Identifying individual- and population-level characteristics that influence rates of risky alcohol consumption in regional communities

Courtney Breen,[1] Anthony Shakeshaft,[1] Rob Sanson-Fisher,[2] Catherine D'Este,[3] Richard P. Mattick,[1] Stuart Gilmour[4]

Abstract

Objective: To examine the extent to which individual- and community- level characteristics account for differences in risky alcohol consumption.

Method: A cross-sectional postal survey of 2,977 randomly selected individuals from 20 regional communities in NSW, Australia. Individuals drinking at harmful levels on the AUDIT and for risk of harm in the short term and long-term were identified. Multi-level modelling of the correlates of risky alcohol consumption at the individual and community level was conducted.

Results: There were differences between communities in alcohol consumption patterns. Being male, unmarried and reporting worse health were significant individual-level correlates for drinking at levels for risk of harm in the long term. The number of GPs (+) and police (-) were significant community characteristics. Being younger (≤25), unmarried, Australian born and with a larger income was associated with drinking at levels for risk of harm in the short term and harmful drinking on the AUDIT. The number of hotels and clubs was positively associated with drinking at levels for risk of harm in the short term.

Conclusions: Rates of risky drinking vary significantly between communities and both individual and community characteristics are significantly associated with risky alcohol consumption.

Implications: A combination of individual- and population-level interventions, tailored to the risk profile of individual communities, is most likely to be optimally effective.

Key words: Alcohol, harm, community, rural

Alcohol use is a leading cause of morbidity and mortality, accounting for an estimated 3.8% of deaths and 4.6% of all Disability Adjusted Life Years (DALYs) internationally.[1] Rates of risky alcohol consumption and harm have been shown to be disproportionately high in rural and regional communities, relative to urban communities.[2-8] It is recognised that macro-level properties (such as population size and availability of resources) differ between communities and that both community level factors (such as the number and density of alcohol outlets)[9-11] and individual characteristics (such as age, sex and level of health) are associated with increased alcohol-related consumption and/or harm.[12-15] The extent to which community-level factors influence rates of risky alcohol consumption and harm, relative to the characteristics of the individuals who live in different communities, has not been adequately quantified.

A recent study in the UK has highlighted regional differences in the development of risky drinking, controlling for individual characteristics.[12] There has been some investigation of the impact of community-level factors on health behaviours (including alcohol consumption) at the neighbourhood level in Melbourne, Australia.[13] Analysis of larger areas, such as regional communities, has not occurred. Existing studies have only examined the relative influence of individual- and community-level characteristics in relation to young people,[14,15] as opposed to the general community, or have focused on alcohol-related harms.[5,16,17]

There has been no large-scale, simultaneous examination of whether there are differences between communities in rates of risky alcohol consumption, nor an adequate exploration of plausible individual-level and community-level explanatory factors. This represents a substantial limitation of the current literature, particularly because policies and intervention programs that are tailored to the characteristics of individuals have been shown to be effective.[18-21] This study examines whether rates of risky alcohol consumption differ between regional communities in NSW Australia, and identifies individual-level and community-level risk factors associated with risky consumption.

1. National Drug and Alcohol Research Centre, School of Public Health and Community Medicine, University of New South Wales
2. School of Medicine and Public Health, Faculty of Health, University of Newcastle, New South Wales
3. Centre for Clinical Epidemiology and Biostatistics, School of Medicine and Public Health, University of Newcastle, New South Wales
4. Department of Global Health Policy, University of Tokyo, Japan
Correspondence to: Dr Courtney Breen, National Drug and Alcohol Research Centre, School of Public Health and Community Medicine, University of New South Wales, Sydney, NSW 2052; e-mail: courtney.breen@unsw.edu.au
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Method

Ethics approval

Ethics approval was granted by the Human Research Ethics Committee at the University of Newcastle and ratified by the University of New South Wales. Alcohol Action in Rural Communities (AARC) is registered with the Australian Clinical Trials Registry (ACTRNO12607000123448).

