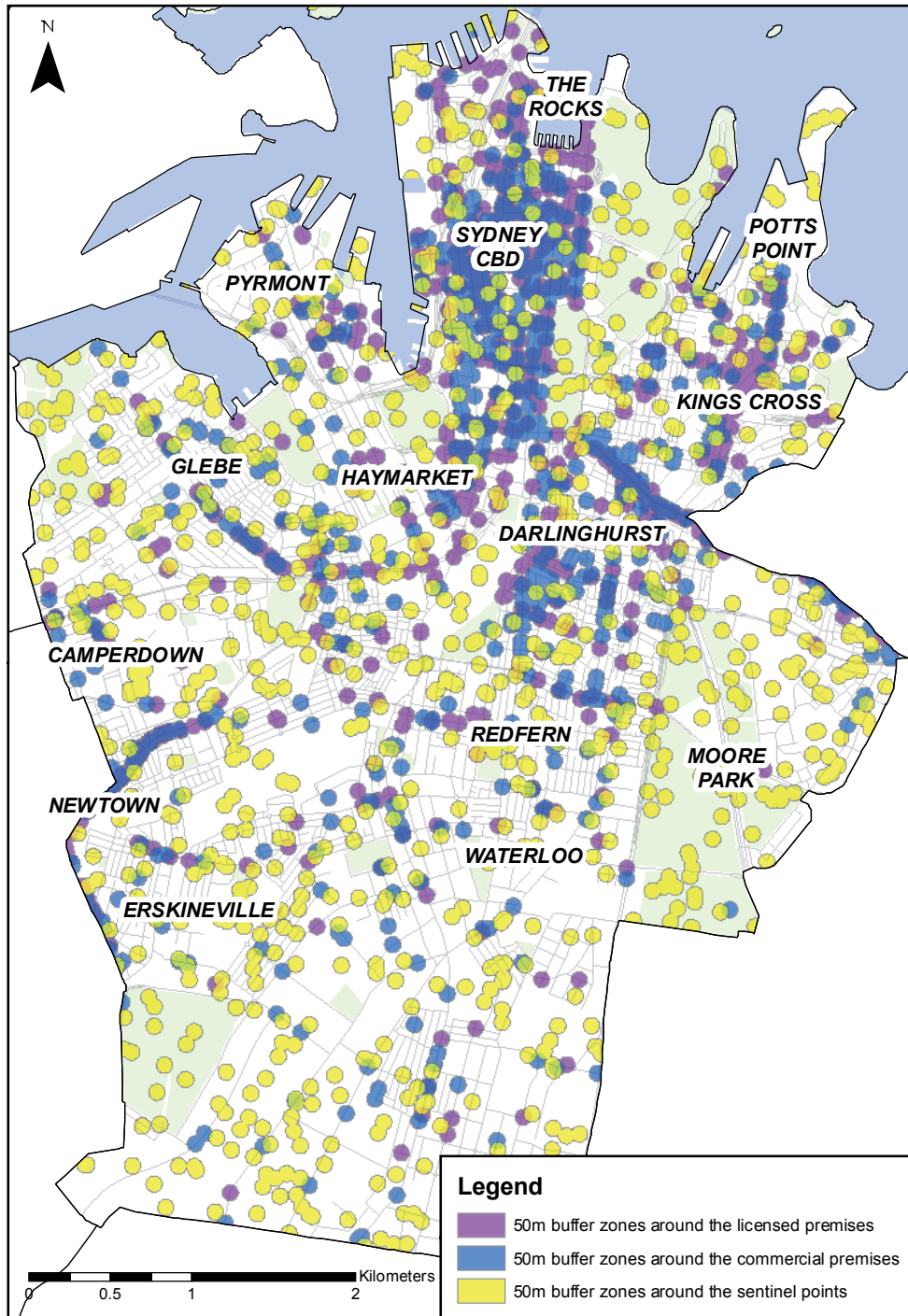
unsurprising given the number of alcohol outlets in Sydney. More than half of the assaults, however, occurred within 50 metres of a liquor outlet. It can be seen that 37 per cent of assaults in Sydney LGA occurred within 20 metres of a liquor outlet. This is considerably higher than the 18 per cent recorded by police as actually occurring on a liquor outlet. In the next section we assess whether this proportion is more than would be expected by chance.

ARE ASSAULTS MORE LIKELY TO HAPPEN AROUND LICENSED PREMISES THAN ELSEWHERE?

