

## **Adolescents' alcohol use and strength of policy relating to youth access, trading hours and driving under the influence: findings from Australia**

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as doi: [10.1111/add.14164](https://doi.org/10.1111/add.14164)

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**Running head:** Alcohol control policy and youth drinking

**Declarations of competing interest:** nothing to declare

**Word count:** 4113 (excluding abstract, references, tables, and figures)

**Abstract word count:** 300

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## Abstract

**Aims:** To determine i) whether strength of Australian alcohol control policy in three domains (youth access, trading hours and drink driving) changed during the 2000s; and ii) estimate associations between these policies and adolescent drinking after adjusting for television alcohol advertising exposures, alcohol outlet density, alcohol price changes, exposure to negative articles about alcohol in daily newspapers and adult drinking prevalence.

**Design:** Repeated cross-sectional surveys conducted triennially from 2002 to 2011.

Multilevel modelling examined the association between alcohol control policies and drinking prevalence after adjusting for covariates.

**Setting:** Four Australian capital cities between 2002 and 2011

**Participants:** Students aged 12-17 years participating in a triennial national representative school-based survey (sample size range/survey: 9805 to 13119).

**Measurements:** Outcome measures were: past month drinking and risky drinking (5+ drinks on a day) in the past seven days. Policy strength in each of three domains (youth access, trading hours, drink-driving) were the key predictor variables. Covariates included: past 3-month television alcohol and alcohol-control advertising, alcohol outlet density, alcohol price change, negatively-framed newspaper alcohol articles, adult drinking prevalence and student demographic characteristics.

**Findings:** Over the study period, strength of youth access policies increased by 10%, trading hours policies by 14% and drink-driving policies by 58%. Past-month and risky drinking prevalence decreased (eg, past-month: 2002: 47% to 2011: 26%). Multivariable analyses that included all policy variables and adjusted for year, student and other covariates showed past-month drinking to be inversely associated with stronger trading hours policies (odds ratio [OR]=0.80, 95% confidence interval [CI]:0.69,0.94), but not youth

access (OR=0.92 95%CI: 0.81,1.04) or drink-driving (OR=1.00, 95%CI:0.93,1.09). Risky drinking was inversely associated with stronger youth access policies (OR=0.82, 95% CI:0.69, 0.98), but not trading hours (OR=0.85, 95%CI: 0.66,1.09) or drink-driving (OR=1.02, 95%CI: 0.90,1.14) policies.

**Conclusions:** Population-directed policies designed to reduce alcohol availability and promotion may reduce adolescents' alcohol use.

**Key words:** adolescents, alcohol use, Alcohol control policy, alcohol advertising, population based, survey

## Introduction

Like several other countries[1,2] there has been a divergence in the drinking patterns of older and younger adult Australians, with adults born after 1990 less likely to drink than older cohorts[3]. In line with these findings, alcohol use in Australian adolescents has declined since the mid 2000s,[4] the period when adults born after 1990 began entering adolescence. While reasons for adolescents' declining alcohol use are not clear, changes in the social environment for alcohol use are likely to play a role[1,2,5-7].

Population-based alcohol control policies help shape a community's social environment for drinking by acting on physical availability (e.g. outlet numbers, trading hours, age restrictions), economic availability (e.g. price) and promotion[8]. Youth drinking behaviours appear to be sensitive to change in discrete policy areas including minimum age,[9] price[10], and social host laws[11], although for the latter two areas associations have not been found consistently[12]. In recognition that these policies do not exist in isolation, several groups in the United States (US) have developed indexes to assess the implementation of multiple alcohol-related policies in a community[8,13,14] with studies finding a negative association between alcohol policy implementation and youth drinking[15-17]. However, as work has shown that this association is attenuated if the influence of alcohol outlet density is adjusted for[17], the relative influence of policy implementation compared to the influence of other known risk factors for adolescent drinking needs further exploration. To our knowledge no study has examined the role of policy implementation on adolescents' alcohol use relative to the role of alcohol advertising, a factor known to influence adolescents' alcohol use[18,19].

Many studies examining the influence of policies on adolescent drinking included adult drinking prevalence in their models as an indicator of social norms for drinking[16, 17].

Diverging alcohol use by older and younger adults suggests that adult drinking rates may not fully capture the current cultural influences on adolescent drinking. Another strategy for capturing contemporary debates and attitudes regarding alcohol may be to examine how alcohol is presented in the news media. Positive or negative portrayals of alcohol in news media influence public perceptions of acceptable or unacceptable use[20,21]. While studies have examined the relationship between newspaper coverage of specific alcohol-related topics and behaviour (e.g drink-driving articles and drink-driving behaviour[22], binge drinking articles and youth binge drinking[21]), an indicator of the framing of alcohol-related stories in the media has not been included in studies examining the impact of policy on adolescent drinking.