Community selection

Location-based communities in New South Wales (NSW), Australia, were invited to participate in a large-scale community action study, the AARC project, if they: had a population between about 5,000 and 20,000 (n=27 communities); were at least 100 km away from a major urban centre, were defined as having a population of at least 100,000 (n=24 communities); and were not known to be currently involved in any other large-scale project aimed to reduce alcohol-related harm (n=20 communities). Characteristics of the participating communities are summarised in Table 1.

Survey sample selection

The study sampling frame was the Australian Electoral Commission (AEC) Electoral Roll, which comprises an estimated 95% of Australian residents aged at least 18 years (voting is compulsory in Australia).[22] The age range of participants (18–62 years) was restricted to the legal age for enrolment in Australia at the lower end and limited at the upper end to reflect reduced levels of alcohol harm.[19] After stratification by sex and five-year age group, the sample size required within strata was determined by proportional allocation and participants were selected by systematic random sampling.[23]

AARC survey development and implementation

The survey comprised five sections: alcohol use; alcohol harms; community action; general health; and demographics. Outcomes other than risky alcohol consumption are reported elsewhere.[24,25] Standardised, psychometrically tested items were used to maximise reliability, validity and comparability with other major Australian datasets and minimise response bias. Six senior alcohol and drug researchers reviewed the survey to optimise its content validity. The readability of the survey was designed to ensure a 12–13 year old would comprehend the text. Responses were anonymous.

The survey was conducted March – September 2005. Each potential participant was mailed a letter explaining the study, the survey and a reply-paid envelope. A thank you/reminder was mailed after two weeks. Non-responders were sent a second survey after four weeks. The benefit of an additional follow-up phone call was explored in a randomised controlled trial of a sample of non-responders, but the 10% increase in response rate was insufficiently cost-effective to be applied to all non-respondents.[25]

Alcohol consumption outcomes

Outcomes were: the proportion of participants who reported likely problem alcohol use (Alcohol Use Disorders Identification Test [AUDIT] score ≥8);[26,27] the proportion of participants who reported risky/high risk consumption for alcohol-related harm in the long term, defined by the then current Australian guidelines of at least 29 (for men) or 15 (for women) standard drinks per week;[28] and the proportion of the participants who reported at least one episode of risky/high risk for alcohol-related harm in the short term in the previous year, defined as more than six standard drinks (for males) or four (for females) on one occasion.[28]

Survey derived individual-level variables

Demographic variables were considered as covariates of interest: gender; age (≤25 years); ethnicity (Indigenous); education (post-school qualification); employment (unemployed); marital status (married); country of birth (Australia); gross (before tax) household income (≥$700.00 per week); and health score (as measured by the EQ5D).[29]

Community-level variables

Community-level variables were obtained if they were known to be associated with risky drinking or if they were resources that could be used in interventions to reduce alcohol-related harm. The proportion of young males (aged 15–24 years) and the proportion of Indigenous people[30] were extracted from 2001 ABS Postal Area census data as these groups are known to experience disproportionately high rates of alcohol-related harms.[31,32] Socio-Economic Indexes For Areas (SEIFA) disadvantage deciles[33] were obtained as an indicator of each community's socioeconomic status (low scores indicating greater disadvantage), given evidence for differential alcohol-related harm by socioeconomic status.[34] Mean Accessibility Remoteness Index of Australia (ARIA) scores were obtained by postcode[35] as indicators of remoteness, since more remote communities have higher per capita consumption and harm.[36]

Numbers of licensed premises were obtained from the NSW Office of Gaming and Racing[37] and classified into three categories, given evidence of differential harm associated by license type: hotels/clubs; wholesalers/retailers; and other (e.g. airports, motels, restaurants and vineyards).[38] The number of full-time police officers and highway patrol officers was obtained from NSW Police. This data was included as random breath testing is an effective strategy to reduce drink-

Table 1: Community characteristics (N=20).