The sentinel point analysis

Figure 4 shows the distribution of the licensed premises, commercial premises and sentinel points across the Sydney LGA. The randomly selected commercial premises are distributed more widely across the LGA than are the licensed premises, although

Figure 4. The distribution of licensed premises clusters, commercial premises clusters and sentinel point clusters in Sydney Local Government Area



there are still significant clusters, often in similar areas to the licensed premises. As would be expected, the random sentinel points are well dispersed across the LGA, much more so than the licensed premises and commercial premises.

To determine whether the concentration of assaults was disproportionately high, we compare the results in Table 1 with the percentage of assaults around the sentinel points (both in number and density of incidents).

The number and density of assault incidents occurring within 20, 50, 100 and 200 metres of the 864 sentinel points is shown in Table 2. The proportion of assaults proximate to the sentinel points is very similar to the land area. For instance, three per cent of assault incidents are located within 4 per cent of the Sydney LGA (20 metre buffer) and 22 per cent of assault incidents are located within 21 per cent of the Sydney LGA (50 metre buffer). The expected assault incident count to land area (per hectare) ratio is therefore roughly 1 to 1.

Table 2. Number and proportion of assault incidents occurring on and around the sentinel points compared with land area, Sydney Local Government Area

Buffer distance around the sentinel points	Assault incidents around the sentinel points	Assault incidents around the sentinel points	LGA area within the sentinel points buffer distance
	n	%	%
20m	176	3.2	3.8
50m	1,238	22.3	20.7
100m	3,556	63.6	56.3
200m	5,506	97.2	86.5

Note: Geocoded incidents only.

Table 3. Number and proportion of assault incidents occurring on and around licensed premises compared with land area, Sydney Local Government Area

Buffer distance around the licensed premises	Assault incidents around licensed premises	Assault incidents around licensed premises	LGA area within the licensed premises buffer distance	Change in per cent of assault incidents around the licensed premises	Change in per cent of the LGA area within the licensed premises buffer distance
	n	%	%	%	%
20m	2,047	37.0	3.0	N/A	N/A
50m	3,157	56.8	12.9	19.8	9.9
100m	4,200	74.9	29.2	18.1	16.3
200m	5,265	92.8	51.3	17.9	22.1

Note: Geocoded incidents and licensed premises only.

THE LAND AREA ANALYSIS

Table 3 shows the number and density of assault incidents occurring within 20, 50, 100 and 200 metres of a liquor outlet in Sydney LGA.

Table 3 shows that a disproportionately high number of assaults occur within the 20, 50, 100 and 200 metre buffer zones around licensed premises. For example, the area within 20 metres of a liquor outlet has 37 per cent of the assault incidents in Sydney LGA, yet accounts for just three per cent of the land area. This equates to approximately 25 assault incidents per hectare, much higher than the count of one incident per hectare around the randomly located sentinel points. The larger the buffer zone, the smaller the discrepancy, indicating that the concentration of assaults is greatest in the immediate vicinity of the licensed premise. For example, in the 20 metre buffer zone the assault rate was more than 12 incidents (37 / 3) for each one per cent of the total LGA land area falling within that buffer zone. In the 200 metre buffer zone by contrast, the assault rate was reduced to about 1.8 incidents (92.8 / 51.3) per one per cent of land area. The final two columns provide another way of looking at the effect of licensed premises. Expanding the buffer zone around the licensed premises from 20 to 50 metres increases the land area by 10 per cent, yet the number of assaults in the cluster

rises by 20 per cent. Expanding the buffer zone again from 50 to 100 metres and then to 200 metres, the size of the increase in assaults is more commensurate with the increase in land area. This suggests that assaults are more densely clustered near licensed premises than further away.

The other commercial premises analysis

It could be argued that the pattern shown in Table 3 is not unique to licensed premises and that larger numbers of assaults would be found next to any commercial premises where people congregate. Table 4 shows the number and density of assault incidents occurring within 20, 50, 100 and 200 metres of 864 randomly selected commercial premises located in the Sydney LGA. The table compares the number of incidents around licensed premises at different buffer distances (see Table 3).

An examination of Table 4 provides some support for the hypothesis that the risk of assault increases with proximity to any commercial premises. Seventeen per cent of assaults occur within 20 metres of the randomly selected commercial premises. The area within this radius, however, accounts for only three per cent of the land area of the LGA. As with the licensed premises, the density of assault incidents is greatest in the immediate vicinity to commercial premises and diminishes with increasing

distance. Close inspection of Tables 3 and 4, however, shows that the concentration of assault incidents around commercial premises is not nearly as great as it is around licensed premises. Thus, while the 13 per cent of Sydney LGA that falls within 50 metres of one of the sample commercial premises accounts for 39 per cent of assaults, the 13 per cent of Sydney LGA that falls within 50 metres of licensed premises accounts for 57 per cent of assaults.