The present study begins these investigations and examines the association between three separate policies: population-based policies relating to drink-driving and trading hours, and a youth-specific policy relating to underage access on youth drinking. The study aims to first determine whether strength of policy in these three domains changed during the 2000s. Using prevalence data from four cross sectional surveys of Australian adolescents conducted between 2002 and 2011 our second aim is to estimate associations between youth drinking and these three alcohol control policies after adjusting for alcohol outlet density, alcohol advertising exposure, relative price of alcohol and newspaper presentation of alcohol-related stories, along with individual student factors

## **Method**

### ***Design***

Repeated cross-sectional surveys of secondary students (12-17 years) in four Australian states conducted every three years obtained data on alcohol use between 2002 and 2011.

For each state, strength of alcohol control policies in the domains of youth access, trading hours and drink driving in the year prior to the survey was determined and merged with student data. Multilevel regression analyses examined associations between the three policies and student drinking after adjusting for a number of alcohol-related and student level covariates.

### ***Adolescent data***

Adolescents' alcohol use data is from the triennial school-based Australian Secondary Students' Alcohol and Drug (ASSAD) surveys[4,23,24] which used a stratified two-stage probability sample with schools randomly selected at the first stage and students at the second. Surveying procedures were the same in each survey year, with external research staff attending the school to administer the pencil and paper survey to students anonymously. Data for the current study were from students aged 12 to 17 years residing in metropolitan areas of four Australian states surveyed in 2002, 2005, 2008, and 2011 areas where both advertising exposure data and outlet density data were available.

### ***Outcome measures: past month alcohol consumption and risky drinking***

Students indicated whether they had consumed alcohol in the past month (yes, no) and how many alcoholic drinks they had consumed on each of the seven days prior to completing the survey. Students consuming five or more drinks on at least one of these days were classified as risky drinkers. Questions assessing alcohol use were identical in all survey years.

### ***Key predictor variables***

*Alcohol control policies:* Alcohol control policy implementation focused on three domains under the control of state legislatures: youth access, trading hours and drink-driving. In each

domain a number of policy topics were assessed for strength with eight topics assessed for youth access and drink driving and nine for trading hours (see Table 1). Two researchers independently extracted policy data through review of each state's relevant liquor licensing and road safety acts for the entire study period. Discrepancies were resolved with input from policy staff at state health and liquor licensing departments. Policies in effect by the end of December each year were coded for.

Effectiveness scores were based on the extent research had demonstrated the policy topic was related to reductions in alcohol consumption as determined by the World Health Organisation [25]. Scores were assigned to each policy topic indicating limited (1), moderate (2), or high (3) effectiveness. Following Brand et al[8] policy topics were scored according to the strength of implementation in legislation, with 0 allocated when the topic was not operational, full points allocated when the entire policy was legislated, and points in between for partially implemented policies. The points allocated to each topic were determined by summing the effectiveness scores of all policy topics within a domain, then, to standardise each domain score to 100, dividing this score into 100. Each topic's maximum potential effectiveness score was determined by multiplying the resulting value by the topic's effectiveness score. For example, the total effectiveness score for the policy domain "youth access" is 17 (See Table 1) giving a score of 5.88 ( $100/17$ ). As the topic 'Prohibits sale of liquor to adult/parent when purchasing on behalf of minor' has an effectiveness score of 2, its maximum potential effectiveness score is 11.76 ( $2 \times 5.88$ ). Full implementation of this policy topic is scored 11.76, while partial implementation is scored 5.88 (Table 1). Implementation levels for the different policy components were determined through consultation with all authors and followed similar procedures used previously for alcohol[8] and tobacco[26]. Partial implementation scores were half, one third or a quarter the

maximum effectiveness score depending on the level of implementation. Table 1 shows the effectiveness ratings, maximum potential effectiveness scores and points assigned to partial or full implementation of policy topics with higher scores indicating stronger policies. Policy strength in each domain was calculated for each state and year between 2001 and 2011.

### ***Alcohol-related covariates***

***Alcohol outlet density:*** The number of licenses in a postcode area of four types: on-premise (consumption at a venue; e.g. restaurants); off-premise (take-away sales; e.g. bottle shops); general (consumption at a venue and take-away); and clubs (e.g. sporting, ethnic/social clubs) were obtained from relevant state licensing authorities[27]. Following previous work[17,28] total alcohol outlet density was used to indicate pervasiveness of alcohol outlets in an adolescent's local environment. To this end, the total number of alcohol outlet licences within each student's postcode in the year prior to the survey year was computed and the density per 1,000 residents within a postcode[29] determined. Historical data on alcohol outlet numbers were only available for four of Australia's five mainland states.

***Alcohol-related newspaper impressions:*** Alcohol-related newspaper article data was derived from a previously described content analysis of Australian newspapers.[30] In brief, a sample of alcohol-related articles in each Australian state's daily and Sunday newspapers was identified and coded for alcohol-related content. For each month, the number of alcohol-related news and opinion/commentary articles where the article's event was presented negatively was calculated, as was the number of all alcohol-related news and opinion articles for that month. For each state and year, an article impression variable was created by multiplying the number of articles appearing in a newspaper by the newspaper's estimated readership for each day of the week. The per-capita number of potential article

impressions was obtained by dividing impressions by the state's population aged 14 years and over[31]. In this study, we used data reflecting the percentage of impressions for negatively slanted alcohol-related news/opinion articles of all alcohol-related news/opinion articles. As research suggests that four months of news coverage exposure can affect attitudes[32], for each student, data were aggregated to reflect impressions over the four months preceding their survey date.

