Response to Question on Notice
Personal choice and community impacts
11 September 2015
Public Health Association Australia

Question

Proof Hansard- 11 September 2015, pages 11-12:

Senator LINDGREN: Professor, would you concede that it would be very difficult for governments who rely on taxpayers' money to fund campaigns to even meet those of the conglomerate of big companies out there—and I will not name who they are—that produce junk food? It would be very difficult for a government to even match that sort of campaigning. Would you concede that would be the case?
Prof. Moore: In fact we have already attempted it and we were quite successful with regard to tobacco. The taxation of tobacco was originally used in order to fund VicHealth, Healthway in Western Australia, Healthpact in the ACT and so on. Money was specifically quarantined for that purpose and so they would buy out advertising. That is one of the ways that we allowed sporting bodies, for example, to remain funded without needing to rely on tobacco funding. That, amongst other things, is part of the reason we have amongst the lowest proportion of smokers in the world. We could consider the same thing with regard to alcohol. The fact that we have alcohol marketing associated with motorsport is an extraordinary thing. The fact that we have it associated with surfing is an extraordinary thing. The marketers know very well why they do it and it does dominate the thinking of people, particularly young people.
CHAIR: I am curious about that—it 'dominates the thinking'. What evidence do you have for that? How do you know? You are always referring young people. How do you know that Ms Dalla is influenced by that marketing? What do you base that on?
Prof. Moore: I would take that question on notice and we will provide you with some evidence.
CHAIR: Okay.

Answer:

Introduction:

If marketing had no power to persuade then we wonder why industry would spend hundreds of millions of dollars on marketing

Broad evidence:
The National Preventative Health Taskforce (Moodie et al) addressed marketing on alcohol, tobacco and 'junk' food in its report.

- Junk Food
  - World Health Organisation, *Diet, nutrition and the prevention of chronic disease.* Report of a joint WHO/FAO expert consultation in WHO Technical Series 916, 2013. WHO Geneva (Taskforce reference 63)
- Tobacco (a series of references are available in the Taskforce Report) including:
  - National Cancer Institute. *Part 2-Tobacco marketing, The Role of the Media. Smoking and Tobacco Control* Monograph No. 19, Bethesda, MD: US Department of Health and Human Services, National Institutes of Health, National Cancer Institute, 2008; Available from: http://cancercontrol.cancer.gov/tcrb/monographs/19/index.html

- Audrain-McGovern J, Tercyak KP, Shields AE, Bush A, Espinel CF and Lerman C. *Which adolescents are most receptive to tobacco industry marketing? Implications for counter-advertising campaigns Health Communication*. 2003;15:499-513. Available from: http://www.informaworld.com/smpp/content~content=a785835589

- Alcohol (a series of references are available in the Taskforce Report) including:
  - King E, Taylor J and Carroll T. *Australian alcohol beverage advertising in mainstream Australian media 2003 to 2005: expenditure, exposure and related issues*. Research and Marketing Group, Department of Health and Ageing, 2005. Available from: www.alcohol.gov.au/internet/alcohol/publishing.nsf/content/BD9ED91EDC948718CA2571E30023FAD3/$File/aust-mainstream.pdf
  - Collins D and Lapsley H. The avoidable costs of alcohol abuse in Australia and the potential benefits of effective policies to reduce the social costs of alcohol. Canberra: Department of Health and Ageing, 2008. Available from: www.nationaldrugstrategy.gov.au/internet/drugstrategy/publishing.nsf/Content/mono70

Key Action Item 3 on Alcohol in the Taskforce report is "Regulate Alcohol Promotion" (p248) and the Technical Paper on Alcohol recommends the "Partial or complete bans on the advertising and promotion of alcohol"

Other references that might be useful to the Committee include:

- Junk Food
  - Cairns G, Angus K, Hastings G. *The Extent, Nature and Effects of Food Promotion to Children: A Review of the Evidence to December 2008*. Geneva (CHE): World Health Organisation; 2009.
  - Chung A, Shill J, Swinburn B, et al *An analysis of potential barriers and enablers to regulating the television marketing of unhealthy foods to children at the state government level in Australia* BMC Public Health. 2012; 12: 1123.
- Tobacco
  - Melanie Wakefield, Kerri Coomber, Meghan Zacher, Sarah Durkin, Emily Brennan, *Michelle Scollo Australian adult smokers' responses to plain packaging with larger graphic health warnings 1 year after implementation: results from a national cross-sectional tracking survey* Tobacco Control Volume 24, Issue Suppl 2 2015 *"Conclusions: "The specific objectives of plain packaging were achieved and generally sustained among adult smokers up to 12 months after implementation".*
  - Choi W, Ahluwalia J, Harris K and Okuyemi K. *Progression to established smoking: the influence of tobacco marketing*. American Journal of Preventive Medicine 2002; 22:228-32.
    "*This study provides evidence that receptivity to tobacco advertising and promotions is an important factor in progressing from experimentation to established smoking among adolescents".*
- Alcohol

  Oversight "Anderson et al's 2009 systematic review summarises the impact of exposure to alcohol marketing quite neatly:

  "we conclude that alcohol advertising and promotion increases the likelihood that adolescents will start to use alcohol, and to drink more if they are already using alcohol."
  - Anderson et al (attached)
  - Ellickson et al (attached)
  - Snyder et al (attached)
  - Stacy et al (attached)

- Smith & Foxcroft (attached)
  "The results of these cohort studies are supported by findings in cross-sectional surveys which consistently report associations between increased exposure to alcohol advertising or marketing and drinking behaviour" and *"The data from these studies suggest that exposure to alcohol advertising in young people influences their subsequent drinking behaviour. The effect was consistent across studies …"* (page 9 of 11) (It should be noted that Smith & Foxcraft also carries a number of disclaimers about confounding factors)

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SPECIAL ISSUE: THE MESSAGE AND THE MEDIA

Impact of Alcohol Advertising and Media Exposure on Adolescent Alcohol Use: A Systematic Review of Longitudinal Studies

