Title

Access to alcohol outlets and harmful alcohol consumption: a multilevel study in Melbourne, Australia

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Declaration of Interest

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Abstract

Aims

To assess the association between access to off-premise alcohol outlets and harmful alcohol consumption.

Design, Setting, Participants

Multilevel study of 2334 adults aged 18 to 75 years from 49 census collector districts (the smallest spatial unit in Australia at the time of survey) in metropolitan Melbourne.

Measurements

Alcohol outlet density was defined as the number of outlets within a one kilometre road network of respondents' homes and proximity was the shortest road network distance to the closest outlet from their home. Using multilevel logistic regression we estimated the association between outlet density and proximity and four measures of harmful alcohol consumption: drinking at levels associated short-term harm at least weekly and monthly; drinking at levels associated with long-term harm and frequency of consumption.

Findings

Density of alcohol outlets was associated with increased risk of alcohol related harm with the strongest association evident for drinking at levels associated with short term harm at least weekly (OR 1.10, 95% CI 1.04-1.16). When density was fitted as a categorical variable, the highest risk of drinking at levels associated with short-term harm was when there were eight or more outlets (short-term harm weekly: OR 2.36, 95% CI 1.22-4.54 and short-term harm monthly: OR 1.80, 95% CI 1.07-3.04). We found no evidence to support an association between proximity and harmful alcohol consumption.

Conclusions

Restricting the number of off-premise alcohol outlets is likely to reduce levels of harmful alcohol consumption.

Introduction

Alcohol use is associated with a wide range of health and social problems and thus there is considerable interest nationally and internationally to develop interventions to reduce consumption of alcohol at levels associated with harm (1, 2). The consequences of binge drinking, or drinking a large number of drinks on one occasion, include injuries, assaults, and self harm. Drinking at high levels over the longer term is associated with an increased risk of chronic diseases such as liver disease, pancreatitis, and cardiovascular disease (1, 3, 4). Although there is considerable research demonstrating individual predictors of hazardous alcohol use, including being male (5), low socio-economic position (6), younger age (5, 7) and Indigenous status (5), there has been less research on the impact of accessibility to alcohol outlets on consumption.

Developed countries such as Australia have either introduced, or are considering, legislation to restrict the number of alcohol outlets, particularly those selling liquor for off-premise consumption (8). However, there is little evidence to support this strategy particularly from countries other than the United States (9). The relationship between access to off-premise alcohol outlets and consumption has generated mixed evidence. Some studies have found higher levels of drinking in areas with a higher density of off-premise outlets (10, 11). A study conducted by Livingston et al. in Melbourne found that the density of off-site alcohol outlet density was associated with an increased prevalence of high-risk drinking in young adults between the ages of 16-24 (12). In New Zealand, a national study found that the density of outlets was associated with increased binge drinking and alcohol related harm (13). Pollack et al. however, did not find evidence to support an association between density and consumption (14). Two studies examined proximity to the nearest alcohol outlet and consumption but neither study found evidence to support an association (14, 15).

Studies to date have had considerable limitations particularly in relation to how exposure to alcohol outlets has been defined. The most frequent measure of outlet density is the absolute number of

outlets in an area (12, 14, 16-18). This approach best represents the exposure of residents at the centre of an area with misclassification more likely for residents closest to the boundary (19, 20). The most accurate reflection of the number of stores near an individual's residence is the number stores that fall within a specified road network distance as opposed to Euclidean or straight-line measures of access. Previous studies have not used this approach with the exception of Schonlau et al. who found a stronger association between alcohol density and consumption when network distance was used as compared to absolute number of outlets in census tracts (10).

Our study improves on previous work in this field by creating two robust measures of access to alcohol outlets: proximity (closest outlet) and density (number of outlets). We define proximity as the road distance from a respondent's home to the closest outlet selling alcohol and density as the number of alcohol outlets within a one kilometre road distance of respondents' homes. In a multilevel study of 2334 adults in Melbourne, Australia, we assess the associations between access to off-premise alcohol outlets and drinking for short-term harm, long-term harm and frequency of alcohol consumption

Methods

This study uses data from the Victorian Lifestyle and Neighbourhood Environment Study (VicLANES) conducted in Melbourne, Australia in 2003. The study was approved by the La Trobe University Human Research Ethics Committee. The approval included access to the Australian Electoral Roll which lists name, residential address and age of registered voters. The aim of VicLANES was to examine the importance of individual and area-level characteristics in relation to three health behaviours: household food-purchasing, physical activity and alcohol consumption (21). The VicLANES study used a two-stage cluster design to select areas and individuals.