**Alcohol price:** State-specific data on alcohol price were obtained from the Australian Bureau of Statistics for the period March 2001-December 2011[33]. A 'real alcohol price index' was calculated by dividing the quarterly consumer price index data for alcoholic beverages by the quarterly all-goods consumer price index (CPI)[34] and multiplied by 100 to get a percentage score. This index provides an estimate of the CPI change in alcohol prices relative to the total CPI change in the student's metropolitan area.

Annual data for each student was ascertained by averaging the current and previous three quarters index, with the current quarter based on student's survey date. Scores under 100 indicate alcohol's price change was below the CPI for general consumer goods for that year.

**Television advertising Target Rating Points (TRPs):** Potential exposure to television advertising was measured using Target Audience Rating Points (TRPs). TRPs are a measure of advertising reach and frequency[35] and are calculated from the number of advertisements aired and the proportion of the target population (i.e., 13- to 17-year-olds) exposed to those ads within a specified time period. A specific TRPs value can have several different combinations of exposure frequency and audience reach, with, for example, 80 TRPs per month equivalent to 80% of adolescents within a media market exposed to the advertisement once during that month, or 40% of adolescents exposed twice, or 20%

exposed four times. TRPs for 13- to 17-year-olds were only available for the capital city regions of Australia's mainland states.

*Alcohol promotion:* Adolescents' potential exposure to alcoholic beverage (beer, wine, spirits and premix/cider) and retailer advertisements on television over the previous month was assessed. For this paper we calculated total alcohol advertising TRPs for each month and aggregated this to reflect potential advertising exposure over a three-month period.

*Alcohol control:* Adolescents' potential exposure to alcohol control advertising in the past month was also determined using TRPs. Alcohol control advertising included government or non-government advertising and alcohol-directed road safety advertising campaigns. Alcohol control advertising for a 3-month period was calculated as for alcohol promotion TRPs.

**Adult drinking prevalence:** Estimates of the proportion of adults (18+ years) in each state-consuming alcohol at least weekly were from the triennial, population-based National Drug Strategy Household Survey conducted in 2001, 2004, 2007 and 2010 (e.g.[36,37]).

### ***Student level covariates***

Age, sex, residential postcode, self-rated academic ability (above average, average or below), and past-month smoking status (yes or no) were collected in each survey year. Socioeconomic status (SES) was coded based on students' residential postcode[38], categorised into quintiles and collapsed into three groups with a low score indicative of relative disadvantage (lowest 40%) and a high score indicative of relative advantage (highest 20%). Each student's survey date was captured from fieldwork codes.

### ***Data management and analysis***

Alcohol policy scores by the end of the year prior to the survey were combined with student data at a state and year level, with, for example, policies in place by end of 2001 assigned to

students surveyed in 2002. As these variables were state based and assessed at only one point in time, all students from that state and year were assigned the same value.

Adolescent past 3-months total alcohol advertising TRPs, past-month alcohol control TRPs and past 4-months news/opinion article impression data were merged with student data by survey date and major city. Following procedures used elsewhere[26,39], for students surveyed after the 16th of the month, the current month's TRPs or newspaper article values were included in the aggregated values, while for students surveyed before the 16th of the month, aggregated values were based on the previous three or four months values as appropriate. Previous years' outlet density data were merged with student data by postcode and survey year. Alcohol CPI data and adult drinking prevalence data were merged by state and survey date as described above. As values for these variables depended on student survey date they differed within state and year. A variable indicating the timing of the survey (in months) was calculated using students' survey month and year.

Descriptive statistics (means, percentages) described the sample's demographic characteristics and alcohol use, policy strength, advertising exposure, newspaper exposures and outlet density in each year. Regression analyses (logistic or linear as appropriate) examined the association between these variables and a linear indicator of year.. Weighted data were used in these analyses, and clustering of students at the school level was adjusted for using Stata's 'svy' procedure. Multivariable mixed effects logistic regression modelling examined univariable and multivariable associations between the three alcohol policy scores, and past-month drinking and past-week risky drinking. In univariable analyses, only the policy variable was included in the model. In the first set of multivariable analyses, each policy variable was entered separately into models adjusting for alcohol-related covariates (advertising TRPs, outlet density, negatively-slanted news impressions, CPI

alcohol price changes and adult drinking rates), student covariates (sex, age, SES, self-rated academic ability and past-month smoking) and survey timing, with past-month drinking and risky drinking as the outcomes.. In the second set of analyses, all policy variables were included in the multivariable model along with the alcohol-related and student level covariates and survey timing. In these analyses, alcohol advertising TRPs were scaled to per 1,000 TRPs, while the policy variables and newspaper impression variables were scaled for a unit to represent a 10% change. In multilevel modelling, students, school and state were included as random effects. Multilevel modelling was conducted on unweighted data using “xtmelogit” procedures in Stata 14.0.