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Abstract — Aims: To assess the impact of alcohol advertising and media exposure on future adolescent alcohol use. **Methods:** We searched MEDLINE, the Cochrane Library, Sociological Abstracts, and PsycLIT, from 1990 to September 2008, supplemented with searches of Google scholar, hand searches of key journals and reference lists of identified papers and key publications for more recent publications. We selected longitudinal studies that assessed individuals' exposure to commercial communications and media and alcohol drinking behaviour at baseline, and assessed alcohol drinking behaviour at follow-up. Participants were adolescents aged 18 years or younger or below the legal drinking age of the country of origin of the study, whichever was the higher. **Results:** Thirteen longitudinal studies that followed up a total of over 38,000 young people met inclusion criteria. The studies measured exposure to advertising and promotion in a variety of ways, including estimates of the volume of media and advertising exposure, ownership of branded merchandise, recall and receptivity, and one study on expenditure on advertisements. Follow-up ranged from 8 to 96 months. One study reported outcomes at multiple time-points, 3, 5, and 8 years. Seven studies provided data on initiation of alcohol use amongst non-drinkers, three studies on maintenance and frequency of drinking amongst baseline drinkers, and seven studies on alcohol use of the total sample of non-drinkers and drinkers at baseline. Twelve of the thirteen studies concluded an impact of exposure on subsequent alcohol use, including initiation of drinking and heavier drinking amongst existing drinkers, with a dose response relationship in all studies that reported such exposure and analysis. There was variation in the strength of association, and the degree to which potential confounders were controlled for. The thirteenth study, which tested the impact of outdoor advertising placed near schools failed to detect an impact on alcohol use, but found an impact on intentions to use. **Conclusions:** Longitudinal studies consistently suggest that exposure to media and commercial communications on alcohol is associated with the likelihood that adolescents will start to drink alcohol, and with increased drinking amongst baseline drinkers. Based on the strength of this association, the consistency of findings across numerous observational studies, temporality of exposure and drinking behaviours observed, dose-response relationships, as well as the theoretical plausibility regarding the impact of media exposure and commercial communications, we conclude that alcohol advertising and promotion increases the likelihood that adolescents will start to use alcohol, and to drink more if they are already using alcohol.

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INTRODUCTION

Adolescents are frequent users of alcohol and increasingly consume it in a risky fashion. For example, in Europe, nearly all (over 9 in 10) 15- to 16-year-old students have drunk alcohol at some point in their life (Currie *et al*., 2004), starting on average just after $12\frac{1}{2}$ years of age. Data from the 2003 European School Survey Project on Alcohol and Other Drugs (ESPAD) found that the average amount of alcohol drunk by 15- to 16-year olds on the last drinking occasion was 60 g (six drinks) (Hibell *et al*., 2004). Over one in eight (13%) of 15- to 16-year-old students reported being drunk more than 20 times in their life, and over one in six (18%) reported binge drinking (5+ drinks on a single occasion) three times or more in the last month. Binge drinking in young people has increased across much of Europe in the last 10 years, although more so in the early part of this period (Anderson and Baumberg, 2006).

Children and adolescents have greater vulnerability to alcohol than adults. As well as usually being physically smaller, they lack experience of drinking and its effects. They have no context or reference point for assessing or regulating their drinking, and, furthermore, they have built up no tolerance to alcohol. From mid-adolescence to early adulthood, there are major increases in the amount and frequency of alcohol consumption and alcohol-related problems (Bonomo *et al*., 2004; Wells *et al*., 2004). Those with heavier consumption in their mid-teens tend to be the ones with heavier consumption, alcohol dependence and alcohol-related harm, including poorer mental health, poorer education outcome and increased risk of crime in early adulthood (Jefferis *et al*., 2005, Englund *et al*., 2008; Pitkänen *et al*., 2008). During adolescence, alcohol can lead to structural changes in the hippocampus (a part of the brain involved in the learning process) (De Bellis *et al*., 2000) and at high levels can permanently impair brain development (Spear, 2002). Drinking by adolescents and young adults is associated with automobile crash injury and death, suicide and depression, missed classes and decreased academic performance, loss of memory, blackouts, fighting, property damage, peer criticism and broken friendships, date rape, and unprotected sexual intercourse that places people at risk for sexually transmitted diseases, HIV infection and unplanned pregnancy (Bonomo *et al*., 2001). Adolescents aged 14–17 years with alcohol use disorders show substantially greater brain activation to alcoholic beverage pictures than control youths, predominantly in brain areas linked to reward, desire and positive affect (Tapert *et al*., 2003). The degree of brain response to the alcohol pictures is highest in youths who consume more drinks per month and report greater desires to drink.

Alcohol advertising is one of the many factors that have the potential to encourage youth drinking. For young people who have not started to drink, expectancies are influenced by normative assumptions about teenage drinking as well as through

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the observation of drinking by parents, peers and models in the mass media. Research has linked exposure to portrayals of alcohol use in the mass media with the development of positive drinking expectancies by children and adolescents (Austin and Knaus, 2000; Austin *et al*., 2000). Young people with more positive affective responses to alcohol advertising hold more favourable drinking expectancies, perceive greater social approval for drinking, believe drinking is more common among peers and adults, and intend to drink more as adults (Chen and Grube, 2002). Fourteen-year olds with greater exposure to advertisements in magazines, at sporting and music events and on television are more advertisement-aware than those with less exposure, as are teens who watch more TV, pay attention to beer advertisements and know adults who drink (Collins *et al*., 2003). Amongst 10- to 17-year olds, the perceived likeability of beer advertisements is a function of the positive affective responses evoked by the specific elements featured in the advertisements. Liking of specific elements featured in beer advertisements, such as humour, animation and popular music, significantly contribute to the overall likeability of these advertisements and subsequently to advertising effectiveness indicated by an intent to purchase the product and brand promoted by the advertisements (Chen *et al*., 2005).

These studies, however, do not establish whether alcohol advertising actually influences young people's drinking behaviour. Answering this question requires either experimental studies, which are not possible for ethical reasons, or systematic observation of real world effects.

One approach to observation is to look for correlations between the amount of alcohol advertising and the amount of drinking taking place in a particular jurisdiction using econometric methods. It is hypothesized that, if advertising has an effect, drinking rates should shadow temporal variations in the amount of advertising. Establishing such a link, however, is problematic for a number of reasons. First, measures of the amount of advertising, which typically use expenditure on advertising, vary in the accuracy and inclusiveness. For example, in the UK, whilst mass media advertising expenditure has been estimated to be £202.2 million (UK Cabinet Office, 2003), expenditure on promotion more generally (taking in point of sale promotion, electronic communications and other 'below the line' activity) is thought to approach £800 million (Drink Pocket Book, 2006). Second, the analysis depends on the construction of a complex model that ascribes values for all the different variables—including price, drinking restrictions and disposable income—as well as advertising (Harrison and Godfrey, 1989; Casswell, 1995; Saffer, 1996) that might be implicated. Third, the duration of advertising effects need to be taken into account: a powerful campaign may continue to have an effect years after it was first deployed. Indeed, advertisers deliberately try to enhance these long-term effects as part of their effort to build brands. Fourth, variations in the amount of advertising tend to be minor (few comprehensive bans have been introduced) so researchers are looking for potentially very small changes in drinking patterns. Finally, and most importantly given our focus on adolescents, measures of the overall amount of advertising do not necessarily give an accurate picture of youth exposure.