Overall, these results suggest that assaults are not evenly distributed across the LGA and are more likely to occur in the vicinity of places where people congregate, such as licensed or commercial premises. However, assaults were more concentrated around the licensed premises than other forms of commercial premises.

WHAT IS THE EFFECT OF EACH ADDITIONAL ALCOHOL OUTLET ON THE NUMBER OF ASSAULTS?

We turn now to the final aim of this bulletin, the effect of additional licensed premises on the number of assaults. A 100 metre buffer was placed around each licensed outlet in the LGA, creating 77 clusters of licensed premises, which became the geographic units of this analysis. Twelve of the 77 clusters had no assaults and were necessarily omitted from the analysis. The characteristics of the remaining 65 collection units are shown in Table 5.

As noted earlier, to estimate the impact of additional licensed premises we fit the following equation to the data:

$$\text{Expected number of assaults} = \alpha(\text{no. of alcohol outlets})^\beta$$

The fitting process yielded estimates of $\alpha = 3.87$ and $\beta = 1.001$.¹⁵ The fact that the return to scale parameter is so close to one means that the expected number of assaults in a cluster of licensed premises defined by a 100 metre buffer distance will double if the number of alcohol outlets doubles and triple if the number of alcohol outlets triples. Thus the impact of additional alcohol outlets on the number of assaults is constant, regardless of the existing density of alcohol outlets. The analysis suggests that, on average, for any year, the expected number of recorded assaults in a buffer unit will be approximately 3.87 times the number of alcohol outlets within the 100 metre buffers.¹⁶ Put another way, each additional alcohol outlet per hectare will result, on average, in an additional 1.38 recorded assaults per annum. Recorded assaults, however, are only a small subset of all assaults that occur. To obtain a more realistic picture of the effect of each additional alcohol outlet we need to scale up 1.38 by the proportion of assaults that are not reported to police. The 2008 Crime and Safety Survey in NSW (Australian Bureau of Statistics, 2010) indicated that only 31 per cent of assaults are reported to police. If this is true of the Sydney LGA, then each additional alcohol outlet would result in an average of 4.5 additional assaults per annum.

Table 4. Number and proportion of assault incidents occurring on and around commercial premises compared with land area, Sydney Local Government Area

Buffer distance around the commercial premises ^a	Assault incidents around commercial premises	Assault incidents around commercial premises	LGA area within the commercial premises buffer distance
	n	%	%
20m	951	17.2	2.8
50m	2,153	38.8	12.5
100m	3,636	65.0	30.2
200m	5,200	91.8	56.5

Note: Geocoded incidents and commercial premises only.

Table 5. Characteristics of the 65 collection units based on 100 metre buffers around licensed premises in the Sydney Local Government Area

	Number of collection units	Mean per collection unit	Std. Dev.	Min	Max
No. of assault incidents	65	48.0	137.2	1.0	738.0
No. of alcohol outlets	65	10.7	34.9	1.0	243.0
Area (ha)	65	10.9	25.6	2.8	177.1

CONCLUSION

This study shows that in the Sydney LGA assaults are more likely to occur around licensed premises than elsewhere. This is supported by the findings that the concentration of assaults:

- is considerably higher in close proximity to licensed premises than it is further away from licensed premises; and
- is higher around licensed premises than it is around commercial (unlicensed) premises or randomly selected points.

Our findings also suggest that the concentration of licensed premises is strongly associated with the number of recorded assaults, and that the association is linear. Assuming the association is causal, doubling the number of licensed premises in an area is likely to result in a doubling of the number of assaults. Conversely halving the number of licensed premises would halve the number of assaults. We did not find evidence of a threshold or ceiling effect such that the effects should not be dependent on the base rate of assaults. The findings are inconsistent with those of Livingston (2008b) who analysed data from Greater Melbourne in 2001. Livingston found that as the outlet density of pubs in a postcode increased it reached a critical point after which violence increased sharply. A key difference however in the two studies is that Livingston specifically excluded the Melbourne CBD whereas our study was restricted to this area within Sydney.

There are several qualifications to our findings that should be taken into account when interpreting them. Firstly, this is a cross-sectional rather than longitudinal study. Cross-sectional studies tell us nothing about the timing of events and are therefore inherently inferior to longitudinal studies in gauging causal effects.