## **Results**

### ***Description of Student Sample***

Number of schools included in the sample ranged from a low of 20 for State D in 2002 and 2005 to a high of 78 for state B in 2008. Table 2 shows the number of students from each state included in the study in each survey year. SES distribution of students was similar over the study period. The proportion of students consuming alcohol in the past month decreased over the study period, while the prevalence of risky drinking began to decline after 2005.

Policy strength in the three different domains increased between 2001 and 2010, though the extent of increase varied between states (Table 3). For instance, over the four states, the strength of youth access policies increased by 10% between 2001 and 2010. However, it increased by 27% in State A but did not change in State B. The greatest change was in the

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drink-driving policy domain with the average strength of policy implementation increasing by 58% between 2001 and 2010 (Table 3).

Table 4 shows that in all states, potential exposure to televised alcohol advertising in the past-three months was greatest in 2002 and 2005. Assuming 100 TRPs represents the entire target audience being exposed to one advertisement a month[26,39], students were potentially exposed to an average of 60 to 67 alcohol advertisements and between 54 and 76 over a three-month period in 2002 and 2005 respectively. Alcohol advertising TRPs decreased after 2005. In all states, potential exposure to alcohol control advertising was low in each survey year. Overall average outlet density in student postcodes did not change over the study period. While in all states the percentage of negatively slanted alcohol-related news article impressions increased between 2002 and 2011, the pattern of change for negatively slanted opinion articles was more varied (Table 4). A significant increase in the price of alcohol was observed, though the CPI value was under 100 in all years. In all states, prevalence of adult drinking in the past year hovered around 50% with a decrease in prevalence seen in three of the four states (Table 4).

### ***Multilevel modelling analysis***

All policy variables were significantly related to past-month drinking and risky drinking in univariable analyses.

There was little difference in the associations between the policy variables and the two drinking outcomes when each variable was entered into multivariable analyses separately and together. Multivariable analyses that adjusted for all control variables and included the three policy variables, found a significant inverse association between past-month drinking and trading hours policies (Table 5). Past-month drinking was inversely associated with

negatively-slanted alcohol-related news articles (Table 5), while a positive association was found with outlet density ( $p < 0.05$ ) and adult drinking prevalence

Multivariable analysis for past seven days risky drinking, found a significant inverse association with youth access policies, indicating that for every 10% increase in the strength of youth access regulations, the odds of an adolescent engaging in risky drinking reduced by 21% (Table 5). Outlet density ( $p < .01$ ), and adult drinking prevalence ( $p < .01$ ) were also positively associated with the two drinking outcomes (Table 5).

## **Discussion**

During the 2000s, aspects of Australian adolescents' social environments became less positive towards alcohol. Our study suggests that changes in the social environment may work to increase or decrease the likelihood of adolescents drinking alcohol. Past-month drinking was inversely related to stronger trading hours policies and greater presence of negatively slanted alcohol-related articles in daily newspapers, while likelihood of risky drinking was inversely associated with stronger youth access policies. However, living in an area with a greater density of alcohol outlets, greater potential exposure to alcohol advertising on television increased the likelihood of drinking. Taken together, our results suggest that population-based policies that attempt to restrict the availability of alcohol, reduce youth access to alcohol, and reduce alcohol advertising on television may contribute to reductions in youth drinking.

We found that policies restricting trading hours and youth access reduced the likelihood of past-month and risky drinking respectively. As most adolescents do not purchase their own alcohol or drink on licensed premises[4], trading hours policies are unlikely to influence adolescents' alcohol use directly. Stronger trading hour policies may influence youth drinking

through perceptions of alcohol availability and social acceptability. During our study period there was significant discussion of the need to curb alcohol-related violence in multiple states' central business districts by reducing trading hours, with some states introducing reduced trading hours in specific night-time entertainment areas. While youth access policies were not significantly related to past-month drinking, they were inversely associated with risky drinking. Many of the components of this policy domain attempt to reduce secondary supply of alcohol (supply without parental knowledge), underage purchase and drinking in specific places (in hotels). While our results need confirmation, they may suggest that the youth access policies Australia adopted during our study period have a stronger impact on the amount of alcohol consumed rather than stopping access.

Similar to others[40-43] we found that alcohol outlet density was positively related to adolescent drinking. Our outlet density indicator combined data across the different licence types into one measure providing an indicator of an adolescent's total local alcohol retail environment. Our study suggests that higher total alcohol outlet density increases the likelihood of Australian adolescents engaging in past month drinking and risky drinking.

We also found that when negative articles made up a greater percentage of the alcohol-related news article impressions, the likelihood of adolescent drinking reduced. The publication of disapproving articles in newspapers may both reflect and influence community attitudes towards alcohol use[21]. The increase in the proportion of negative alcohol news articles impressions over the study period may indicate that drinking, or some aspects of drinking, became less acceptable in the Australian community. The proportion of negatively-slanted opinion articles increased in most states, peaking in 2008. Between 2005 and 2008 a number of changes relating to alcohol attracted much debate in the media, including a

70% increase in the tax on ready-to-drink alcohol products[44]. The increase in the number of negative newspaper articles reported here likely reflects these debates.