To obtain this focus on young people, it is necessary to do research directly with them. Such investigations come in two forms: cross-sectional and longitudinal. Cross-sectional studies take a snapshot of advertising exposure (awareness and/or appreciation) and levels of drinking, and look for correlations between the two. However, because they cannot show whether exposure preceded drinking uptake, they leave open the possibility that any correlation is as likely to reflect drinking encouraging young people to take an interest in advertising, as vice versa.

As Aitken *et al*. (1988) point out, however, paying attention to advertising presupposes that the viewer is getting some benefit or reward from it—most fundamentally that they are doing the right thing by consuming the advertised product—and advertisers deliberately design their work to provide such rewards (Aitken, 1988). Thus, cross-sectional data can shed a useful light on the role of alcohol advertising in young people's drinking.

Longitudinal studies take the debate a step further by measuring exposure at time *A*, and how this relates to drinking at time *B*. Provided potential confounders (such as peer and parental drinking) are controlled for, any correlation indicates a causative relationship. This review therefore focuses on longitudinal studies with young people. It builds on and extends reviews conducted by Jernigan (2006), Smith and Foxcroft (2007) and Booth *et al*. (2008).

METHODS OF THE REVIEW

Types of studies

We considered studies that examined the association between alcohol advertising and promotion, the portrayal of alcohol in mass media, and adolescent drinking. We included only longitudinal studies in which individuals' drinking behaviour and exposure to advertising, receptivity or attitudes to alcohol advertising, or brand awareness were measured at baseline and individuals' drinking behaviours were then measured in one or more follow-ups. Experimental, cross-sectional and time-series or econometric studies were excluded from this review.

Types of participants

Studies that included adolescents 18 years of age or younger were reviewed with the exception of US-based studies, where the legal drinking age of 21 years was taken as the cut-off.

Types of intervention

The 'intervention' is alcohol mass media advertising by the industry, including portrayal of alcohol in the mass media, alcohol promotion and media exposure that contained alcohol advertisements. Mass media channels of communication include advertising delivered through television, radio, newspapers, outdoor advertising, posters, etc. Alcohol promotion includes give-aways and items bearing alcohol industry logos. In practice, the measure of exposure to the intervention may not discriminate between specific types of advertising, since adolescents are exposed to many sources.

Types of outcome measures

Self-reported drinking status.

Search strategy

We searched MEDLINE, the Cochrane Library, Sociological Abstracts, and PsycLIT, from 1990 to September 2008, supplemented with searches of Google scholar, hand searches of

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key journals and reference lists of identified papers and key publications for more recent publications. The search strategy combined the following four sets of terms. *Child Search Strategy*: Child(MeSH) OR Child* OR Schoolchild* OR School age* OR Kid OR Kids OR Adolescent(MeSH) OR Adoles* OR Teen* OR Boy* OR Girl* OR Minors(MeSH) OR Minors OR Schools(MeSH) OR Primary school* OR Secondary school* OR Elementary school* OR High school* OR Highschool* Or College* OR Universit* OR Young OR Youth*. *Alcohol Search Strategy*: Alcohol drinking(MeSH) OR Alcohol* drink* OR Alcoholic beverages(MeSH) OR Alcohol* beverage* OR Beer(MeSH) OR Beer* OR Wine(MeSH) OR Wine* OR Liquor* OR Spirits OR Alcohol*. *Marketing Search Strategy*: Marketing(MeSH:NoExp) OR Marketing OR Advertising as Topic(MeSH) OR Advert* OR Promot* OR Sponsor* OR Television(MeSH) OR Televis* OR TV* OR Radio(MeSH) OR Radio OR Radios OR Motion picture* OR Movie* OR Film* OR Display* OR Billboard* OR Poster OR Posters OR Newspapers(MeSH) OR Newspaper* OR Magazine* OR Mass media(MeSH) OR Internet(MeSH) OR Internet. *Longitudinal Studies Search Strategy*: Longitudinal Studies(MeSH) OR Longitud* OR Cohort* OR Follow-up* OR Prospectiv* OR Subsequ* OR Wave*.

There were four stages in the review process:

1. Studies identified in the electronic search were prescreened for relevance by a reviewer. Articles were rejected if the title and abstract did not focus on the impact of alcohol advertising or promotion on adolescent drinking behaviour. If the article could not be rejected with certainty, the full text was obtained and screened by two reviewers.
2. Two reviewers independently assessed relevant studies for inclusion.
3. One reviewer extracted data from included studies using a form and a second reviewer checked these data.
4. Studies were combined using qualitative narrative synthesis because there was heterogeneity among study designs, type of 'intervention' and outcomes measured.

RESULTS

The search strategy resulted in 810 titles, reduced to 729 following deletion of duplicates. Initial assessment of the titles and abstracts reduced the number of papers to 131, further reduced to 29 on closer assessment of the abstract and full text. Sixteen publications reporting on 13 studies met the inclusion criteria. One longitudinal study was excluded, because the use of alcohol at baseline was not accounted for (Wingood *et al*., 2003). No additional methodological quality criteria were used in selecting papers for inclusion. Table 1 summarizes the studies, describing the alcohol marketing and media exposures, the drinking behaviour outcome measures, the sample and study designs, the survey methods, the baseline sample sizes and follow-up rates, the methods of analyses, the confounders analysed and the outcome at follow-up. The individual studies were not ranked for methodological quality.

The 13 studies included a variety of different age groupings that ranged between 10 and 21 years of age at baseline. Ten studies were conducted in the United States, one in Belgium, one in Germany and one in New Zealand. The years during which data were collected ranged between 1985 and 2005. Baseline sample sizes ranged from 630 to 6522, with a total of over 38,000 at follow-up across the 13 studies.

Two studies investigated the impact of media exposure (television and music videos) on the use of alcohol; three studies, alcohol use in motion pictures; two studies, a range of marketing exposure (including TV, magazines, concession stands at sports or music events, and in store advertisements); two studies, ownership of alcohol branded merchandise; one study, TV alcohol commercials alone; one study, recall and liking of advertisements; one study, outdoor advertising; one study, brand recognition, recall and receptivity to alcohol marketing; and one study, volume of and expenditure on advertisements.