Sampling of areas units and audits

The first stage involved the sampling from 4170 census collector districts (CCDs) from the 21 innermost local government areas in Melbourne. These LGAs were situated in an approximately 20km radius from the central business district of Melbourne. CCDs are used by the Australian Bureau of Statistics (ABS) to collect population census data and were the smallest geographic area defined in the Australian Standard Geographical Classification in 2001 (22). CCDs in the sampling area had an average of 557 residents, and a mean size of 0.34km². All CCDs located within the local government areas were ranked according to the proportion of households with a weekly pre-tax income of less than $400AUS/week (low income households). CCDs were subsequently stratified into septiles based on ranking, and a random sample of 50 CCDs from the highest (17 CCDs), middle (16 CCDs) and lowest (17 CCDs) strata were selected.

The names and addresses of all alcohol outlets in Victoria that sold alcohol for consumption off-premise were obtained from the Victorian Liquor Licensing Authority (23) and field audit was used to verify the accuracy and completeness of the list. We geocoded all alcohol outlets that sold liquor that could be consumed off-premises within a catchment area of 2km Euclidian distance of the centroid of the selected CCDs. This catchment area captured all outlets within a 1km road network distance of all participants' homes.

Sampling of individuals and response rate

We used the Australian Electoral roll to identify all households in the selected CCDs who had at least one adult aged between 18 and 75 years (it is compulsory for all persons aged 18 and over to vote and it is estimated that 97.7 % of persons eligible to vote are enrolled (24)). We randomly selected one person in a household when there was more than one eligible adult. Four thousand and five individuals were sampled. A postal survey was used to collect individual and household data. A tailored design method for mail surveys was used in order to maximise response rates to the postal

survey (25). Valid responses were obtained from 2349 respondents, a response rate of 58.7 % (54.6% in the most disadvantage septile, 59% in the middle septile and 62.1% in the most advantaged septile). Participation rates were inversely associated with area disadvantage, with high SES strata areas having higher rates than mid and low SES strata areas. Compared with census data of our CCDS, our sample had a lower proportion of: households in the lowest quintile of income, persons with no post-school qualification, blue collar workers, men, and persons aged 18 to 24 years (data not shown).

Outcome measure: Alcohol consumption

The questions relating to alcohol consumption were based on the 2001 National Household Drug Survey (26). In the postal questionnaire, participants were asked if they ever consumed alcohol. If they responded yes, they were then asked:

1. The frequency with which they consumed an alcoholic drink in the last 12 months with eight response categories: everyday; 5-6 days/week; 3-4 days/week; 1-2 days/week; 2-3 days a month; about one day a month; less often; and no longer drink.
2. How many drinks they usually consumed per drinking occasion with six response categories: 13 or more; 11-12; 7-10; 5-6; 3-4; and 1-2 drinks.
3. The frequency with which they consumed alcohol at levels associated with short-term harm. Male respondents were asked how many times in the past year they consumed more than six standard drinks in a day and females were asked the frequency with which they consumed more than four standard drinks. The response to this question included the same eight categories as the first question.

One standard drink was defined as 10g of alcohol, in accordance with the Australian National Health and Medical Research Councils (NHMRC) alcohol guidelines (3). Pictures of typical serving sizes showing the equivalent number of standard drinks were used to help participants estimate their consumption.

We used the NHMRC alcohol consumption guidelines to define levels of harmful consumption Short-term harm was defined as six or more drinks for men and four or more drinks for women. We computed two short-term harm variables which referred to drinking at levels associated with short-term harm at least once per week (short-term harm weekly) or at least once per month (short-term harm monthly). Long-term harm was computed by multiplying the responses to the first question with the second question with midpoints used when the category included a range. Long-term harm was defined as 29 standard drinks or more for men and 15 drinks or more per week for women. We also derived a variable to represent frequency of consumption which was coded as 0=drink less than five days per week and 1=drinks on 5 or more days per week. The frequency of consumption measure captures frequent consumption but does not necessarily represent frequent consumption to levels associated with harm.