We used a CPI-based measure of alcohol price, which reflected whether price changes in all alcohol products were more or less than general CPI changes and did not find a significant association between this measure and adolescent drinking in multivariable analyses. While CPI price measures have been associated with changes in total population alcohol consumption[45], it may be that this measure is not appropriate for adolescents. As indicated, the tax on ready-to-drink alcoholic products increased substantially in 2008[46]. However as these drinks were only one category of many included in the CPI calculations, their price increase may have had little impact on the overall relation of alcohol prices to the CPI. Future work may benefit from using a measure of alcohol price that is more appropriate for adolescents. However as most adolescents do not buy their own alcohol, work may be needed to determine what the most appropriate price measure is for adolescents.

We have previously reported a positive association between alcohol advertising TRPs and adolescent drinking when not adjusting for policy implementation or outlet density[39]. The present study suggests that while adjusting for these other factors may reduce some of the influence of television alcohol advertising on youth drinking, the significant association between past 3-month alcohol advertising and risky drinking suggests alcohol advertising still contributes to youth drinking. Our previous work showed a significant inverse association between potential exposure to anti-drink-driving television advertising and risky drinking[39]. While the current study found a similar negative association, it was not statistically significant. Potential exposure to alcohol control advertising was also not related to the drinking outcomes assessed here. Levels of anti-drink driving advertising and alcohol control advertising on television were extremely low compared to levels for alcohol advertising. At

these low levels, alcohol control advertising is unlikely to influence youth drinking relative to the influence of alcohol advertising, alcohol outlet density and even alcohol policy variables.

A number of limitations to our study need to be noted. Although the study used data from several survey years, our analyses are cross-sectional. However measures for the three policy variables, advertising and newspaper article exposure and outlet density reflected periods prior to students' surveys. Nevertheless our findings need to be confirmed in longitudinal studies. Our policy measures did not consider enforcement, so we do not know the extent policies were implemented in practice. Further our study only considered some policy domains and some components within these domains, with policies relating to the retail serving of alcohol (responsible service, liability laws) and school education policies for example not included in our analysis. As these and other policies may also influence an adolescent's alcohol-related environment and their alcohol use, further studies are needed to examine the association between adolescent drinking and an expanded number of policies. We did not seek input from a broad range of alcohol control experts regarding the implementation levels used to assess policy strength. While we followed procedures used to assess tobacco policy implementation, further work is needed to validate our policy implementation indicators. As our advertising exposure measure focused only on television, adolescents total advertising exposure is likely to be underestimate. Secular changes, including the way adolescents socialise (e.g. greater use of social media and the internet) may also be contributing to declines in youth drinking[5]. Further work is needed to determine the influence of different secular trends on youth drinking and to examine their relative influence on youth drinking. Finally, restrictions on data availability meant we could only study the association between alcohol-related policies and adolescent drinking for students residing in capital cities of four Australian states. While the majority of Australians

live in capital city areas, studies using data from all adolescents regardless of where they live, are needed to confirm our findings.

Despite these limitations, findings from the current study provide important quantitative information on the potential role of a number of alcohol-related policies on adolescents' drinking behaviours. Specifically, our results suggest that policies that aim to reduce the number of alcohol outlets and their trading hours in a community and reduce exposure to alcohol advertising may reduce the likelihood of youth drinking. In addition, our findings suggest that strengthening policies regulating youth access may help to reduce risky drinking in youth. Although our findings need to be confirmed by other studies, they provide evidence that population-directed policies that influence alcohol availability and promotion may also influence adolescents' alcohol use.

#### **ACKNOWLEDGEMENTS**

This study was supported by a National Health & Medical Research Council (NHMRC) Partnership Project Grant #1037104 with the Victorian Health Promotion Foundation and the Foundation for Alcohol Research and Education.

M.L. is supported by a NHMRC Early Career Fellowship and by FARE. R.R. is supported by FARE. T.C. is supported by a NHMRC Career Development Fellowship. M.W. is supported by a NHMRC Principal Research Fellowship.

Funding for data collection for the student surveys used in this paper was made available from Cancer Councils and state health departments as well as the Australian Government Department of Health and Ageing.

TRPs data used in this study are from OzTAM Pty Ltd, provided through Nielsen Australia.

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Table 1: Policy components and scores for youth access, trading hours and drink driving policy domains.

Component of legislation – Policy Topic	Effectiveness rating	Maximum Potential score	Policy strength score	Extent of policy
<b>Youth access policy domains</b>			0	Absent
Prohibits sale and supply of liquor to minors by licensee/ permittee on licensed premise	2	11.76	5.88	Partial (in company of parent/guardian &/or ancillary to meal)
			11.76	Prohibited
Prohibits sale of liquor to adult/parent when purchasing on behalf of minor	2	11.76	0	Absent
			11.76	Prohibited
Requires proof of age card/document to bear a photograph	2	11.76	0	Absent
			11.76	Yes
It is an offence for a person (other than parent/guardian or someone authorised by parent) to supply liquor in a residence to a minor. It is also an offence to not responsibly supervise minor if liquor is supplied	2	11.76	0	Absent
			3.92	Partial (parent/guardian can supply)
			7.84	Partial (covers both parent/ guardian supply and responsible supervision)
			11.76	Prohibited (no one can supply minors with alcohol)
Prohibits supply of liquor to minor in public place	2	11.76	0	Absent
			5.88	Partial (in company of parent/ guardian)
			11.76	Prohibited
Prohibits minors to enter or remain on premises where liquor is served by a licensee	2.5	14.7	0	Absent
			7.35	Partial (in company of parent/ guardian &/or ancillary to meal)