Measures	Minimum	Maximum	Mean	Standard deviation
Population[a]	6,571	29,005	14,106	6,397
Proportion young males[a]	0.05	0.07	0.06	0.01
Proportion Indigenous[a]	0.01	0.17	0.05	0.04
Remoteness indicator (ARIA score)	0.98	7.72	2.90	1.47
SEIFA score[b]	1	6	3.40	1.31
Rate of hotels/clubs[c]	5.41	19.04	10.58	3.87
Rate of wholesalers/retailers[c]	0.89	9.37	3.37	2.12
Rate of other licensed premises[c]	7.05	26.62	14.03	5.43
Rate of police officers[c]	2.70	44.09	17.94	10.02
Rate of highway patrol officers[c]	0	6.94	2.96	1.83
Rate of GPs[c]	6.17	36.7	11.13	6.73

a From 2001 Census Postal Area population (ABS)
b SEIFA - Socio-Economic Indexes For Areas (low scores indicate high levels of disadvantage)
c Per 10,000 population

driving[39] and police enforcement improves liquor licensing law compliance.[40] Since screening and brief intervention by general practitioners (GPs) is cost effective,[41-44] the number of GPs in each community was obtained from the electronic telephone directory and cross-checked with Divisions of General Practice. These community variables were standardised to a rate of 10,000 population.

Data analysis

All analyses were performed in SAS v9.2.[45] The χ^2 test was used to compare categorical data and t-tests were used for comparison of means. For non-normal variables (e.g. health scores), the Kruskal Wallis test was conducted to examine differences in medians.

Regression analyses were undertaken using SAS v9.2,[45] which precluded the combination of multilevel analysis of non-linear outcomes and the use of weights to adjust for probability sampling in one model. Consequently, the modelling process involved two steps: the first estimated the mixed model and associated clustering effects; and the second accounted for the sampling methodology using a variation inflation adjustment. The probability sample was stratified by age and gender within communities and strata weights were calculated.

To account for the clustering of the individuals within communities, generalised linear mixed models with a logit link function and random intercept were implemented, modelling a binomial outcome. The individual-level variables derived from the survey were level one variables and the community characteristic variables were level two variables.

The coefficients were estimated from a linear model using a multilevel modelling procedure and the variance inflation adjustment (obtained using SURVEYFREQ) was applied to the standard errors and t-statistics of these estimates and the p-values revised accordingly. As the variance inflation adjustment makes all variables less significant, it was applied after model-building had been conducted on the non-linear mixed model. Variables that were statistically significant in the model, but did not remain so after this adjustment, are also reported to delineate the effect of the probability sampling process on the model (Table 3).

Models were constructed for risky/high risk drinking in the long- and short-term and problem drinking on AUDIT. All individual-level and community-level variables that showed some statistical association with each outcome ($p \leq 0.25$) on univariate analysis were included as covariates, although age and gender were retained in all models due to their known association with risky consumption.[46] The least significant variable was then removed in a backward stepwise procedure until only statistically significant variables remained ($p \leq 0.05$). The variation inflation adjustment was then applied.

Results

Response rates

Of the 7,985 surveys mailed, 405 were marked 'returned to sender' or the respondent was no longer at the address. Of the remaining 7,580 surveys, 3,080 were returned (41%) of which 63 were blank and 40 provided no demographic data (age, gender or postcode) to allow weighting, leaving a sample size of 2,977 (39%).

Community characteristics and consumption patterns

Respondents' demographic and alcohol consumption characteristics are presented in Table 2. The mean age was 40 years. About half the sample was male (49%) and had a post-high-school qualification (47%). A majority were married or de facto (69%) and had a gross weekly household income of at least $700 (58%). A minority identified as Indigenous (2.3%) and a minority were unemployed (2.4%). Relatively few respondents reported either not drinking at all (9.6%) or drinking at a level that placed them at risk/high risk of harm over the long term (9.6%). Most risky/high-risk drinking was related to short-term harm (46%) and a substantial proportion of respondents reported an AUDIT score ≥8 (26%).

