EPIDEMIOLOGY

Do Community Characteristics Predict Alcohol-Related Crime?

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Abstract — Aims: Alcohol-related crime is a substantial community problem. There is evidence to suggest that certain geographic areas experience higher rates of alcohol-related crime and that both individual and community factors are associated with alcohol-related crime. There is limited research at the community level despite communities being the target of interventions designed to reduce alcohol-related harm. This study aims to determine whether there are differences in alcohol-related crime at the community level and examines whether certain community characteristics are associated with increased alcohol-related crime. Methods: Routinely collected police data from 20 rural communities in New South Wales, Australia were analysed. The ratio of alcohol to non-alcohol-related criminal incidents was used as a proxy for alcohol-related crime. Predictor variables were population-adjusted community characteristics, including demographic and resource variables. Results: Regression analyses suggest that there are differences between communities in alcohol-related crime. Less socioeconomic disadvantage and more GPs and licensed premises (pubs and clubs) are associated with greater alcohol-related crime at the community level. Conclusions: Decreasing the socioeconomic well-being of a community is not appropriate; however, introducing additional taxes to increase the cost of alcohol may decrease consumption and therefore alcohol-related crime. Reducing or capping the number of pubs and clubs, specifically the number of pubs and clubs, may be an appropriate strategy to reduce alcohol-related crime in rural communities.

INTRODUCTION

The negative acute consequences of alcohol consumption (such as road traffic accidents and violence) are prevalent, costly and cause substantial public concern (World Health Organisation, 2000). In Australia, for example, the annual social cost of alcohol-related harm for 2004/2005 has been estimated at $15,318 million, second only to tobacco for all drug-related costs. Alcohol-related crime accounted for 15% of all alcohol-related harm at an estimated cost of $1612 million (Collins and Lapsley, 2008).

Individual characteristics, including age, gender, ethnicity, poverty and unemployment, have been found to be associated with both alcohol consumption and crime (Williams, 2001; Australian Institute of Health and Welfare, 2005). Historically, attempts to reduce alcohol-related harm have targeted individual-level risk factors. Recent interest has focused on identifying community characteristics that promote alcohol-related crime, and for which community-level interventions are appropriate (Holder, 2000).

Most research examining the relationship between community characteristics and alcohol-related crime shows greater alcohol availability, and outlet density are associated with increased rates of violence, assault, property damage and public disorder, controlling for demographic and socioeconomic factors (Stevenson et al., 1999a; Briscoe and Donnelly, 2003; Donnelly et al., 2006; Gruenewald et al., 2006; Livingston, 2008; Ray et al., 2008). Although cross-sectional studies into alcohol sales or outlet density and crime largely show significant positive relationships, the specifics of the relationship vary between communities (Livingston et al., 2007). The relationship between the density of bars and violence, for example, is moderated by local community characteristics: increased bar density is related to increased violence in poor and rural middle-income areas, but not otherwise (Gruenewald et al., 2006).

Relationships between community characteristics and alcohol-related crime are largely based on routinely collected police or hospital data. These data are advantageous for community-level research as they are low cost, often collected at the postcode level and can be used retrospectively (Treno and Holder, 1997). In Australia, routinely collected police data provide a measure of alcohol involvement in crime with alcohol-related offences flagged as such in police databases. As the decision to flag an incident as alcohol-related in the police database is a subjective judgement by individual officers at a particular time and is strongly influenced by policing practices (Brinkman et al., 2001), the reliability of this measure for examining crime differences between location or over time is problematic.

Surrogate or proxy measures have been developed to improve the reliability and validity of trend analysis and have been widely used to examine alcohol-related harms (Wagenaar and Holder, 1991; Holder and Wagenaar, 1994; Treno and Holder, 1997), including examining national and state trends in alcohol-related violence in Australia (Matthews et al., 2002). These measures do not allow for prevalence estimates but enable analysis over time. They have not been utilized at the community level, although recent research into the utility of community-level measures established a reliable proxy measure for alcohol-related crime that incorporates the ratio of assaults and public nuisance offences occurring at times likely to involve alcohol to the same offences occurring at times that are not likely to involve alcohol (Breen et al., 2011a).