In 10 studies, participants were followed up once after baseline. The duration of the follow-up was 12 months, 18 months, 24 months, 30 months and 12–26 months. One study followed up participants at 8, 16 and 24 months. The New Zealand study reported outcomes at multiple time points, 3 years, 5 years and 8 years. One study evaluated participants at four time points and presents results for follow-up after 21 months taking the multiple time points into account in the analysis (Snyder *et al*., 2006). Attrition rates varied from 31% to 100% (the sample with 100% follow-up included and analysed all students with alcohol consumption measurements at baseline and follow-up (Casswell and Zhang, 1998). Three studies used imputation for missing data (Ellickson *et al*., 2005; Collins *et al*., 2007; Wills *et al*., 2008); all other studies excluded participants with missing data from the analyses.

All studies measured alcohol use at follow-up. Eight studies provided data on initiation of alcohol use amongst non-drinkers (Robinson *et al*., 1998; Ellickson *et al*., 2005; Sargent *et al*., 2006; Fisher *et al*., 2007; Henriksen *et al*., 2008; Hanewinkel and Sargent, 2008; McClure *et al*., 2008; Wills *et al*., 2008), three studies on maintenance and frequency of drinking amongst baseline drinkers (Robinson *et al*., 1998; Casswell and Zhang, 1998; Casswell *et al*., 2002; Ellickson *et al*., 2005) and six studies on alcohol use of the total sample of non-drinkers and drinkers at baseline (Connolly *et al*., 1994; Stacy *et al*., 2004; Van den Bulck and Beullens, 2005; Snyder *et al*., 2006; Collins *et al*., 2007; Pasch *et al*., 2007).

Study samples included random samples of youth (Snyder *et al*., 2006; McClure *et al*., 2008; Wills *et al*., 2008), randomly selected schools with all participants invited to participate (Stacy *et al*., 2004; Van den Bulck and Beullens, 2005; Sargent *et al*., 2006), all elementary schools in a State (Collins *et al*., 2007; Hanewinkel and Sargent, 2008), all middle and high schools in a city (Henriksen *et al*., 2008), all participants at six schools, with no information given on how the schools were selected (Robinson *et al*., 1998), the original sample of participants selected for participation in an RCT (Ellickson *et al*., 2005; Pasch *et al*., 2007), all participants of a longitudinal cohort study (Fisher *et al*., 2007) and a sub-sample of a longitudinal cohort study who had exposure and outcome data available at all follow-up periods (Connolly *et al*., 1994; Casswell and Zhang, 1998; Casswell *et al*., 2002).

Measurement of exposure and alcohol use were by self-reported questionnaires in seven studies (Robinson *et al*., 1998; Stacy *et al*., 2004; Ellickson *et al*., 2005; Collins *et al*., 2007; Henriksen *et al*., 2008; Hanewinkel and Sargent, 2008), by both face-to-face interview and computer interview in one (Connolly

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Table 1. Summary of included studies

Study [reference] Country Baseline survey date Age group (years)	Study objective Alcohol marketing and media exposure Drinking behaviour outcome measure[a]	Sample/study design	Survey method	Baseline sample size	Follow-up (months) Follow-up rate	Analysis	Covariates/ confounders analysed	Outcome at follow-up
Connolly *et al*. (1994) New Zealand 1985 13 and again at 15	Impact of recall of alcohol-related mass media material on subsequent alcohol consumption Alcohol portrayals in mass media (e.g. TV, radio) including commercial advertising (product advertising, sponsorship) and entertainment media Average amount of alcohol consumed on an occasion during a year; maximum of typical amounts consumed across all drinking locations; total frequencies of beer and other drinks (wine and spirits) consumed	Participants in a multi-disciplinary longitudinal study of growth and development	Face-to-face interview at 13 and 15 years; computer survey at 18 years	667 who were present for alcohol interviews at ages 13, 15 and 18 years	60 and 36 435/667 (65%) (analysed sample)	Multiple regression analyses; only *P* values reported	Gender Socio-economic status Living situation Occupation Peer approval of people who drink Number of moderation messages recalled Number of hours of TV watched	Impact of number of commercial advertisements recalled at ages 13 and 15 on average and maximum amounts of alcohol consumed on an occasion and on frequency of drinking. There was no significant relationship with wine and spirit consumption. For males, number of commercial advertisements recalled at age 15, but not 13, predicted average ($P = 0.047$) and maximum amounts of beer ($P = 0.008$) consumed on an occasion. For females, the number of commercial advertisements recalled at age 13, but not 15, predicted frequency of beer consumption ($P = 0.029$)
Robinson *et al.* (1998) USA (California) 1994 Mean age (SD) 14.6 (0.5)	Impact of media exposure on initiation of alcohol use and maintenance of drinking among existing drinkers Exposure to TV, music videos (on music channels and rental videotapes); videotape viewing; computer and video game use on typical school and weekend days Frequency of lifetime alcohol drinking (a typical single serving); frequency of drinking in past 30 days	Non-randomized prospective survey across six public high schools	Paper survey	2609	18 1583/2609 (61%)	Analysis included 1533 students with complete data on both alcohol use and media exposure Logistic regression to calculate odds ratios adjusted for main confounders	Age Gender Ethnicity Hours of other media watched	During the 18-month follow-up, 325 (36%) non-drinkers began drinking. Controlling for the effects of age, gender, ethnicity and the exposure to other media, each 1-h increase per day in TV viewing associated with a 9% increased risk for initiating drinking [OR=1.09 (1.01–1.18)]. Each 1-h increase per day in watching music videos associated with a 31% increased risk for initiating drinking [OR=1.31 (1.17–1.47)]. During the 18-month follow-up, 322 (51%) drinkers continued drinking. There were no significant associations between media exposure and maintenance of drinking