In addition to Table 2, there was a significant difference between communities in their proportions of long-term risky/high-risk drinkers (4.7-15%, z=-38.9, $p<0.0001$), short-term risky/high-risk drinkers (38-56%, z=-5.7, $p<0.0001$) and those with an AUDIT score ≥ 8 (19-37%, z=-16.01, $p=<0.0001$).

Predictors of risky alcohol consumption

Proportion of long-term risky/high-risk drinkers

At an individual level, the odds of risk of harm in the long term were lower for females, and higher for those not in a married or de facto relationship and who reported worse subjective health (Table 3). At a community level, communities with a higher rate of GPs had a significantly higher proportion of long-term risky/high-risk drinkers and those with a higher rate of police had a significantly lower proportion of long-term risky/high-risk drinkers.

Table 2: Characteristics of survey respondents (N=2977[a]).

Characteristics	Mean (SD)	Range	
Age	40 (12)	18-63[b]	
	n	% (SE)[c]	(95%CI)
Gender (male)	1,307	49 (1.1)	47-52
Indigenous Australian	59	2.3 (0.4)	1.6-3.0
Post-school qualification	1,368	47 (1.1)	45-49
Unemployed	59	2.4 (0.3)	1.7-3.1
Married/de facto	2,145	69 (1.0)	67-71
Gross household income ≥$700/week	1,687	58 (1.1)	55-60
Alcohol consumption[d]			
Abstinent	311	9.6	8.4-11
Long-term risky/high-risk[e]	257	9.6	8.3-11
Short-term risky/high-risk[e]	1,228	46	44-49
AUDIT score ≥ 8	678	26	24-28

a. Excludes missing data for age, gender or town. Unweighted frequencies are reported.

b. Some participants selected in the 58- 62 age range turned 63 by the time they completed the survey

c. Percentages of 10 percent or more are rounded to full integers, those <10 are reported to one decimal place.

d. Unweighted frequencies are reported. Weights are reported for estimates - %, SE and CI.

e. Numbers do not add to total sample size due to missing values for long-term (n=117) and short-term (n=123). The number of low risk vary by outcome: long-term (n=2292) and short-term (n= 1315).

Proportion of short-term risky/ high-risk drinkers

At an individual level, the odds of risk of harm in the short term are lower for those born overseas and higher for those who were aged ≤25 years, not in a married or de facto relationship and reported a gross weekly household income of at least $700 (Table 3). At a community level, communities with a higher rate of hotels/clubs had a significantly higher proportion of short-term risky/ high-risk drinkers and those with a higher proportion of Indigenous Australians had a significantly lower proportion of short-term risky/high-risk drinkers.

Problem drinking on AUDIT (score ≥8)

At an individual level, the odds of scoring at least 8 on AUDIT were lower for females and those born overseas, and higher for those aged ≤25 years, not in a married or de facto relationship, who reported worse general health and a gross weekly household income of at least $700. At a community level, the proportion of Indigenous residents in the community had a destabilising effect, with an extreme parameter estimate and standard error, and the model was fitted with this variable removed.

Table 3: Characteristics associated with risky/high-risk and problem drinking.[a]

