

Proximity to Liquor Stores and Adolescent Alcohol Intake: A Prospective Study

Georgina S.A. Trapp, PhD,^{1,2,3} Matthew Knuiman, PhD,³ Paula Hooper, PhD,² Sarah Foster, PhD⁴

From the ¹Telethon Kids Institute, University of Western Australia, West Perth, Western Australia; ²Centre for the Built Environment and Health, University of Western Australia, Crawley, Perth, Western Australia; ³School of Global and Population Health, University of Western Australia, Crawley, Perth, Western Australia; and ⁴Royal Melbourne Institute of Technology University, Melbourne, Victoria, Australia

Address correspondence to: Georgina S.A. Trapp, PhD, Telethon Kids Institute, University of Western Australia, PO Box 855, West Perth, Western Australia, 6872. E-mail:

gina.trapp@telethonkids.org.au.

Introduction: Cross-sectional studies have reported associations between liquor store availability and alcohol use among adolescents, but few prospective studies have confirmed this association. The aim of this study was to examine whether proximity to liquor stores at age 14 years was associated with alcohol intake at ages 14, 17, and 20 years.

Methods: Participants of the Western Australian Pregnancy Cohort (Raine) Study ($n=999$) self-reported alcohol intake at age 14 years (early adolescence, 2003–2005), age 17 years (middle adolescence, 2006–2008), and age 20 years (late adolescence, 2009–2011). A GIS measured proximity to the closest liquor store from participants' home and school addresses at age 14 years. Regression analyses in 2017 assessed the relationship between distance to the closest liquor store around home, school, or both (≤ 800 m vs >800 m) and alcohol intake.

Results: In cross-sectional analyses (age 14 years), having a liquor store within 800 m of school was associated with ever having part of an alcoholic drink (OR=2.34, $p=0.003$). Also, having a liquor store within 800 m of home or school was associated with ever having part of an alcoholic drink (OR=1.49, $p=0.029$) and ever having engaged in heavy drinking (OR=1.79, $p=0.023$). In prospective analyses, liquor store proximity at age 14 years was a significant predictor of alcohol intake at age 17 years (OR=2.34, $p=0.032$) but not at age 20 years.

Conclusions: Liquor store availability in early adolescence may be a risk factor for alcohol intake in early and middle, but not late, adolescence. Improved understanding of the longer-term impacts of liquor store exposure on sensitive populations could help inform future licensing regulations.

INTRODUCTION

Underage drinking is a major public health issue for many countries.¹ In the U.S., United Kingdom, and Australia, around 20%–30% of secondary school students regularly consume alcohol and drinking to get wasted is perceived as integral to social life.^{2–7} Numerous negative health and social consequences are associated with underage drinking, including drug use, aggression and violence, unprotected sex, trouble in school or with the police, and increased risk of injuries and suicide.^{8–10} Moreover, the age at which young people start regular drinking is predictive of adult drinking and alcohol-related problems later in life.¹¹ Accumulating evidence from neurologic research about the impact of adolescent drinking on impaired brain development¹² further adds to the compelling need to identify influencing factors amenable to intervention.

Understanding how liquor store availability impacts underage drinking is an important research avenue as governments can regulate the location and density of liquor stores. International research shows adults living in neighborhoods with greater availability of liquor stores have higher alcohol intakes.^{13–16} Plausibly, the impact of widespread alcohol availability on adolescents may be more pronounced, given their receptivity to alcohol normalization, and the importance of proximate access for an age group with limited mobility. Indeed emerging evidence suggests liquor store availability impacts adolescent drinking.¹⁷ However, most studies are cross-sectional, few measure individual-level liquor store exposure around the home and school or measure an aspect of availability other than density. Therefore, this study aims to examine liquor store proximity around home and school at age 14 years and its association with alcohol intake at ages 14, 17, and 20 years.

METHODS

Study Sample

Participants were from the Western Australian Pregnancy Cohort (Raine) Study (88% Caucasian),¹⁸ resided in Perth and self-reported alcohol intake in early adolescence (age 14 years, 2003–2005, $n=999$), middle adolescence (age 17 years, 2006–2008, $n=648$) and late adolescence (age 20 years, 2009–2011, $n=696$). The following ethics committees provided approval: Princess Margaret Hospital, King Edward Memorial Hospital, the University of Western Australia.

Measures

Self-reported alcohol intake at ages 14 and 17 years used the binary items: *Have you ever had even part of an alcoholic drink?* (age 14 years only); *Have you had an alcoholic drink in the past 12 months?*; *Have you been drunk anytime in the last 6 months?*; *Have you ever drunk 6 or more alcoholic drinks at one time or drunk so much alcohol that you threw up (vomited)?* (heavy drinking measure). Self-reported alcohol intake (grams of ethanol/day) at age 20 years was assessed by the Cancer Council of Victoria¹⁹ (note: selling or supplying alcohol to anyone aged <18 years on licensed premises is illegal in Western Australia).²⁰

Participants' home and school addresses at age 14 years were geocoded using GIS. Liquor store locations were sourced from an electronic telephone directory database (2005, SENSIS) and mapped in GIS. Distance-to-closest liquor store along the road network from home and school (≤ 800 m vs >800 m) and presence of a liquor store within 800 m of home or school (yes versus no) was calculated. Adolescents perceive 800 m an easy walking distance.²¹

Statistical Analysis

Cross-sectional analyses used logistic regression to examine associations between distance-to-closest liquor store and alcohol intake. Prospective analyses applied logistic and linear

regression to examine associations between distance-to-closest liquor store at age 14 years and alcohol consumption at ages 17 and 20 years, with and without adjusting for alcohol intake at age 14 years. All analyses in SPSS, version 24 controlled for gender and family income.