Component of legislation – Policy Topic	Effectiveness rating	Maximum Potential score	Policy strength score	Extent of policy
			14.7	Prohibited
Prohibits minors to possess/consume liquor on licensed premises	2.5	14.7	0	Absent
			7.35	Partial (in company of parent/ guardian &/or ancillary to meal)
			14.7	Prohibited
Prohibits minors to possess/consume liquor in public place	2	11.76	0	Absent
			5.88	Partial (in company of parent/ guardian &/or ancillary to meal)
			11.76	Prohibited
<b>Total</b>	<b>17</b>	<b>100</b>	<b>n/a</b>	
<b>Trading hours policy domains</b>				
Off-premises outlets trading hours: Monday-Saturday	2	11.11	0	Midnight close
			5.56	11pm close
			11.11	10pm close or earlier
Off-premises outlets trading hours: Sunday	2	11.11	0	Midnight close
			3.7	11pm close
			7.41	10pm close or earlier
			11.11	No trading
Off-premises outlets: 24-hour trading	2	11.11	0	Yes
			11.11	Prohibited
On-premises outlets trading hours: Monday-Saturday	2	11.11	0	No restriction/ commissioner's discretion
			5.56	Midnight close
			11.11	11pm close
On-premises outlets trading hours: Sunday	2	11.11	0	No restriction/ commissioner's discretion
			2.78	Midnight close

Component of legislation – Policy Topic	Effectiveness rating	Maximum Potential score	Policy strength score	Extent of policy
			5.56	11pm close
			8.33	10pm close or earlier
			11.11	No trading
On-premises outlets: 24-hour trading	2	11.11	0	Yes
			11.11	Prohibited
General (hotels) outlets trading hours: Monday-Saturday	2	11.11	0	No prescribed hours (commissioner's discretion)
			5.56	Midnight close
			11.11	11pm close
General (hotels) outlets trading hours: Sunday	2	11.11	0	No restriction/ commissioner's discretion
			2.78	Midnight close
			5.56	11pm close
			8.33	10pm close or earlier
General (hotels) outlets: 24-hour trading	2	11.11	11.11	No trading
			0	Yes
			11.11	Prohibited
<b>Total</b>	<b>17.5</b>	<b>100</b>	<b>n/a</b>	
<b>Drink-driving policies assessed</b>				
<b>Youth</b>				
Graduated licensing for young drivers^	2	11.43	3.81	2-step Probationary licensing scheme
			3.81	Passenger restrictions
			3.81	Night-time curfew
Legal blood alcohol limit	3	17.14	0	BAC 0.02

Component of legislation – Policy Topic	Effectiveness rating	Maximum Potential score	Policy strength score	Extent of policy
			17.14	BAC zero
Penalties for exceeding legal limit <sup>^</sup>	2	11.43	3.81	Fine
			3.81	Demerit points
			3.81	Disqualification/ cancellation of license
Blood alcohol limit for licence suspension	2	11.43	0	Absent
			3.81	BAC 0.15+
			7.62	BAC 0.09-0.14
			11.43	BAC 0.01-0.08
<b>Adult</b>				
Legal blood alcohol limit	3	17.14	0	BAC more than 0.05
			17.14	BAC less than 0.05
Penalties for exceeding legal limit	2	11.44	2.86	Fine
			2.86	Demerit points
			2.86	Disqualification/ cancellation of license
			2.86	Age dependent penalty
Blood alcohol limit for licence suspension	2	11.43	0	Absent
			3.81	BAC 0.15+
			7.62	BAC 0.09-0.14
			11.43	BAC 0.01-0.08
Alcohol ignition interlocks	1.5	8.57	0	Absent
			4.29	Discretionary (determined by courts)
			8.57	Yes
<b>Total</b>	<b>17.5</b>	<b>100</b>	<b>n/a</b>	

<sup>^</sup> each policy element scored as being present or not, with total scores for policy topic determined by summing each element's score.

Table 2: Sample characteristics of metropolitan students aged 12 to 17 years in each survey year

Variable	Survey year				Chi-square for year
	2002	2005	2008	2011	p-value
<b>Number of students surveyed</b>					
State A (n)	2,628	3,232	3,166	3,735	n/a
State B (n)	3,445	3,275	4,931	5,066	n/a
State C (n)	2,336	2,728	1,905	3,201	n/a
State D (n)	1,396	1,262	1,822	1,822	n/a
Total (n)	9805	10497	11824	13119	n/a
Age % 12-15 year olds	68.8	73.0	70.3	71.1	0.83
Males (%)	49.8	50.7	49.8	49.5	0.98
<b>SES categories (%)</b>					
Lowest 40% (most disadvantaged)	27.1	27.2	34.4	25.4	0.20
Middle 40%	42.5	28.8	39.0	40.6	
Top 20% (least disadvantaged)	30.4	34.0	26.6	34.0	
<b>Self-rated academic ability (%)</b>					
Average or below	58.6	56.6	57.4	53.9	0.01
<b>Smoked in past month (%)</b>	17.8	12.9	10.9	8.5	<0.001
<b>Alcohol use</b>					
<b>Drinking in past month (%)</b>					

All students	47.4	41.8	36.0	26.3	<0.001
<b>Drinking at risk in previous seven days (%)</b>					
All students	10.3	10.0	7.5	5.2	<0.001

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*Note.* Population weighted percentages.