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Casswell and Zhang (1998). Same sample as Connolly *et al.* (1994) above New Zealand 1990/199118	Impact of liking for alcohol advertising and brand allegiance at age 18 years on drinking and alcohol-related aggression at age 21 years Exposure to alcohol advertising (e.g. TV, radio, cinema advertising and sponsorship) Combined average volume of beer drunk at own home, someone else's home, hotel, tavern or bar, sports clubs and nightclubs over previous year; whether ever experienced problems with aggression associated with drinking alcohol	Participants in a multi-disciplinary longitudinal study of growth and development	Computer-based questionnaire and face-to-face supplementary interview	Sample restricted to 630 of those who drank beer at age 18 years	36 Sample restricted to those who provided information at baseline and follow-up	Structural equation modelling analysis	Gender	The measure of liking of alcohol advertising was based on responses to three items: 'alcohol advertisements have plenty of action'; 'alcohol advertisements show the type of people I admire'; 'Comparing alcohol adverts generally with other ads, which of the following you most agree with?' Liking of alcohol advertisements at age 18 predicted beer consumption at age 21 [standardized coefficient 0.36 (SE = 0.06, $T = 6.6$)]
Casswell *et al.* (2002). Same sample as Connolly *et al.* (1994) and Casswell and Zhang (1998) above New Zealand 1990/1991 18	To identify developmental trajectories of drinking between the ages of 18 and 26 years and to identify variables at age 18, including liking of alcohol advertisements, which predict these trajectories Exposure to alcohol advertising (undefined/no examples given) Frequency of drinking over past year and typical quantity consumed per drinking occasion at own home, someone else's home, hotel, tavern or bar, sports clubs and nightclubs	Participants in a multi-disciplinary longitudinal study of growth and development	Computer-based questionnaire and face-to-face supplementary interview	Sample restricted to 714 participants who were drinkers of alcohol at ages 18, 21 and 26 years	Trajectories of drinking over 96 months Sample restricted to 714 participants who were drinkers of alcohol at ages 18, 21 and 26 years	Trajectory analysis using method of Jones *et al.* (2001)	Gender Ease of access to alcohol Access to licensed premises Living arrangement Parental consumption Level of education Age of onset of regular drinking	The measure of liking of alcohol advertising was based on responses to three items: 'alcohol advertisements have plenty of action'; 'alcohol advertisements show the type of people I admire'; 'Comparing alcohol adverts generally with other ads, which of the following you most agree with?' Liking of alcohol advertisements at age 18 did not project trajectories of quantities of alcohol consumed per occasion for both men and women over the age 18–26 years. Liking of alcohol advertisements at age 18 marginally predicted being in a higher trajectory for frequency of drinking for men (OR = 1.6, $P =$ 0.0706) but not for women over the age 18–26 years
Stacy *et al*. (2004) USA (California) 2000 US seventh grade (normally 12–13 years)	Impact of TV alcohol commercials on alcohol use Exposure to TV adverts for alcohol aired during 20 popular TV series; and during professional baseball, college and professional basketball, professional soccer and hockey, and on subscription sports channel in previous months Frequency of drinking alcohol in last 30 days; frequency of '3-drink episodes' (≥3 drinks of typical serving size in a row over couple of hours) in past 30 days	Randomized prospective survey across 20 middle schools	Paper survey	2998	12 2250/2998 (75%)	Logistic regression to calculate odds ratios adjusted for main confounders	Gender Ethnicity School Participation in team sports Perception of friends' alcohol use Perceived peer approval of alcohol use Intentions to use alcohol Perceptions of adults' alcohol use General TV viewing frequency Ad memorability (cued-recall and drawing)	Each 1 standard deviation increase in alcohol advertising exposure associated with 44% increase in odds of beer drinking (95% CI: 27%–61%), 34% increase in odds of wine/liquor drinking (95% CI: 17%–52%) and 26% increase in odds of consuming three or more drinks on one occasion (95% CI: 8%–48%) during previous 30 days

(*Continued*)

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Table 1. Continued

Study [reference] Country Baseline survey date Age group (years)	Study objective Alcohol marketing and media exposure Drinking behaviour outcome measure[a]	Sample/study design	Survey method	Baseline sample size	Follow-up (months) Follow-up rate	Analysis	Covariates/ confounders analysed	Outcome at follow-up
Van den Bulck and Beullens (2005) Belgium 2003 13 and 16 years of age	Impact of TV and music video exposure on the use of alcohol whilst going out Exposure to music video TV programmes and normal TV viewing between 7 am and 1 am Number of alcoholic drinks usually drank when going out (to a bar, party, disco, etc.) ranging from never to ≥9; frequency of going out	Randomized prospective survey across 15 secondary schools	Paper survey	2546	12 1648/2546 (65%)	Multiple regression analyses accounting for covariates	Age School year Gender Pubertal development status Smoking status Drinking at baseline	Quantity of alcohol consumed while going out at the follow-up period related to overall TV viewing ($\beta = 0.068$, $t = 3.46$, $P = 0.001$) and music video exposure ($\beta = 0.073$, $t = 3.05$, $P = 0.004$)
Ellickson *et al.* (2005) USA (South Dakota) 1997 Seventh grade (age 12–13 years)	Impact of exposure to different forms of alcohol advertising on the initiation of alcohol use and the frequency of drinking amongst existing drinkers, and whether exposure to a prevention programme mitigates any such relationship Exposure to TV beer advertisements (aired during professional football and basketball and during four late-night shows popular with age group), magazines with alcohol advertisements, beer concession stands and in-store advertisement displays Frequency of drinking alcohol in the past year (five options ranging from 0 to +20 times)	Randomized controlled trial of an alcohol use prevention programme involving 41 middle schools in South Dakota	Paper survey	3780	30 3111/3780 (82%)	Regression models accounting for covariates	Gender Ethnicity TV viewing Adult drinking Adult approval of drinking Peer drinking Peer approval of drinking School grades Religiosity Parental monitoring Alcohol beliefs Deviance Impulsivity Playing sports Exposure to prevention programme	48% of 1206 grade 7 non-drinkers consumed alcohol in previous year at grade 9. Controlled for main confounders, including exposure to all different types of advertisement and the impact of the prevention programme, exposure to beer concession stands at sports or music events predicted drinking onset for non-drinkers in previous 12 months (OR = 1.42, $P < 0.05$), whereas exposure to TV beer adverts (OR = 1.05, $P > 0.05$), magazines with alcohol advertisements (OR = 1.12, $P > 0.05$) and exposure to in-store advertisements (OR = 1.06, $P > 0.05$) did not. Weekly TV viewing, controlled for alcohol advertisement exposure, was inversely related to the onset of drinking, explained as a 'babysitter' effect, whereby youth who watch more TV have fewer opportunities to drink. 77% of 1905 grade 7 drinkers consumed alcohol in the previous year at grade 9. Exposure to beer concession stands at sports or music events predicted the frequency of drinking amongst existing drinkers in previous 12 months (coefficient = 0.09, $P < 0.05$), as did exposure to magazines with alcohol advertisements (coefficient = 0.10, $P < 0.05$), whereas exposure to TV beer adverts (coefficient = −0.01, $P > 0.05$) and exposure to in-store advertisements (coefficient = 0.02, $P > 0.05$) did not