Model and covariates	β[a]	Adjusted SE	Adjusted t value	Adjusted p value	OR	95%CI
Model 1: Long-term harm[b]						
Individual level covariates						
Age (≤25 years)	0.17	0.24	-0.74	0.50	1.19	0.75-1.9
Gender (female)	-0.39	0.15	2.69	0.01	0.68	0.51-0.90
Not married/de facto	0.39	0.17	-2.32	0.02	1.48	1.06-2.07
Health Score[c]	-0.85	0.28	3.03	0.00	0.43	0.25-0.74
Population level covariates						
Rate of GPs[d]	0.02	0.007	-2.61	0.01	1.02	1.00-1.03
Rate of police[d]	-0.02	0.007	2.41	0.02	0.98	0.97-1.00
Model 2: Short-term harm[b]						
Individual level covariates						
Age (≤25 years)	1.23	0.20	6.09	0.00	3.41	2.30-5.06
Gender (female)	-0.10	0.10	-0.95	0.30	0.91	0.74-1.11
Indigenous	-0.51	0.30	-1.71	0.09	0.6	0.33-1.08
Not married/de facto	0.46	0.11	4.30	0.00	1.58	1.28-1.94
Australian born	-0.53	0.24	-2.20	0.03	0.59	0.37-0.95
Gross household income ≥$700/week	0.57	0.10	5.89	0.00	1.77	1.46-2.14
Population level covariates						
Hotels/clubs[d]	0.04	0.01	3.58	0.00	1.04	1.02-1.06
% Indigenous community	-0.02	0.007	-3.22	0.00	0.98	0.96-0.99
Model 3: AUDIT						
Individual level covariates						
Age (≤25 years)	1.16	0.21	5.76	0.00	3.19	2.09 to 4.86
Gender (female)	-1.38	0.14	-10.08	0.00	0.25	0.19 to 0.33
Not married/de facto	0.54	0.15	3.78	0.00	1.72	1.27 to 2.32
Australian born	-0.59	0.32	-1.92	0.04	0.56	0.29 to 1.06
Gross household income ≥$700/week	0.54	0.12	4.49	0.00	1.72	1.34 to 2.22
Health Score[c]	-0.67	0.37	-1.87	0.04	0.51	0.24 to 1.08

a. Model adjusted with design effect: long-term harm 1.45, short-term harm past year 1.43 and AUDIT 1.53. All variables that were statistically significant in the model ($p<0.05$), but did not remain so after this adjustment, are also reported to delineate the effect of the probability sampling process on the model.

b. GENMOD was used as the GLIMMIX model would not converge

c. Health score from EQ5D. A negative association indicates worse health.

d. Per 10,000 population

Discussion

This study examines community differences in alcohol consumption and simultaneously identifies both individual- and community-level characteristics that are significantly associated with rates of risky drinking across whole communities. It used data from 20 communities. Mixed models were used to control for clustering within communities (as individuals within a community may be more similar to each other than to individuals in another community), and to facilitate the simultaneous analyses of both individual and community characteristics. The results show that rates of drinking at levels for risk of harm in both the short and long term and experiencing alcohol-related harm are significantly different between communities, suggesting public health policies and interventions should be tailored to specific communities in order to be optimally efficient. The results are consistent with previous analyses of routinely collected data that have shown significant differences between communities in rates of alcohol-related crime[17,47] and traffic crashes.[48] Providing tailored feedback of such data to communities could be an adequate intervention to help them identify local issues of concern and significantly reduce rates of risky alcohol consumption and harms, given the provision of feedback has been shown to be an effective behaviour change mechanism for individuals.[20,49,50] The internet provides an obvious mechanism to facilitate such feedback and its effectiveness at the community level would need to be evaluated.

The individual characteristics found to be associated with drinking at levels for risk of harm (youth, gender, marital status) were largely consistent across models and are supported by past research.[51-53] A novel finding was that those with higher incomes were significantly more likely to report drinking at levels for risk of harm in the short term and experiencing alcohol-related harm (AUDIT score), which is highly consistent with evidence suggesting that young people with more discretionary income are at greater risk of alcohol-related harm.[14] Although income as a statistically significant risk factor suggests price controls may be an effective strategy to reduce drinking at levels for risk of harm in the short term, modelling shows that in response to alcohol price increases, Australians are most likely to increase the number of days on which they abstain, and reduce the number of days on which they consume a small number of drinks, in order to preserve the frequency with which they drink heavily.[54] This means reducing harms associated with short-term risky drinking is likely to require complementary strategies that impose greater restrictions on the availability of alcohol, such as earlier

closing hours.[55] Nevertheless, the lack of prospective evaluation trials of these types of interventions means that the scientific rigour of the evidence for their effectiveness is limited.