A large-scale randomized controlled trial involving 20 rural communities in NSW, Australia, provided an ideal opportunity to build on existing research by examining the likely effect of a broader range of community characteristics on alcohol-related crime. Rural communities are uniquely relevant for such analyses as there is evidence of differential consumption and alcohol-related harm in regional areas.
compared with metropolitan areas in Australia (Stevenson et al., 1999a,b; Chikritzhs et al., 2003) though rural areas have received relatively little research attention. This study investigates differences in alcohol-related crime at the community level and examines whether community characteristics are associated with increased alcohol-related crime.

METHODS

Data sources and definitions

Communities

Rural communities in NSW, Australia were considered for participation in the Alcohol Action in Rural Communities (AARC) project if they had an urban-centre locality population between 5000 and 20,000, were at least 100 km away from a major urban centre (population ≥ 100,000) and were not currently involved in another public health project for alcohol harm (n = 20). The population size of the communities that is defined by 2001 census Postal Area (POA) information ranged from ~6500–29,000.

Crime data

NSW Police data on recorded criminal incidents in the communities for the 5-year period from January 2001 to December 2005 were examined. De-identified unit record data of each criminal incident were provided by the Bureau of Crime Statistics and Research (BOCSAR). Incidents were selected on the basis of the postcode in, and the date on, which they occurred.

A criminal incident is defined as an activity detected by, or reported to, police, which: involves the same offender(s), involves the same victim(s), occurred at one location, occurred during one uninterrupted period of time, falls into one offence category or falls into one incident type (e.g. ‘actual’, ‘attempted’, ‘conspiracy’) (Bureau of Crime Statistics and Research New South Wales).

Alcohol-related crime measure

Time of day has been shown to be useful in determining the likelihood of alcohol involvement in crime (Ireland and Thommeny, 1993; Briscoe and Donnelly, 2003; Palk et al., 2007). A proxy measure of alcohol-related violence used to examine state trends in Australia (Matthews et al., 2002) identified specific types of crimes that occur at specific times, relative to the same crimes that occur at non-alcohol-related times. The current study uses the same time periods defined as alcohol-related and non-alcohol-related (Chikritzhs et al., 2000), but includes a greater number of crimes, capturing a greater proportion of alcohol crime while maintaining the reliability of the measure (Breen et al., 2011b).

Alcohol crimes

The alcohol-related crime types used in this study are: assaults (actual bodily harm, grievous bodily harm and common assault), sexual assaults (sexual assault, aggravated sexual assault, indecent assault or act of indecency, aggravated indecent assault or act of indecency), malicious damage (malicious damage to property) and street incidents (offensive conduct, offensive language and wilful and obscene exposure) (Breen et al., 2011a).

Alcohol and non-alcohol-related offence times

Incidents were defined as alcohol-related if they occurred between: Sunday 10pm–Monday 6am, Monday 10pm–Tuesday 2am, Wednesday 10pm–Thursday 2am, Friday 10pm–Saturday 6am and Saturday 6pm–Sunday 6am.

Non-alcohol-related incidents were defined as those that occurred between: Monday 6am–Monday 6pm, Tuesday 6am–Tuesday 2pm, Wednesday 10am–Wednesday 2pm, Thursday 6am–Thursday 2pm, Friday 6am–Friday 10am.

There are equal number of hours in the alcohol and non-alcohol time periods, but not all hours are covered by these definitions.

Community variables

Community-level variables were extracted from data available from the Australian Bureau of Statistics. POA census data for 2001 for the 20 communities were used as this study focuses on individuals’ communities. In addition, the use of this geographic unit corresponds with the unit for the outcome measure (crime).

Information on the proportion of young males (aged 15–24 years) and the proportion of indigenous people was extracted from census data for each community (Australian Bureau of Statistics).

Geographic characteristics were indexed through the Accessibility/Remoteness Index of Australia (ARIA) score. ARIA scores incorporate the concept of remoteness based on the distance that people must travel by road to get to services centres (areas where they can access goods and services and interact socially). Mean scores for postcode were obtained (Australian Department of Health and Ageing). Low scores indicate greater accessibility (i.e. less remote).