RESULTS

Sample characteristics are presented in Table 1. Cross-sectional analyses at age 14 years (Table 2; $n=999$) revealed a consistent positive association (all ORs >1.0) between distance-to-closest liquor store from home, school, or both and the four alcohol intake measures. Three of the 12 associations reached statistical significance: a liquor store within 800 m of school was associated with a 2.34-fold increase in the odds of ever having part of an alcoholic drink; and a liquor store within 800 m of home or school was associated with a 49% increase in the odds of ever having part of an alcoholic drink and a 79% increase in the odds of ever engaging in heavy drinking.

In prospective analyses, there was a consistent positive association (all ORs >1.0) between distance-to-closest liquor store from home, school, or both at age 14 years and the three measures of alcohol intake at age 17 years (Table 3; $n=648$). However, only one association reached statistical significance; an outlet within 800 m of home was associated with a 2.34-fold increase in the odds of having an alcoholic drink in the past 12 months. No prospective association was found between distance-to-closest liquor store from home or school (or both) at age 14 years and alcohol intake at age 20 years (Table 4; $n=696$).

DISCUSSION

This study found cross-sectional evidence that liquor stores proximate to home or school in early adolescence were positively associated with alcohol consumption. It also found partial evidence suggesting living close to a liquor store in early adolescence constituted a risk factor for alcohol consumption in middle, but not late, adolescence.

Positive associations between alcohol availability and alcohol consumption have been reported in other cross-sectional studies of young people.^{17,22-24} The findings were also consistent with a recent longitudinal Australian study²⁵ that found living in areas with higher baseline liquor store density was associated with increased alcohol consumption 1-year later. Together, the emerging evidence and these results suggest greater regulation of community liquor stores could potentially reduce the proportion of young people engaging in underage drinking, with subsequent population-level health and social benefits.

Adolescent drinking behavior may be susceptible to proximate liquor stores for several reasons. For a population with limited mobility, having a store nearby increases the convenience of obtaining alcohol, either by asking a family member/stranger/peer to buy alcohol for them or purchasing it themselves.^{26,27} It may also influence parental alcohol purchases, potentially increasing alcohol accessibility at home. Further, a liquor store nearby may increase a young person's perceived availability of alcohol²²⁻²⁴ and reinforce normalization of drinking in their formative years.²⁸ Indeed, Australian and U.S. research has implicated the prominent alcohol advertising associated with liquor stores with adolescent drinking.^{29,30} The mechanisms behind the finding that liquor store proximity at age 14 years is a risk factor for alcohol consumption in middle, but not late, adolescence warrant further investigation. Conceivably, exposure to liquor stores in early adolescence contributes to a perceived normalization of alcohol use, which is carried into middle adolescence. However,

once at the legal drinking age, peer and family factors and increased mobility may have stronger influences on consumption than early environmental factors.

Limitations

Study strengths include the prospective design, inclusion of objective individual-level alcohol exposure measures around home and school, and the population-based sample. Although this study was novel in its focus on proximity to liquor stores, other accessibility factors (e.g., opening hours), within-store factors (e.g., prices/promotions) and license types (e.g., on premise, clubs) should be considered in future studies. Available control variables also limited the current study including whether teens moved closer or further from a liquor store over the time period, and inability to examine whether participants obtained alcohol from their closest outlet to home or school. Exposure to and use of liquor stores in other places adolescents spend their time (i.e., within their total activity space) should be examined in future studies. Furthermore, alcohol consumption was self-reported and the ever had part of an alcoholic drink variable did not distinguish participants who had only one sip from those consuming one or more standard drinks.

CONCLUSIONS

The findings highlight liquor store availability in early adolescence may be a risk factor for alcohol intake in early and middle, but not late, adolescence. Improved understanding of the longer-term impacts of liquor store exposure on sensitive populations could help inform future licensing regulations.

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GT and SF conceptualized the study. GT performed the analyses that were guided by MK and had input from SF and PH. GT drafted the manuscript. All authors interpreted findings, reviewed and edited drafts of the manuscript, and approved the final version.