Predictors

Access to alcohol

The location of participants homes were geocoded using ArcGIS version 9.3. There had a 100% match rate with respondent's addresses because the address data came from the Australian Electoral Roll and was not self-reported. With regards to alcohol outlets, again we achieved a 100% match rate as the address data was first sourced from Liquor Licensing Victoria, who requires valid addresses to issue the licence. Further to this, the location of the store was validated by fieldwork auditors whose purpose was to ensure the store was trading and selling liquor for off-site consumption. For the network distance analysis the types of roads were not considered because we were interested in a driving distance, not driving time which is where a consideration of road is more important. Our road network was set up so that restrictions were placed on one-way roads and U turns were permitted.

We did not include pedestrian walkways and alleys in the route options as we were interested in the usual minimum travel distance by car. Information obtained in the audit showed that all areas sampled had reasonable quality of sidewalks so pedestrians would have the option to travel along the same routes as cars.

Density was calculated by counting the number of outlets within a 1km road network distance from respondent's home. Proximity was the road distance (in kilometres) from the respondent's home to the nearest alcohol outlet. We modelled proximity and density as continuous variables, and as categorical variables to explore weather there were potential threshold effects. Proximity was classified into the following categories: <0.4km; 0.4<0.8km; 0.8 to <1.2km; and ≥1.2km. Density was categorised as: no outlets; 1 outlet; 2 outlets; 3-4 outlets; 5-7 outlets and 8 or more outlets.

Confounders

We included a range of variables which we hypothesised were likely to be confounders as they could influence both where people live and their patterns of alcohol consumption. These were: individual socio-economic position (education, occupation and household income), ethnicity (Australian-born or not), age, sex and household composition.

Education

Education level was obtained from responses to survey questions enquiring about levels of primary and secondary education completed and further education post secondary school. Responses were recoded into groupings of highest level of education completed (1) bachelor degree or higher (2) diploma (associate or under-graduate (3)) vocational and (4) no post-school qualification.

Occupation

The Australian Standard Classification of Occupations (ASCO) was used to code respondent occupations, into groups of occupations requiring similar levels of education, knowledge, responsibility, on the job training, and experience (27). Occupation was then recoded into professionals (managers, administrators, professionals, and paraprofessionals), white collar employees (clerks, sales persons and service workers) and blue collar employees (tradespersons, machine operator, drivers, labourers and related workers). A fourth category of 'not working' was created for respondents who were retired, studying, unemployed, not looking for work, or unable work.

Household income

Respondents were asked to provide an estimate of total household income before tax using 14 categories of either weekly or annual income. Responses were recoded into 5 categories (1) less than $20 800 (2) $20 800-36 399 (3) $36 400-51 999 (4) $52 000-77 999 and (5) $78 000 or more.

Household composition

Household composition was obtained from survey questions asking respondents about the numbers of persons living in households, how many and the ages of children in households and the living arrangements of respondents. Responses were recoded into four categories (1) single adult, no children (2) single adult with children (3) two or more adults, no children and (4) two or more adults with children. We refer to education, occupation, and household income as measures of individual socioeconomic position

Country of birth

Survey responses on country of birth were coded into either Australian born or not Australian born.

Age and sex

Age and sex of respondents were obtained from the postal survey responses or from the electoral role if the survey responses were missing. Age was classified into 10 year age groups (18-24, 25-34, 35-44, 45-54, 55-64 and ≥65 years).

Area-level Disadvantage

Area socio-economic disadvantage was classified by the proportion of households within a CCD with a weekly pre-tax income of less than $400 per week. These proportions were categorised with areas defined as least disadvantaged (mean 7.0%, range 3.5% – 8.5%), mid disadvantaged (mean 15.3%, range 14.4% – 16.7%), or most disadvantaged (mean 31.4%, range 24.1% – 59.6%).

Analysis

Residents living in the Melbourne central business district (CBD) were removed from all analyses due to the fact that this area was mainly commercial. All analyses were undertaken using the remaining 49 CCDs and included 2334 respondents.