Socioeconomic characteristics of each postcode were indexed through the Socio-Economic Indexes For Areas (SEIFA) disadvantage deciles (Australian Bureau of Statistics, 2004). The SEIFA disadvantage deciles are derived from census data and summarize the socioeconomic well-being of an area. It is the most general SEIFA score and includes all census variables that either reflect or measure disadvantages such as income, educational attainment, unemployment and wealth (e.g. owning a car, number of bedrooms in a dwelling). Low scores indicated high levels of disadvantage and high scores show relatively low disadvantage within the area. The score summarizes the socioeconomic well-being of an area, rather than any individual within that area.

The number of licensed premises were extracted by postcode from information published by the NSW Office of Gaming and Racing in 2004 (Gaming and Racing A NSW Government Department, 2004). Due to evidence of differential harm associated with license type (Stockwell et al., 1992), the number of pubs and clubs, the number of wholesalers and retailers and the number other licensed premises (airport, function centres, motels, restaurant, theatre, vignerons and on-off-wine) were considered as distinct variables.

The number of full-time police officers and highway patrol officers was collated from information provided by the Police Local Area Command. The number of general
practitioners was obtained by searching the electronic telephone directory for each community and cross-checking with the relevant Divisions of General Practice.

The proportion of individuals identified at drinking at risky levels for alcohol-related harm in the short and long-term (National Health and Medical Research Council, 2001) and those identified as having harmful or hazardous alcohol use as measured by the Alcohol Use Disorders Identification Test (AUDIT) (Saunders et al., 1993) were obtained for each community from a community survey 3017 randomly selected community members (Breen et al., 2010).

**Statistical methods**

Rates per 10,000 population were derived for community characteristics that examined a number of specific resources (e.g. licenses, GPs and police). The average of the population recorded for the 2001 and 2006 censuses was used as the denominator for these calculations.

**Ratio method of defining alcohol-related crime**

Alcohol-related crime is estimated as the ratio of incidents occurring at alcohol-related times relative to the same incident type occurring at non-alcohol-related times.

This ratio method (Matthews et al., 2002) minimizes the impact extraneous variables (such as police activity) may have on the consistency in reporting.

For each community and for each year from 2001–2005, the ratio of the crimes in alcohol times to the crimes in non-alcohol times was calculated. The mean crime ratio for the years 2001–2005 was calculated for each community (Fig. 1). The period 2001–2005 was utilized as it was the baseline period prior to the introduction of interventions aimed at reducing alcohol-related harm. The average crime ratio is treated as a continuous variable with a normal distribution.

**Spatial autocorrelation**

Postcodes that are close in proximity to each other may be more similar and lack independence, leading to a failure of spatial autocorrelation. This was investigated using CrimStat III (Levine, 2009). The latitude and longitude for each community were applied and tested with the outcome variable. Autocorrelation was tested using Moran’s I statistics on a standardized Z score assuming independence among outcome variables of interest.

**Linear regression analyses**

Analysis was conducted using SAS 9.2 (SAS Institute, 2002–2008). Univariate regression models were used to identify community characteristics that were significantly associated with the crime ratio. Variables with $P < 0.25$ (Hosmer and Lemeshow, 1989) were considered for inclusion in the multivariate linear regression model constructed to identify community-level variables that explain the heterogeneity in ratios of alcohol-related crime. The least significant variable (greatest $P$-value) was removed, and the new model fitted and checked for confounding until the final model, containing only those variables where $P \leq 0.05$, was obtained.

Regression diagnostics were examined for each model to ensure that residual errors were normally distributed. The presence of multicollinearity was investigated using the variance inflation factor. Correlation coefficients indicated the amount of variance accounted for by each individual variable.

**RESULTS**

The Moran’s I test for spatial autocorrelation was found not to be significant ($I = 0.0007$) and this, with the $Z$ score of 0.44, indicates that there is no spatial clustering for the

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**Fig. 1.** Average crime ratio$^1$ for 20 AARC towns 2001–2005. $^1$Average annual crime ratio defined as number of crimes in alcohol times over the number of crimes in non-alcohol times.
on average, there were 2.2 crimes that occurred in alcohol-related times. Analyses of incidents, by offence type and alcohol time, included in the crime ratio. The average crime ratios for the 20 communities ranged from 1.15 to 3.68 (mean 2.2, SD 0.62; Fig. 1), indicating that, on average, there were 2.2 crimes that occurred in alcohol-related time to every one in a non-alcohol-related time.