Secondly, the estimated four to five additional assaults per one additional alcohol outlet per hectare is an average across all of the licensed premises in Sydney LGA. It should not be assumed that this effect is constant for all alcohol outlets. The effect of an additional alcohol outlet will depend on factors such as the quantity of alcohol sold, the level of adherence to responsible service guidelines, the type of license, the trading hours, patron numbers, patron demographics, type of beverage consumed, environmental characteristics of the drinking setting and so forth. The average is also only relevant to Sydney LGA as a whole. The effect of establishing additional alcohol outlets may vary between neighbourhoods in the LGA.

Thirdly, the estimate of four to five assaults per hectare ignores the fact that a large proportion of the land area in the Sydney LGA is covered with buildings. In reality the majority of assault

incidents (42 per cent) take place in public outdoor spaces and thus the four to five additional assaults will actually occur in an area much smaller than a hectare.

Fourthly, in our analysis we attempted to isolate the impact of licensed premises on assault by comparing assaults around licensed premises with the number around commercial premises. It is still possible, however, that there are other factors which co-occur with licensed premises which affect the frequency of assaults which we haven't considered. For instance, it is possible that people who frequent alcohol outlets (or thereabouts) have only an average risk of assault but the sheer volume of people in those areas accounts for the high concentration of assault. Alternatively, many assaults might be occurring at bus stops or taxi ranks which also happen to be located near licensed premises. Recent evidence has pointed to the effectiveness of trading restrictions (Jones et al., 2009) or the threat of trading restrictions (Moffatt et al., 2009) in reducing violence on licensed premises. This study suggests that with so many assaults occurring not just on but around the premises, the impact of such measures may be even higher still.

Future research could consider the different business hours between licensed and other premises. For example, unlicensed commercial premises are often open during the day and closed during the night, while the reverse is generally the case for licensed premises. Briscoe and Donnelly (2001b) showed that the majority of assault incidents in NSW took place during night time periods. The changes in premises operating hours and the higher frequency of assault incidents at night could mean that the differences between assault densities around licensed and commercial premises is even greater than the present results indicate.

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NOTES

1. Briscoe and Donnelly's (2001b) study examined assault incidents in NSW over the two year period from July 1999 to June 2000.
2. Harm indicators included assaults, drink-driving offences, alcohol-attributable hospitalisations and alcohol-attributable deaths.
3. This was after controlling for economic factors, age, race, urbanity and social structures within the cities.
4. However when re-analysing these data at the smaller census tract data, Speer et al. (1998) found that alcohol outlet density was related to violent crime (homicide, rape, aggravated assault and robbery). Their results indicated that a 1 per cent decrease in outlet density (measured as a density per 100 persons) was associated with a 1 per cent decrease in violent crime.
5. However this was not evident in all neighbourhoods once controls for local social and environmental characteristics were used (Lipton & Gruenewald, 2002; Gruenewald et al., 2006).
6. Livingston's (2008a) study examined assault incidents in 186 postcodes from the greater Melbourne region over the period from 1996 to 2005.
7. These variables included sex, educational level, a deprivation index and a rurality index.
8. Self-reported harms generally ranged from whether the respondents' drinking has had a harmful effect on their work, family and social life.
9. This study employs the definition of assault defined by the Australian Bureau of Statistics as "the 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". Incidents classified as assault include the NSW police incident categories recorded in COPS as actual bodily harm, common assault, assault officer, grievous bodily harm (including malicious wounding) and shoot with intent other than to murder. Assault incidents flagged as domestic violence related are included in the analyses. The counting units are recorded criminal incidents rather than recorded offences. A recorded criminal incident is defined as an activity detected by or reported to police which: involved

the same alleged offender(s), involved the same alleged victim(s), occurred at the one location, occurred during one uninterrupted period of time, falls into one offence category and falls into one incident type (for example, 'actual', 'attempted', 'conspiracy').

10. Seventy-three per cent of assault incidents were geocoded to the place name, landmark or exact street address described in COPs, twenty seven per cent were geocoded to the street and less than 0.5 per cent were not geocoded.
11. The distance of 210 metres allows for a 200 metre buffer around licensed premises occurring on the LGA boundary plus an additional 10 metres accounting for the edge effect problem.
12. Buffer zones were calculated using Euclidean rather than Manhattan distance due to software limitations.
13. This was to ensure that the results were not biased by the presence or absence of licensed premises around the selected commercial premises.
14. The 20 metre buffers are not displayed as they are not clearly visible at the map scale.
15. The upper (UC) lower (LC) 95% confidence intervals for each parameter were as follows:

	LCL	UCL
α	2.93	5.11
β	0.82	1.18

16. This result stayed statistically consistent even when three influential observations were removed from the group.

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