Table 3: Strength of alcohol control policy (expressed as percent of total possible implementation score) in the three domains<sup>a</sup>, 2001-2010

Variable	Policy year (survey year)				Relative	
	2001 (2002)	2004 (2005)	2007 (2008)	2010 (2011)	% Change <sup>a</sup> 2001- 2010	Year trend p-value
<b>Youth access:</b>						
<b>Total</b>	<b>58</b>	<b>61</b>	<b>63</b>	<b>64</b>	<b>10</b>	<b>&lt;0.001</b>
State A	44	56	56	56	27	n/a
State B	61	61	61	61	0	n/a
State C	69	69	81	81	17	n/a
State D	65	65	65	73	12	n/a
<b>Trading hours:</b>						
<b>Total</b>	<b>51</b>	<b>51</b>	<b>50</b>	<b>58</b>	<b>14</b>	<b>&lt;0.001</b>
State A	54	54	54	54	0	n/a
State B	46	46	46	57	24	n/a
State C	58	58	55	55	-5	n/a
State D	50	50	50	69	38	n/a
<b>Drink-driving: Total</b>						
<b>Total</b>	<b>50</b>	<b>63</b>	<b>71</b>	<b>79</b>	<b>58</b>	<b>&lt;0.001</b>
State A	55	71	74	86	56	n/a
State B	57	79	82	82	44	n/a
State C	28	28	39	65	132	n/a

Variable	Policy year (survey year)				Relative	
					%	
					Change <sup>a</sup>	Year
					2001-2010	trend
	2001 (2002)	2004 (2005)	2007 (2008)	2010 (2011)	2001-2010	p-value
State D	48	48	63	71	48	n/a

n/a: p-value not calculated as all students in a state received same score for each year.  
 ^ Strength of implementation of the three policy domains. Policy domain scores standardised to range from 1 to 100. Higher scores indicate stronger policy  
 a: change in score between 2001 and 2010 expressed as percentage of 2001 score..

Table 4: Average past 3-month adolescent alcohol advertising TRPs, per cent negatively slanted alcohol-related news impressions in past 4-months and average alcohol outlet density, 2002-2011

Variable	Survey year				% Change <sup>a</sup>	Year
	2002	2005	2008	2011	2002-2011	trend
						p-value
<b>Television Advertising TRPs</b>						
<b>Past 3 month Alcohol advertising</b>						
<b>Total</b>	<b>6500</b>	<b>6508</b>	<b>2603</b>	<b>2544</b>	<b>-61%</b>	<b>&lt;0.01</b>
State A	6613	5464	2018	2551	-61%	<0.01
State B	6728	7586	2616	2701	-61%	<0.01
State C	6334	6441	3779	2512	-60%	<0.01
State D	6001	6526	2356	1906	-68%	<0.01
<b>Past 3 months alcohol control advertising</b>						
<b>Total</b>	181	0	62	8	<b>-96%</b>	<b>&lt;0.01</b>
State A	312	0	172	0	-100%	<0.01
State B	0	0	0	0	0	n/a
State C	408	0	100	32	n/a%	n/a
State D	1	0	0	0	n/a	n/a
<b>Past 3 months anti-drink driving advertising</b>						
<b>Total</b>	398	476	234	168	<b>-58%</b>	<b>&lt;0.01</b>
State A	756	971	649	466	-38%	<0.01

Variable	Survey year				% Change <sup>a</sup>	Year
	2002	2005	2008	2011	2002-2011	trend
						p-value
State B	404	0	132	80	-80%	<0.01
State C	0	683	31	20	n/a	<0.01
State D	377	0	0	0	-100%	<0.01
<b>Outlet density per 1000 adults per postcode area (mean)<sup>b</sup></b>						
<b>Total</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>1.1</b>	<b>0.0</b>	0.74
State A	1.2	1.5	1.5	1.5	25%	0.32
State B	1.0	1.1	1.1	1.1	10%	0.41
State C	0.7	0.7	0.8	0.7	0	0.73
State D	1.6	0.9	1.2	0.9	-44%	0.04
<b>Newspaper coverage</b>						
<b>Percent negatively slanted news article impressions in previous 4 months (mean %)</b>						
<b>Total</b>	<b>43.4</b>	<b>53.0</b>	<b>60.9</b>	<b>54.7</b>	<b>26%</b>	<b>&lt;0.01</b>
State A	45.3	49.4	54.8	57.1	26%	<0.01
State B	46.7	58.1	63.9	53.6	14%	<0.01
State C	44.8	52.7	65.3	61.2	37%	<0.01
State D	29.3	49.8	58.7	32.6	11%	<0.01
<b>Percent negatively slanted opinion</b>						