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Snyder *et al.* (2006) USA 1999 15–26 (52% <21)	Impact of alcohol advertising expenditures and the degree of exposure to alcohol advertisements on alcohol use Exposure to beer, liquor and premixed drink advertising on TV, radio, magazines and billboards in the past month. Industry data on amount spent on alcohol advertisements Number of alcoholic drinks in the past months calculated from the frequency of drinking alcohol (past 4 weeks); average quantity of drinks per day and maximum quantity of drinks on one occasion	Randomized survey sample from 24 Nielsen media markets	Telephone interviews	1872	21 588/1872 (31%)	Multi-level linear modelling to calculate event rate ratio	Gender Age Ethnicity School status Alcohol sales per capita	For those aged <21 years, each additional alcohol advertisement seen increased the number of drinks consumed in the previous month by 1% (event rate ratio = 1.01, 95% CI: 1.001–1.021). Each additional dollar spent on alcohol advertisements increased the number of drinks consumed in the previous month by 2.8% (event rate ratio = 1.028, 95% CI: 1.002–1.056). Seeing more or fewer advertisements in a particular month than he or she typically saw is a predictor of drinking (event rate ratio = 1.002, 95% CI: 1.001–1.003)
Sargent *et al.* (2006) USA (New Hampshire and Vermont) 1999 10–14	Impact of exposure of alcohol use in motion pictures on the initiation of alcohol use Exposure to US box-office hit movies content-coded for on-screen alcohol use (consumption, implied possession and purchase of alcohol) Initiation of alcohol drinking (unknown to parents)	Randomized cross sectional survey with longitudinal follow-up on non-drinkers at baseline in 15 middle schools	Paper survey, with follow-up telephone interview	3577 non-drinkers	12–26 (average 17 months) 2406/3577 (67%)	Multi-level logistic regression to calculate ORs adjusted for covariates	Grade Gender Parental education School performance Self-esteem Maternal support Maternal control Rebelliousness Sensation seeking Smoking status	357/2406 (15%) initiated drinking alcohol. Exposure predicted use of alcohol during the follow-up period (OR = 1.15, 95% CI: 1.06–1.25). Analysis with quadratic exposure effect (OR = 0.996, 95% CI: 0.992–0.999) showed that the relationship between exposure of alcohol use in motion pictures and the initiation of alcohol use was stronger among adolescents in lower exposure categories
Collins *et al.* (2007) USA (South Dakota) 2000 Grade 6 (11–12)	Impact of exposure to alcohol marketing on beer use Exposure to beer ads on TV (on subscription sports channel, other sports programmes, other TV programmes), in magazines, on radio, at concessions stands and on in-store displays Ownership of alcohol promotional items (hats, posters or T-shirts) Beer drinking over the past year	Longitudinal survey across 39 schools	Paper survey	1786	12 1699/1786 (95%) and 1740/1786 (97%)	Multivariate with logit and logistic regression	Gender Ethnicity Parental monitoring Adult drinking Peer drinking Parent approval Friend approval School grades Depressed mood Deviance Impulsivity Religiosity Sports participation Weekly TV viewing Parental education Grade 6 beer drinking	17% reported past year beer drinking at grade 7. OR (95% CI) for beer drinking were: ESPN cable network (an American cable TV network dedicated to broadcasting and producing sports-related programming 24 h a day) 1.08 (0.83–1.42); other sports beer ads 1.19 (1.01–1.40); other TV beer ads 1.13 (0.95–1.34); magazine reading 0.96 (0.87–1.06); radio listening 1.17 (1.00–1.37); beer concessions 1.01 (0.91–1.13); in-store beer displays 1.03 (0.92–1.14); beer promotional items 1.76 (1.23–2.52). Joint effect of exposure to ads from all sources: $F(8, 28) = 8.36$, $P < 0.0001$; and from three TV sources: $F(3, 33) = 3.35$, $P < 0.05$. Twenty percent of youth in 75th percentile of alcohol marketing exposure at grade 6 reported past year beer drinking at grade 7, compared with 13% in 25th percentile

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Table 1. Continued

Study [reference] Country Baseline survey date Age group (years)	Study objective Alcohol marketing and media exposure Drinking behaviour outcome measure[a]	Sample/study design	Survey method	Baseline sample size	Follow-up (months) Follow-up rate	Analysis	Covariates/ confounders analysed	Outcome at follow-up
Fisher *et al.* (2007) USA 1998–1999 11–18	Impact of ownership of or willing to use alcohol promotional item on the initiation of alcohol use and subsequent binge drinking Exposure to alcohol advertisements or TV commercials; alcohol promotional item (e.g. hat, T-shirt, bag) ownership and willingness to use Initiation of alcohol drinking (ever sipped or had whole serving of alcoholic drink); ever binge drinking (≥5 drinks in few hours) in past year	Non-random prospective cohort study of never drinking children of mothers in Nurses' Health Study II	Postal survey	16,882 recruited in 1996; 11,834 completed follow-up in 1998 and 1999. Sample comprised 5511 non-drinkers who completed alcohol questions in 1998 and 1999	12 11,834/16,882 (70%) Analysis confined to the 511 non-drinkers	Multivariate logistic regression	Age Pubertal status Race Geographical area Social self-esteem Athletic self-esteem Global self-esteem Scholastic self-esteem Cigarette smoking Family composition Family dinner at home Adults drink at home Siblings <21 drinking Peer drinking Attitudes and beliefs about alcohol consumption	611/3283 girls (19%) and 384/2228 boys (17%) initiated alcohol use. The odds ratio of alcohol initiation during the 12-month period was 1.74 (1.37–2.19) for girls and 1.78 (1.36–2.33) for boys for those who owned or were willing to use an alcohol promotion item compared with those who did or would not. 149/611 drinking girls (24%) and 112/384 drinking boys (29%) engaged in binge drinking. The odds ratio of binge drinking amongst drinkers was 1.79 (1.16–2.77) for girls and 0.87 (0.51–1.48) for boys for those who owned or were willing to use an alcohol promotion item compared with those who did or would not
Pasch *et al.* (2007) USA (Chicago) 2003 Mean age 12.2 years	Impact of exposure of outdoor alcohol advertisements within 1500 feet (457 m) of 63 Chicago schools on alcohol use Outdoor alcohol advertisements, including at bus shelters/benches, on billboards, outside liquor, grocery, or convenience stores or outside bars. Content-coded on a 22-item system for theme(s) Drinking behaviour measures include the frequency of drinking alcohol over past 30 days; frequency of drinking ≥5 drinks over past 2 weeks	Sixth grade students in project Northland Chicago, a randomized controlled trial of an alcohol use prevention programme involving 61 public schools in Chicago	Digital camera and GPS positioning of alcohol advertisements; paper survey of alcohol use and intentions	4137	24 2586/4137 (62.5%)	Mixed-effect regression models	Gender Ethnicity School socio-economic status Exposure to other forms of alcohol advertising Awareness of outdoor advertising Prevention programme	On average, each school site had 14.8 alcohol advertisements within 1500 feet (457 m). 2027/2586 (78%) students followed up were non-users of alcohol at baseline, but the initiation of alcohol use was not reported. Exposure to alcohol advertisements at sixth grade did not predict alcohol behaviour amongst sixth grade alcohol users and non-users at eighth grade, but, amongst sixth grade non-users, did predict at eighth grade intentions to use (e.g. 'do you think you will be drinking alcohol in the next month'), $f = 6.29$, $P = 0.01$ and outcome expectancies, $f = 4.62$, $P = 0.03$