Table 1 presents the descriptive statistics for the number of incidents, by offence type and alcohol time, included in the crime ratio.

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Table 2 presents the descriptive statistics for the community-level measures used in the linear regression analyses.

Community characteristics considered in the linear regression analyses were: SEIFA disadvantage decile, proportion indigenous, and number of pubs and clubs, other licensed premises and GPs per 10,000 population. There was a linear association between community variables and the crime ratio.

The final model selected had no multicollinearity and the residuals were normally distributed. The regression model selected indicates that 74% of the variance in crime ratios is accounted for by: a measure of socioeconomic disadvantage (SEIFA disadvantage index), the number of GPs and pubs and clubs per 10,000 population ($F = 14.98$, $P < 0.0001$; Table 3).

The final model suggests that an increase in SEIFA decile (indicating less disadvantage) and increases in the number of pubs and clubs and GPs are associated with increased alcohol-related crime.

### DISCUSSION

This study examined community characteristics that may account for differences in alcohol-related crime for 20 communities in rural NSW. The analyses found the model that incorporated a measure of socioeconomic disadvantage, the number of GPs and the number pubs and clubs per 10,000 population, accounted for the majority (74%) of the variability in alcohol-related crime.

#### Methodological considerations

A number of methodological considerations are worth noting. First, the analyses were limited to 20 communities and therefore the generalizability of the findings needs to be considered as well as the small sample size increasing the potential for Type II error, i.e. the failure to find a relationship between a community characteristic and alcohol-related crime when a relationship exists. Significant relationships were detected despite the small sample size, although it is possible that others were not detected.

Secondly, the average crime ratio for 2001–2005 was used in this analysis, as the focus was examining differences between locations. Community variables were available for one time point (or in some cases, two) and preliminary investigation of the crime ratios for 6 monthly interval (2001–2005) showed no change over time (Breen et al., 2011a); therefore the data for 2001–2005 were collapsed.

The validity of the measure is unknown, and the difficulty of quantifying validity is evidenced by the lack of published validation studies (Ireland and Thommeny, 1993; McClelland and Teplin, 2001; Palk et al., 2007). The types of crimes selected have consistently been found to involve alcohol. The measure used was found to have greater utility for examining differences between locations than previously used measures (Breen et al., 2011b). Previous research used serious assault offences as a proxy for alcohol-related crime; however, at the community level there are a limited number of these offences affecting the usefulness of examining them in isolation. Research at the community level is important; however, the appropriateness of using existing proxy measures for smaller geographical units needs consideration and measures may need to be adapted.

The crime ratio included types of crime (assaults, sexual assaults, malicious damage and street offences). It could be argued that the severity of the crime is more important than the number of incidents. Communities may appear similar with regard to number of incidents but they may differ in severity (e.g. all serious assaults compared with all offensive behaviour incidents). To account for this possibility, regression analysis was conducted using a crime-cost ratio in...
which the number of each type of crime was multiplied by the estimated cost, based on cost per incident (J. Brynes et al., submitted for publication). The same community variables (socioeconomic disadvantage, the number of GPs and pubs and clubs per 10,000 population) remained in the final model, which accounted for 73% of the variability in alcohol-related crime.

The data in this study were aggregated and a ratio derived. Research analysing incident level data, thus accounting for the multi-level nature of the data, could be considered. These analyses would examine the association of the community characteristics with crimes that have been committed in alcohol-related crime.

The study findings of increased alcohol-related crime in communities with less socioeconomic disadvantage and more GPs and pub licenses, has the potential to guide community-level interventions and policies.

The relationship between rate of GPs and higher alcohol-related crime is unexpected. GPs were considered in the analyses, as they are a point of contact in strategies to reduce alcohol-related harm among non-dependent problem drinkers. The majority of problem drinkers. Research suggests that GP-based interventions reduce consumption and therefore communities with more GPs, potentially providing brief intervention, should have less harm. The positive association between GPs and alcohol-related crime do not support this theory. As there is no evidence to suggest that GPs commit disproportionate numbers of alcohol-related crimes, it may be that the GPs do not provide brief intervention or are not providing it to the right people. Given that there are more GPs in communities with higher alcohol-related crime, if GPs provided brief intervention effectively to appropriate individuals, they may have an impact on alcohol-related harm.