Communities with more hotels/clubs had higher proportions of drinkers at risk of harm in the short term, which most likely reflects the greater availability of alcohol.[10,11,56,57] It also provides further evidence for differential harm across alcohol outlet types; the number of hotels/clubs were significantly associated with short-term risky drinking while the number of wholesalers and retailers and other licences were not. Reducing the number of hotels/clubs locally is likely to have effect on short-term consequences of drinking such as reducing alcohol-related crime.[9]

That communities with higher proportions of Indigenous Australians had significantly lower proportions of people drinking at levels for harm in the short term is consistent with existing research showing that a much higher proportion of Indigenous Australians, relative to non-Indigenous Australians, do not drink alcohol, but those who do drink are more likely to have substantial alcohol-related problems.[31,58] It is an important outcome for communities because short-term risky drinking is more prevalent than long-term risky drinking and focusing on marginalised groups is unlikely to reduce the proportion of short-term risky drinkers in their community. By contrast, interventions that more directly limit opportunities for drinking to excess on one occasion (i.e. drinking at levels for harm in the short term) across the whole population, such as restricting trading hours, are more likely to be effective.[57,59]

Communities with higher rates of GPs had significantly higher proportions of drinkers at risk of harm in the long term. This may reflect that communities with more GPs and with higher average disposable incomes may drink more frequently. Although socioeconomic advantage (higher SEIFA scores) was not significantly associated with higher proportions of risky drinkers, the SEIFA measure includes a range of factors other than income.[33] Utilising GPs in a community to provide screening and brief intervention (SBI) could be a useful strategy to reduce the proportion of people drinking at risk of harm in the long term. There are more GPs in communities with higher proportions of people drinking at levels for risk of harm in the long term and there is substantial evidence for the cost-effectiveness of GP-delivered SBI.[39,60] Modelling suggests GP-delivered SBI will not be sufficient by itself to achieve community-level reductions in risky drinking.[61] That communities with more police had significantly lower proportions of long-term risky drinkers may reflect that there are more police per capita in communities with higher rates of crime generally. It could also be that a greater police presence reduces the average level of consumption because drinkers perceive they are more likely to be charged as a consequence of their involvement in an alcohol-related incident.

Methodological considerations

Although a range of community characteristics were used as covariates (e.g. socioeconomic disadvantage, remoteness, alcohol licenses, services per population), it may be that some relevant variables, such as the extent of local drug and alcohol policy, and 'social capital' (the value of social networks, mutual support, reciprocity, and trust)[62] were omitted. Social capital is difficult to measure directly so proxy indicators have been developed. These indicators include participation rates in community groups, activities or events, although are not available at the postcode level.[63] Nevertheless, the variables included a range of factors known to be associated with risky drinking, or that could be used to reduce risky drinking, and were largely population values (e.g. data from census, number of licensed premises, GPs per population). This overcomes issues of using aggregate variables (from individual survey data) that are vulnerable to sampling error.

As noted previously, there is limited research in regional communities, however, in urban settings there has been neighbourhood-level research.[64] There may be too much diversity within each individual community in this study; however, the population range of the communities was about 6,500 to 29,000 and breaking down the data further than postcode-level would be difficult. Although this is the largest study of regional participants, only a limited number of communities were included for logistical reasons (n=20), limiting the statistical power of the analyses and potentially the generalisability of the results. Although unlikely to be comparable to urban communities, these communities were randomly selected and the limited statistical power indicates that the significant results are likely to be robust. At the individual level, sample sizes across communities ranged from 128 to 177, providing sufficient statistical power. Moreover, the mixed models simultaneously controlled for both community-level and individual-level covariates.

Conclusion

Rates of risky drinking vary significantly between communities with individual and community factors significantly associated with drinking at levels for risk of harm in the short and long term, and alcohol-related harm. To be optimally effective, interventions should be tailored to individual communities and target the type of harm (e.g. reducing alcohol availability by limiting the number of pubs, to reduce drinking at levels for harm in the short term). A range of complementary individual-level and community-level strategies should be implemented simultaneously.

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