Data were missing on a number of key variables including income (35% missing). Complete data on all variables was available for 61% of the sample. Rather than analysing complete cases only, potentially biasing estimates, missing data were imputed under a Missing At Random (MAR) assumption where missing values were modelled as a function of observed variables (28). Twenty datasets with imputed values for missing items on each variable were estimated using the Imputation by Chained Equations (ICE) command in Stata 10.1.

As each outcome variable was dichotomous, we used multilevel logistic regression to account for clustering of individuals within CCDs. Analysis was undertaken in Stata 10.1 using the GLLAMM function prefixed by the user-written "mim" command (created by JC Galati, P Royston, and JB

Carlin) which allowed for analysis to be undertaken across multiple datasets. Results from the multilevel analysis are presented as odds ratios (OR) with 95% confidence intervals (95% CI).

Men and women were combined in the analyses as we did not find evidence to support potential effect modification by sex (i.e. there were no significant interactions between density and proximity (modelled as continuous variables) and sex for any of the alcohol consumption measures). Density and proximity were modelled as continuous and categorical variables with the lowest access category as the baseline (no outlets for density and ≥1.2km for proximity). All models were adjusted for potential confounders: age, sex, household composition, individual socio-economic position (education, occupation, income) and area-level disadvantage.

Results

The frequency of drinking at levels associated with harm varied across the measures (short term harm weekly 13.5%, short term harm monthly 30.4%, long term harm 5.5% and frequency of consumption 18.7%). The median number of stores in a 1km network distance was one with a range of zero to seven and the median distance to the closest store was 790 metres. As the number of alcohol outlets increased the risk of consumption at levels associated with long-term and short-term harm weekly and monthly increased (P for trend 0.024, 0.006 and 0.004 respectively). There were no statistically significant associations between proximity and drinking at levels associated with harm but the highest levels of drinking for short-term harm weekly and monthly consumption were found in the respondents living closest to an outlet. Women were less likely to drink at harmful levels across all the alcohol consumption outcomes measures. Alcohol consumption was also higher in households with only one adult (or two or more adults and no children). Drinking for short-term harm was more prevalent in blue collar occupations than those in professional occupations and for respondents living in low income households compared with high income households. Frequent alcohol consumption was more common in lower income households, and

also among those who were not working or in professional occupations. Consumption of alcohol at levels associated with short-term harm was more frequent in younger age groups while consumption of alcohol five days a week or more was more common in the older age groups. There was no clear relationship between area socio-economic disadvantage and consumption of alcohol at levels associated with short and long-term harm; however, residents living in the least disadvantaged areas were more likely to report frequent alcohol consumption. (see Table 1)

Table 1 about here

Proximity

We did not find evidence to support an association between proximity of alcohol outlets and alcohol consumption at levels associated with short- or long-term harm or frequency of consumption (see Table 2)

Table 2 about here

Density

The density of outlets was linearly associated with increased risk of all measures of harmful alcohol consumption. The risk of harmful consumption was highest when there were eight or more outlets (short-term harm weekly: OR 2.36, 95% CI 1.22-4.54 and short-term harm monthly: OR 1.80, 95% CI 1.07-3.04). (see Table 3)

Table 3 about here

Discussion

Access to an increased number of alcohol outlets is associated with a higher risk of harmful alcohol consumption. We found some evidence to suggest that the association between outlet density and consuming alcohol at levels associated with short-term harm may not be linear. When outlet density was fitted as a categorical variable the increased risk of drinking at levels associated with short-term harm at least weekly was observed when there were three to five, and eight or more outlets within a 1 kilometre network area. The increased risk of drinking at levels associated harm at least monthly was observed when there were five or more outlets. We find so evidence to suggest that when the number of outlets in an area is eight or more, the risk of drinking at levels associated with short term harm (weekly or monthly) is increased. Evidence regarding a potential threshold effect in relation to the association between access to alcohol outlets selling packaged liquor and assaults has been reported in another Victorian study (28). Livingston et al. used postcodes as the spatial unit of analysis (a much larger spatial unit than CCDs) and found evidence to suggest that when the number of outlets was 15 or more the risk of assault increased sharply (29). Our finding, which has not been reported in relation to individual alcohol access previously, suggests that policies should concentrate on reducing the number of outlets in areas with a high density of outlets as well as preventing the opening of new outlets..