Variable	Survey year				% Change <sup>a</sup>	Year
	2002	2005	2008	2011	2002-2011	trend
						p-value
<b>articles impressions in previous 4 months (mean %)</b>						
<b>Total</b>	13.7	27.8	36.4	17.1	+25%	<0.01
State A	6.7	22.4	29.2	4.3	-36%	<0.01
State B	9.2	34.9	28.5	34.4	+273%	<0.01
State C	25.7	38.8	99.3	0	-100%	<0.01
State D	17.7	0	4.4	30.8	+74%	<0.01
<b>Alcohol CPI relative to total CPI</b>						
<b>Total</b>	<b>93.5</b>	<b>96.4</b>	<b>97.7</b>	<b>98.8</b>	<b>6%</b>	<b>&lt;0.01</b>
State A	91.1	95.0	98.6	98.7	8%	<0.01
State B	92.1	96.3	97.2	98.8	7%	<0.01
State C	96.5	97.6	98.4	98.9	2%	<0.01
State D	95.3	97.5	96.6	99.3	4%	<0.01
<b>Adult past year drinking prevalence<sup>c</sup></b>						
<b>Total</b>	50%	53%	52%	49%	-2%	<.001
State A	48%	51%	49%	46%	-4%	<.001
State B	50%	50%	50%	48%	-4%	<.001
State C	53%	59%	59%	53%	0	.876

Variable	Survey year				% Change <sup>a</sup> 2002-2011	Year trend	p-value
	2002	2005	2008	2011			
	State D	48%	52%	53%	51%	4%	<.001

<sup>a</sup> Change in values between 2002 and 2011 expressed as percentage of 2002 value.

<sup>b</sup> Mean number of outlets per 1,000 residents across all postcodes included in the study.

<sup>c</sup> Years data are for: 2001, 2004, 2007 and 2010.

Table 5: Univariable and Multivariable odds ratios (OR) and 95% confidence intervals (CI) for associations between past month drinking and past week risky drinking and alcohol policies, potential television advertising exposure, outlet density, alcohol related newspaper coverage, and alcohol CPI change adjusting for student level covariates

Variable	Past month drinking			Past week risky drinking		
	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
<b>Alcohol Control policy domains (in 10% increments)</b>						
Youth access and supply	0.59 (0.49, 0.71)**	0.95 (0.84, 1.07)	0.92 (0.81, 1.04)	0.63 (0.49, 0.81)**	0.80 (0.67, 0.95)**	0.79 (0.66, 0.95)*
Trading hours	0.65 (0.54, 0.77)**	0.82** (0.71, 0.94)	0.80 (0.69, 0.94)**	0.66 (0.51, 0.85)**	0.87 <b>(0.70, 1.08)</b>	0.85 (0.66, 1.09)

Variable	Past month drinking			Past week risky drinking		
	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Drink-driving	0.77 (0.72, 0.82)**	1.05 (0.98, 1.13)	1.00 (0.93, 1.09)	0.82 (0.75, 0.88)**	1.05 <b>(0.95, 1.17)</b>	1.02 (0.90, 1.14)
<b>Outlet density past year/1000 population</b>						
Alcohol outlet density			1.02 (1.00, 1.03)*			1.04 (1.02, 1.06)**
<b>Television advertising TRPs/1000</b>						
Past 3-months Alcohol advertising TRPs			1.03 (1.00, 1.05)	1		1.05 (1.00, 1.10)*

Variable	Past month drinking			Past week risky drinking		
	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Past-3 month Government advertising TRPs			1.05 (0.73, 1.52)			1.03 (0.58, 1.85)
Past- 3 month Anti- Drink Driving advertising TRPs			0.99 (0.83, 1.18)			0.83 (0.63, 1.09)
<b>Newspaper coverage (in 10% increments)</b>						
Disapproving news article impressions			0.99 (0.98, 0.99)**			1.00 (0.99, 1.00)

Variable	Past month drinking			Past week risky drinking		
	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>	Uni- variable	Single policy Multivariable <sup>a</sup>	Full policy model Multivariable <sup>b</sup>
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
over 4 months						
Disapproving opinion						
article impressions						
over 4 months			1.00 (1.00, 1.00)			1.00 (0.99, 1.00)
<b>Price CPI index</b>			1.02 (0.99, 1.06)			1.04 (0.99, 1.10)
<b>Adult drinking rates</b>			1.06 (1.02, 1.09)**			1.09 (1.05, 1.14)**

<sup>a</sup>Adjusted for clustering of students at the school level and state, all variables, excluding other policy variables in the table, and sex, age, socioeconomic status, students self-reported academic ability, language spoken at home, smoking in the past month, and timing of survey (year and month).

<sup>b</sup>Adjusted for clustering of students at the school level and state, all policy variables, all other variables in the table, and sex, age, socioeconomic status, students self-reported academic ability, language spoken at home, smoking in the past month, and timing of survey (year and month).

\* $P < .05$ , \*\*  $p < 0.01$ .