Finally, due to the availability of data, community variables were from different time points. To ensure comparability between communities, count data were converted to per 10,000 population, using an average of the 2001 and 2006 census population for each community, thus controlling for change in population over that time. In addition, as data were applied to all communities, difference in the time frame for community variables should have no impact on relative comparisons.

**Implications**

The study findings of increased alcohol-related crime in communities with less socioeconomic disadvantage and more GPs and pub licenses, has the potential to guide community-level interventions and policies.
greater skills, etc.) and a greater per capita number of alcohol outlets suggests a greater number of opportunities to be involved in alcohol-related crime. The incidents considered in the measure of alcohol-related crime (assault, malicious damage and offensive behaviour) could be considered crimes of opportunity related to intoxication in public venues. It should be noted however that alcohol offence times are the same as non-working hours and therefore the opportunity for offending by working individuals is greater during the alcohol times.

The finding of wealthier communities having more alcohol-related crime is also consistent with international evidence showing wealthier countries have greater per capita alcohol consumption (Rehm et al., 2009). One potential means of limiting the alcohol crime associated with socioeconomic status is to increase the price of alcohol—a strategy known to decrease average alcohol consumption across a population (Chisholm et al., 2004). Introducing a volumetric tax has the capacity to increase the average price of alcohol and has been identified as the most cost-effective strategy that Australia could introduce (Cobiac et al., 2009).

Although there is limited research in Australia on the relationship between socioeconomic variables and alcohol-related harms, the finding of less disadvantage being associated with increased alcohol-related crime is not consistent with some research. A recent study investigating income inequality and alcohol-related harm found a curvilinear relationship with alcohol harms generally increasing with increasing income inequality, except at low levels of income inequality where the reverse was found (Dietze et al., 2009). Respondents to a crime and safety survey in poorer neighbourhoods were more likely to report problems with drunkenness than those in less-disadvantaged areas (Donnelly et al., 2006) and reconviction rates among drink driving offenders have been found to be higher among the more disadvantaged (Tromboli and Smith, 2009).

This study also shows that the proportion of risky drinkers in a community is not associated with alcohol-related crime, suggesting that interventions aimed at reducing rates of risky drinking in a community are unlikely to reduce alcohol-related crime. It could be argued that strategies aimed at tightening controls on public drinking would more cost-effectively reduce alcohol-related crime than strategies aimed at reducing rates of risky drinking per se, but there are very few high-quality evaluations of community-level harm reduction strategies (N. Hawkins et al., submitted for publication). An alternative possibility is that self-reported rates of risky drinking are not sufficiently accurate and more objective information (such as sales data) is required. Unfortunately, these data are not available in NSW despite acknowledgement of their importance for more evidence-based public health policy (Hall et al., 2008).

Most studies assume that alcohol consumption and harm are spread equally across license type (Chikritzhs et al., 2007), despite research indicating that outlet type is associated with differential harm (Stockwell et al., 1992). This study provides further evidence for differential harm across different alcohol outlet types; the number of pubs and clubs were associated with alcohol-related crime, while the number of wholesalers and retailers and other licenses were not. Reducing the number of licensed premises is likely to have an effect on short-term consequences of drinking such as alcohol-related crime and effects are likely to take place at a local level (i.e. postcode or neighbourhood in urban areas; Livingston et al., 2007). Local governments may consider highly targeted interventions: capping the rate of pubs and clubs per capita is likely to be more practical than closing existing premises. The implementation of such interventions is likely to be highly cost-effective, since the introduction of new legislation is both relatively inexpensive to implement and monitor for compliance through existing approval processes.

CONCLUSIONS

This study found that communities with less socioeconomic disadvantage, the number of GPs and the number of pubs and clubs in a community were associated with more alcohol-related crime. This association suggests that more wealth in a community could provide a greater opportunity for the drinking of alcohol in public and the negative consequences associated with alcohol use, such as alcohol-related crime. Although inappropriate to limit socioeconomic advantage, taxation to increase the cost of alcohol may decrease consumption across a community and, in turn, alcohol-related crime. Tailored strategies that target pubs and clubs in those communities with relatively high rates of alcohol-related crime could also be implemented.

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