Given that we found associations between outlet density and harmful alcohol consumption, the lack of evidence to support an association between proximity and consumption is surprising. The potential explanation for the lack of association may be the limited range of values in this sample (access to outlets within 1.2kms of their home). This means that we have a small exposure gradient and thus limited power to detect an effect.However, our findings are consistent with other studies whereby associations between outlet density and consumption have been reported (10-12) while no studies have found an association between proximity and consumption (14, 15). Although the association between outlet density and both frequent consumption and drinking at levels associated

with long term harm were not statistically significant (p = 0.076 for frequent consumption, p = 0.059 for long term harm), the direction of the effects are suggestive of a positive association. The lack of a significant association between outlet density and increases in the average consumption was reported by Connor in New Zealand(13). As long term harm was less common than drinking at levels associated with short term harm, this may have reduced our power to detect a statistically significant effect.

This study has a number of strengths and limitations. First, it is possible that respondents self-select into areas in such a way that people who are at risk of drinking at levels associated with harm may also live in areas with a higher density of outlets. This self-selection could potentially result in overestimates of the association between outlet density and consumption. However, higher SEP groups are more able to choose their place of residence and we controlled for three measures of individual and household SEP and therefore we believe it is unlikely that self-selection could account for the results. Second, we used a one kilometre network distance which is approximately equivalent to a 15 minute walk or a five minute car ride and thus outlets at this distance would be highly accessible to people's homes. We fitted densities with higher buffer distances and found that they yielded similar but slightly attenuated results. Third, this study is cross-sectional and thus we cannot conclude the associations are causal, as businesses that sell alcohol may set up in areas where there is already a high prevalence of people drinking at levels associated with harm. Intervention studies are needed to test the impact of changes in exposure to alcohol outlets on changes in consumption. In addition, the levels of alcohol consumption were self reported and it is likely that these were underestimated by respondents. Finally, there is potential for residual confounding due to unmeasured area-level characteristics. To verify our findings we ran models with CCDs fitted as fixed effects. The estimates obtained from these models were closer to the null than for the random effects models but the direction of the effect remained the same (data not shown). Fixed effects models will eliminate confounding due to area effects but reduces power and

may also result in overadjustment for area-level mediators of the associations between alcohol density and proximity and risk of alcohol related harm. Thus the true estimate is likely to lie somewhere between the random and fixed effects models. Previous studies have used random effects and thus may have overestimated the association between outlet density and harmful alcohol consumption.

The study has considerable strengths. The study has considerable strengths. First, our measures of access to alcohol outlets are more sophisticated than those used previously. We measure density and proximity using road network distance calculated from respondents' homes while previous studies were derived from administrative units or calculated using Euclidian distances. Second, we were able to control for a large number of confounders, including individual and area-level SES potential predictors of self-selection, minimising the possibility of residual confounding.

Our study suggests that policies that restrict the number of outlets in areas may have a significant impact on the proportion of residents who consume alcohol at levels associated with harm. However, direct translation of these findings into clear policy recommendations is more difficult because the sophisticated individual measures of access to alcohol outlets used in this study. The best evidence would be obtained from evaluating policy interventions that control the number of outlets so that we can better understand how access to alcohol outlets affects consumption.

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Table 1

Alcohol related harm and alcohol density and proximity and socio-demographic variables, n=25,690 imputed observations from 2334 respondents.