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Henriksen *et al.* (2008) USA (California) 2003 10–15	Influence of alcohol advertising and promotions on the initiation of alcohol use Exposure to alcohol advertising (beer and vodka mix products) and to alcohol branded items (e.g. T-shirt, lighter, matches, hat or sunglasses) Initiation of alcohol use (either finished a serving of alcoholic drink ever, in last 30 days or last 7 days) and transition to current drinker (finished ≥1–2 servings of alcoholic drink in last 30 days)	Non-random longitudinal survey of adolescents from three middle and two high schools in Tracy California (pop 56,929) in the Survey of Teen Opinions about Retail Environments, a longitudinal study primarily of smoking initiation	Paper survey	1527 non-drinking students	12 1080/1527 (71%)	Logistic regression to calculate odds ratios	Grade Gender Ethnicity Parental drinking Peer drinking Perceived peer drinking Perceived peer approval of drinking Risk taking Unsupervised hours after school Self-reported grades	29% of never drinkers at baseline had initiated alcohol use at follow-up. Brand recognition, OR = 1.15 (1.02–1.29); brand recall, OR = 1.16 (1.05–1.29) and high receptivity to alcohol marketing, OR = 1.77 (1.27–1.48) predicted initiation. When receptivity to alcohol marketing was controlled, recall and recognition no longer statistically significantly predicted alcohol initiation
Hanewinkel and Sargent (2008) Germany 2005 10–16 (mean age 12.4)	Influence of exposure to alcohol use in movies on the initiation of alcohol use Exposure to Germany's box-office hit movies content-coded for on-screen alcohol use (consumption, implied possession and purchase of alcohol) including viewing on TV, DVD and video Initiation of alcohol drinking (unknown to parents); ever binge drinking (≥5 drinks in a row within 2 h)	Random selection of 42 schools of which 27 secondary schools participated in Schleswig–Holstein, a State of Germany; 85% of all fifth–ninth grade students surveyed	Paper survey	3432 never drinkers	12–13 months 2708/3432 (79%)	Generalized linear models using log link, adjusted for clustering	Age Gender School socio-economic status Parental drinking pattern Parenting style Friend drinking School performance TV in bedroom TV watching time Sensation seeking/rebelliousness	The estimated mean movie alcohol exposure was 3.2 h, subsequently divided into four quartiles. Thirty-three percent of students initiated drinking without parental knowledge and 14% binge drinking (five or more drinks within 2 h). Compared with quartile 1, the adjusted RRs (95% CI) for drinking without parental knowledge were 1.42 (1.16–1.74) for Q2, 1.94 (1.65–2.28) for Q3 and 2.0 (1.69–2.37) for Q4; and for binge drinking 1.44 (0.96–2.17) for Q2, 1.95 (1.27–3.0) for Q3 and 2.23 (1.48–3.37) for Q4

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Table 1 Continued

Study [reference] Country Baseline survey date Age group (years)	Study objective Alcohol marketing and media exposure Drinking behaviour outcome measure[a]	Sample/study design	Survey method	Baseline sample size	Follow-up (months) Follow-up rate	Analysis	Covariates/ confounders analysed	Outcome at follow-up
Wills *et al*. (2008) USA 2003 10–14	Influence of exposure to alcohol use in movies on ever use of alcohol, binge drinking and alcohol-related problems Exposure to US box-office hit movies content-coded for on-screen alcohol use (consumption, implied possession and purchase of alcohol) Initiation of alcohol drinking (unknown to parents); ever binge drinking (≥5 drinks in a row); recent binge drinking; whether experienced problems caused when someone drinks alcohol	Random longitudinal digit dial telephone survey of adolescents aged 10–14 years	Telephone survey with computer-assisted telephone-interviewing procedure	6522	8, 16 and 24 5503/6522 (84%) at 8 months; 5019 (77%) at 16 months; 4574 (70%) at 24 months	Structural equation modelling analysis	Age Gender Ethnicity Parenting (maternal responsiveness and maternal monitoring) Rebelliousness Sensation seeking Self-regulation School performance Availability of alcohol at home Friend's use of alcohol Expectancy about alcohol Parental use of alcohol Parental education Family structure Family income Urbanicity Region	Viewed alcohol use in movies averaged 31 min at baseline, 35 min at 8 months, 30 min at 16 months. Movie alcohol exposure at baseline predicted alcohol use at 8 months (coefficient = 0.1). Movie alcohol exposure between baseline and 8 months did not predict alcohol use at 8 months (coefficient = −0.03), but did predict alcohol problems at 16 months (coefficient = 0.13). Movie alcohol exposure between 8 and 16 months predicted alcohol use at 16 months (coefficient = 0.08). At all times, alcohol use predicted alcohol problems and there were significant indirect and independent effects of movie exposure at baseline, 8 and 16 months on alcohol problems at 24 months
McClure *et al*. (2008). Same sample as Wills *et al*. (2008) above USA 2003 10–14	Influence of ownership of alcohol branded merchandise (ABM) on the initiation of alcohol use and binge drinking ABM (e.g. clothing, headwear, jewellery, key chains, shot glasses, posters, pens) ownership Initiation of alcohol drinking (unknown to parents); ever binge drinking (≥5 drinks in a row)	Random digit dial telephone survey of adolescents aged 10–14 years	Telephone survey with computer-assisted telephone-interviewing procedure	4309 non-drinkers	8 and 16 3762/4309 (87%) at 8 months 3317/4309 (77%) at 16 months	Logistic regression to estimate hazards ratios (HR)	Age Gender Ethnicity Susceptibility to alcohol use (response to peer offers, intentions and positive expectancies) Exposure to movie alcohol use Peer drinking Parent drinking Alcohol availability at home Sensation seeking Rebelliousness Parenting (maternal responsiveness and maternal monitoring) Extracurricular activities School performance TV viewing length of time Parent report education Household income	ABM ownership increased from 11% at baseline to 20% at 16 months. 10% of adolescents tried drinking for the first time and 5% tried binge drinking during each of the two 8-month periods. There was a reciprocal relationship between susceptibility and ABM ownership. Ownership of ABM at baseline did not have a significant direct impact on alcohol initiation at 8 months (HR = 1.41, 95% CI: 0.98–2.01), nor on alcohol initiation between 8 and 16 months (HR = 1.57, 95% CI: 0.99–2.5), but did on initiation of binge drinking at 8 months (HR = 1.80, 95% CI: 1.28–2.54), but not initiation of binge drinking between 8 and 16 months (HR = 1.44, 95% CI: 0.90–2.31). New ownership of ABM at 8 months had a significant direct impact on alcohol initiation at 16 months (HR = 2.31, 95% CI: 1.6–3.35) and initiation of binge drinking at 16 months (HR = 2.22, 95% CI: 1.49–3.32)