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Table 1. Characteristics of Sample

Characteristic	Early adolescence (14 years, n=999)	Middle adolescence (17 years, n=648)	Late adolescence (20 years, n=696)
	n (%)	n (%)	n (%)
Gender			
Female	500 (50.1)	335 (51.7)	360 (51.7)
Male	499 (49.9)	313 (48.3)	336 (48.3)
Family income at 14 years			
<\$35,000	222 (23.4)	122 (19.7)	123 (18.5)
\$35,001–\$50,000	148 (15.6)	90 (14.5)	97 (14.6)
\$50,001–\$78,000	268 (28.2)	182 (29.4)	199 (30.0)
\$78,001–\$104,000	145 (15.3)	103 (16.6)	116 (17.5)
≥\$104,001	166 (17.5)	123 (19.8)	129 (19.4)
Alcohol consumption			
Ever had part of an alcoholic drink			
Yes	800 (80.1)	616 (95.2)	
No	199 (19.9)	31 (4.8)	
Had an alcoholic drink in the past 12 months			
Yes	595 (59.6)	586 (90.4)	
No	389 (38.9)	62 (9.6)	
Been drunk in the last 6 months			
Yes	113 (11.5)	441 (68.7)	
No	868 (88.5)	201 (31.3)	
Ever engaged in heavy drinking			
Yes	76 (7.7)	395 (61.5)	
No	908 (92.3)	247 (38.5)	
Alcohol consumption (g ethanol/day), mean (SD)			696 (17.6, 18.6)
Distance-to-closest liquor store at 14 years			
From home			
≤800 m	240 (24.0)		
>800 m	759 (76.0)		
From school			
≤800 m	155 (15.5)		
>800 m	844 (84.5)		
Has an liquor store within 800 m of home or school			
Yes	346 (34.6)		
No	653 (65.4)		

Table 2. Association Between Liquor Store Proximity at 14 Years and Alcohol Consumption at 14 Years (Logistic Regression)

Distance-to-closest liquor store	Ever had part of an alcoholic drink ^a		Had an alcoholic drink in the past 12 months ^a		Been drunk in the last 6 months ^a		Ever engaged in heavy drinking ^a	
	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value	OR (95% CI)	<i>p</i> -value
≤800 m around home (ref: >800 m)	1.26 (0.85, 1.87)	0.250	1.14 (0.83, 1.56)	0.421	1.20 (0.75, 1.90)	0.450	1.59 (0.92, 2.74)	0.095
≤800 m around school (ref: >800m)	2.34 (1.33, 4.10)	0.003	1.35 (0.93, 1.97)	0.118	1.03 (0.59, 1.80)	0.920	1.62 (0.88, 2.99)	0.120
Has a liquor store within 800 m of home or school (ref: no)	1.49 (1.04, 2.13)	0.029	1.14 (0.86, 1.51)	0.357	1.21 (0.80, 1.85)	0.371	1.79 (1.08, 2.97)	0.023

Note: Boldface indicates statistical significance ($p < 0.05$).

^aAdjusted for gender and family income.

Table 3. Association Between Liquor Store Proximity at 14 Years and Alcohol Consumption at 17 Years (Logistic Regression)

Distance-to-closest liquor store	Had an alcoholic drink in the past 12 months ^a		Been drunk in the last 6 months ^a		Ever engaged in heavy drinking ^a	
	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 1 OR (95% CI)	Model 2 OR (95% CI)
≤800 m around home (ref: >800 m)	2.34 (1.08, 5.06)*	2.42 (1.05, 5.60)*	1.42 (0.94, 2.13)	1.41 (0.92, 2.15)	1.24 (0.84, 1.82)	1.22 (0.82, 1.82)
≤800 m around school (ref: >800 m)	1.38 (0.63, 3.00)	1.08 (0.48, 2.43)	1.22 (0.77, 1.95)	1.16 (0.72, 1.87)	1.23 (0.79, 1.92)	1.20 (0.77, 1.89)
Has an liquor store within 800 m of home or school (ref: no)	1.70 (0.93, 3.10)	1.61 (0.85, 3.05)	1.29 (0.90, 1.85)	1.23 (0.85, 1.78)	1.33 (0.94, 1.89)	1.31 (0.92, 1.87)

Model 1: Adjusted for gender and family income

Model 2: Adjusted for gender, family income and alcohol intake at 14yrs (same variable as at 17yrs)

Note: Boldface indicates statistical significance * $p < 0.05$

Table 4. Association Between Liquor Store Proximity at 14 Years and Alcohol Consumption (Grams-Ethanol/Day) at 20 Years (Linear Regression)

Distance-to-closest liquor store	Model 1		Model 2	
	B (95% CI)	<i>p</i>-value	B (95% CI)	<i>p</i>-value
≤800 m around home (ref: >800 m)	2.06 (−1.12, 5.24)	0.203	1.89 (−1.31, 5.09)	0.246
≤800 m around school (ref: >800 m)	0.12 (−3.66, 3.99)	0.950	−0.67 (−4.43, 3.09)	0.729
Has an liquor store within 800 m of home or school (ref: no)	1.55 (−1.32, 4.42)	0.290	1.20 (−1.68, 4.08)	0.415

Notes: Model 1: Adjusted for gender and family income. Model 2: Adjusted for alcohol intake at 14 years (Had a drink in the past 12 months), gender, and family income.