		Type of Harm			
Variable	**Category (%)**	**Short Term (weekly)**	**Short term (monthly)**	**Long Term**	**Frequent**
		Harm % (95% CI)	Harm % (95% CI)	Harm % (95% CI)	Harm % (95% CI)
Density					
No stores	(38)	12 (10 - 14)	29 (26 - 32)	5 (4 - 6)	16 (14 - 19)
1	(26)	13 (10 - 16)	28 (25 - 32)	4 (3 - 6)	21 (17 - 24)
2	(14)	12 (8 - 15)	28 (23 - 33)	6 (3 - 8)	19 (14 - 23)
3 to 4	(10)	18 (13 - 23)	36 (30 - 42)	9 (5 - 12)	21 (16 - 27)
5 to 7	(9)	15 (10 - 20)	37 (30 - 43)	6 (3 - 10)	20 (14 - 26)
8 +	(4)	25 (16 - 34)	41 (31 - 52)	9 (3 - 15)	19 (11 - 28)
Trend		P= *0.006*	P= *0.004*	P= *0.024*	P= *0.211*
Proximity					
1.2km +	(26)	12 (10 - 15)	30 (26 - 33)	4 (3 - 6)	16 (13 - 19)
0.8 - <1.2 km	(23)	13 (10 - 16)	31 (27 - 35)	6 (4 - 8)	18 (14 - 21)
0.4 - <0.8 km	(33)	13 (11 - 15)	28 (25 - 31)	6 (4 - 7)	21 (18 - 24)
< 0.4 kms	(17)	17 (14 - 21)	35 (30 - 40)	7 (4 - 10)	19 (15 - 23)
Trend		P= *0.264*	P= *0.555*	P= *0.107*	P= *0.296*
Sex					
Male	(44)	19 (17 - 22)	38 (35 - 41)	6 (5 - 8)	24 (21 - 27)
Female	(56)	9 (7 - 11)	25 (23 - 27)	5 (4 - 6)	14 (12 - 17)
χ^2		P= *<0.001*	P= *<0.001*	P= *0.001*	P= *<0.001*
Aust Born					
No	(29)	6 (4 - 8)	16 (13 - 19)	3 (1 - 4)	17 (14 - 21)
Yes	(71)	17 (15 - 18)	36 (34 - 39)	7 (6 - 8)	19 (17 - 21)
χ^2		P= *<0.001*	P= *<0.001*	P= *<0.001*	P= *0.001*
Household Type					
One adult	(18)	18 (14 - 22)	32 (28 - 37)	7 (4 - 9)	18 (14 - 22)
One adult, children	(6)	14 (8 - 20)	27 (29 - 34)	4 (0 - 7)	14 (8 - 20)
2 or more adults	(41)	16 (13 - 18)	36 (33 - 39)	7 (5 - 8)	20 (18 - 23)
2 or more adults, children	(35)	9 (7 - 11)	23 (20 - 26)	4 (3 - 5)	18 (15 - 21)
χ^2		P= *<0.001*	P= *<0.001*	P= *<0.001*	P= *<0.001*
Education					
Bachelor or higher	(32)	11 (9 - 13)	29 (26 - 32)	6 (4 - 8)	21 (18 - 24)
Diploma	(12)	8 (5 - 12)	26 (20 - 31)	3 (1 - 5)	19 (14 - 24)
Vocational	(20)	18 (14 - 22)	35 (31 - 40)	6 (4 - 8)	21 (17 - 25)
No post school	(37)	15 (13 - 17)	31 (27 - 34)	6 (4 - 8)	16 (13 - 18)
Trend		P= *0.002*	P= *0.124*	P= *0.580*	P= *0.124*
Occupation					
Professional	(36)	12 (10 - 14)	34 (30 - 37)	5 (4 - 7)	21 (18 - 24)
White Collar	(16)	15 (11 - 18)	35 (30 - 40)	6 (3 - 8)	12 (8 - 15)
Blue Collar	(12)	25 (20 - 30)	42 (36 - 48)	6 (3 - 9)	15 (10 - 19)
Not working	(35)	11 (9 - 13)	21 (18 - 24)	6 (4 - 8)	21 (18 - 24)
χ^2		P= *<0.001*	P= *<0.001*	P= *0.187*	P= *<0.001*
Income					
$20,799 or less	(30)	14 11 - 17)	38 (34 - 42)	6 (4 - 8)	23 (20 - 27)
$20,800 - $36,399	(20)	13 10 - 17)	31 (26 - 36)	7 (4 - 9)	18 (14 - 22)
$36,400 - $51,999	(17)	13 9 - 16)	29 (24 - 34)	5 (2 - 7)	17 (12 - 21)
$52,000 - $77,999	(17)	14 11 - 18)	25 (21 - 30)	5 (2 - 7)	15 (12 - 19)
$78,000 or more	(17)	13 10 - 17)	23 (18 - 28)	5 (3 - 7)	16 (12 - 20)
Trend		P= *0.612*	P= *<0.001*	P= *0.179*	P= *0.012*
Age					
18-24	(8)	23 (17 - 29)	55 (48 - 62)	8 (4 - 11)	3 (1 - 6)
25-34	(18)	19 (15 - 22)	42 (37 - 47)	7 (4 - 9)	8 (5 - 10)
35-44	(21)	13 (10 - 16)	32 (28 - 36)	4 (2 - 6)	14 (11 - 17)
45-54	(21)	12 (9 - 14)	26 (22 - 30)	5 (3 - 7)	23 (19 - 26)
55-64	(17)	11 (8 - 14)	24 (20 - 28)	6 (3 - 8)	28 (23 - 32)
65+	(15)	10 (6 - 13)	15 (11 - 19)	5 (3 - 8)	30 (25 - 35)
Trend		P= *<0.001*	P= *<0.001*	P= *0.409*	P= *<0.001*
Strata					
Most advantaged	(36)	11 (9 - 13)	29 (26 - 32)	5 (4 - 7)	24 (21 - 27)
Middle	(33)	15 (12 - 17)	33 (30 - 36)	7 (5 - 8)	17 (14 - 19)
Least advantaged	(31)	15 (12 - 18)	29 (25 - 32)	5 (3 - 7)	15 (12 - 18)
Trend		P= *0.090*	P= *0.700*	P= *0.954*	P= *<0.001*

Table 2

Multi-level logistic regression of proximity to alcohol outlets and alcohol-related harm adjusted for age, sex, household composition, individual socio-economic and area-level disadvantage

	Type of Harm			
	Short Term (weekly)	Short term (monthly)	Long Term	Frequent
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Continuous Measure				
Total Distance (km)	0.88 (0.69 - 1.12)	1.01 (0.86 - 1.19)	0.84 (0.62 - 1.13)	0.89 (0.75 - 1.05)
Categorical Measure				
1.2+ kms	*1.00*	*1.00*	*1.00*	*1.00*
0.8 - <1.2 km	0.98 (0.65 - 1.48)	1.18 (0.86 - 1.63)	1.39 (0.80 - 2.44)	1.21 (0.83 - 1.77)
0.4 - <0.8 km	1.04 (0.70 - 1.57)	0.98 (0.73 - 1.33)	1.31 (0.77 - 2.25)	1.43 (1.03 - 2.00)
< 0.4 kms	1.29 (0.81 - 2.05)	1.35 (0.95 - 1.91)	1.53 (0.84 - 2.81)	1.33 (0.87 - 2.02)
Test for trend				
P Value	0.309	0.278	0.219	0.093

Table 3

Multi-level logistic regression of density of alcohol outlets in 1 kilometre network distance and alcohol-related harm adjusted for age, sex, household composition, individual socio-economic and area-level disadvantage

	Type of Harm			
Variable	Short Term (weekly)	Short term (monthly)	Long Term	Frequent
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Continuous Measure				
Total Distance (km)	1.10 (1.04 - 1.16)	1.09 (1.04 - 1.14)	1.07 (1.00 - 1.16)	1.05 (1.00 - 1.11)
Categorical Measure				
None	*1.00*	*1.00*	*1.00*	*1.00*
1	1.15 (0.79 - 1.66)	1.01 (0.77 - 1.32)	0.86 (0.51 - 1.45)	1.29 (0.95 - 1.76)
2	0.95 (0.60 - 1.50)	0.95 (0.68 - 1.33)	1.10 (0.60 - 2.01)	1.24 (0.84 - 1.81)
3 to 4	1.75 (1.12 - 2.76)	1.41 (0.99 - 2.00)	1.69 (0.95 - 3.01)	1.33 (0.88 - 1.99)
5 to 7	1.32 (0.79 - 2.21)	1.56 (1.07 - 2.28)	1.29 (0.65 - 2.57)	1.46 (0.94 - 2.28)
8 +	2.36 (1.22 - 4.54)	1.80 (1.07 - 3.04)	1.47 (0.62 - 3.46)	1.36 (0.71 - 2.62)
Test for trend				
P Value	0.009	0.002	0.092	0.077