[a]Although some included studies measured additional outcomes, this systematic review was concerned with longitudinal studies measuring self-reported drinking behaviour at follow-up. Thus, it is the only outcome measure detailed in this table.

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et al., 1994; Casswell and Zhang, 1998; Casswell *et al*., 2002), by postal survey in one (Fisher *et al*., 2007) and computer-aided telephone interview in three (Snyder *et al*., 2006; Sargent *et al*., 2006; McClure *et al*., 2008; Wills *et al*., 2008). One study used digital photography and GPS positioning to ascertain exposure and self-reported questionnaire for consumption data (Pasch *et al*., 2007).

Connolly *et al.* (1994) investigated the impact of the number of commercial advertisements recalled at ages 13 and 15 years on average and maximum amounts of alcohol consumed on an occasion and on the frequency of drinking and age 18 years amongst 667 participants in a multi-disciplinary longitudinal study of growth and development in New Zealand. There was no significant relationship with wine and spirit consumption. For males, the number of commercial advertisements recalled at age 15, but not 13, predicted average ($P = 0.047$) and maximum amounts of beer ($P = 0.008$) consumed on an occasion. For females, the number of commercial advertisements recalled at age 13, but not 15, predicted the frequency of beer consumption ($P = 0.029$). Although significant relationships were detected, they could have been due to chance, since results for more than 35 statistical tests were reported. Based on the same cohort, Casswell and Zhang (1998) followed 630 aged 18 beer drinkers until age 21 years, and found that liking of alcohol advertisements at age 18 predicted beer consumption at age 21 [standardized coefficient 0.36 (SE = 0.06, $T = 6.6$)]. The measure of liking of alcohol advertising was based on responses to three items: 'alcohol advertisements have plenty of action'; 'alcohol advertisements show the type of people I admire'; 'Comparing alcohol adverts generally with other ads, which of the following you most agree with?' Based on the same cohort, Casswell *et al.* (2002) studied 714 participants who were alcohol drinkers at ages 18, 21 and 26 years, and found that liking of alcohol advertisements at age 18 did not predict trajectories of quantities of alcohol consumed per occasion for both men and women over the age 18–26 years. Liking of alcohol advertisements at age 18 marginally predicted being in a higher trajectory for the frequency of drinking for men (OR = 1.6, $P = 0.0706$), but not for women over the age 18–26 years.

Robinson *et al.* (1998) studied the impact of media exposure (TV, music video and videotape viewing, and computer and video game use) on initiation of alcohol use and maintenance of drinking among existing drinkers amongst 1533 14- to 15-year olds from six public high schools in California. During 18-months follow-up, 325 (36%) baseline non-drinkers initiated drinking and 322 (51%) drinkers continued drinking. Controlling for the effects of age, gender, ethnicity, and the exposure to other media, each 1-h increase per day in television viewing was associated with a 9% increased risk for initiating drinking [OR = 1.09 (1.01–1.18)]. Each 1-h increase per day in watching music videos was associated with a 31% increased risk for initiating drinking [OR = 1.31 (1.17–1.47)]. During 18-month follow-up, 322 (51%) drinkers continued drinking. There were no significant associations between media exposure and the maintenance of drinking.

Stacy *et al.* (2004) studied the impact of TV alcohol commercials on alcohol use amongst 2250 12- to 13-year-old school children in California. At baseline, 16% reported drinking beer, 15% wine and 8% three-drink episodes in the past month. At 12-month follow-up, the prevalence was 18% reported drinking beer, 20% wine and 12% three-drink episodes. At 1-year follow-up, each one standard deviation increase in alcohol advertising exposure as measured by the watched TV shows index was associated with a 44% increase in odds of beer drinking (95% CI: 27–61%), a 34% increase in odds of wine/liquor drinking (95% CI: 17–52%) and a 26% increase in odds of consuming three or more drinks on one occasion (95% CI: 8–48%) during the previous 30 days, controlling for covariates related to drinking behaviour. Self-reported frequency of exposure was also positively associated with beer drinking, OR = 1.21 (95% CI: 1.04–1.41), but not to wine/liquor drinking or three or more drinks on one occasion. The cued-recall memory test and draw-an-event memory test did not show significant relationships with any of the outcomes, and, although the relationships were in the direction of positive associations, there was one exception, the draw-an-event memory test being associated with a reduced risk of beer use (OR = 0.86, 95% CI: 0.75–0.99).

Van den Bulck and Beullens (2005) studied the impact of TV and music video exposure on the use of alcohol whilst going out amongst 2546 first- and fourth-year secondary school students in Flanders, Belgium. Two-thirds of students (64%) watched music videos at least several times a week, and about one-third watched daily. The quantity of alcohol consumed while going out at follow-up period related to overall TV viewing ($\beta = 0.068$, $t = 3.46$, $P = 0.001$) and music video exposure ($\beta = 0.073$, $t = 3.05$, $P = 0.004$).

Ellickson *et al.* (2005) studied the impact of exposure to different forms of alcohol advertising on the initiation of alcohol use and the frequency of drinking amongst existing drinkers, and whether exposure to a prevention programme mitigates any such relationship amongst US adolescents aged 12–13 years. Forty-eight percent of 1206 grade 7 non-drinkers consumed alcohol during the previous year at grade 9. Bivariate relationships found a signicant impact of all types of alcohol advertisement exposure on initiation of drinking. Controlled for main confounders, including exposure to all different types of advertising and the impact of the prevention programme, exposure to beer concession stands at sports or music events predicted the drinking onset for non-drinkers in the previous 12 months (OR = 1.42, $P < 0.05$), whereas exposure to TV beer adverts (OR = 1.05, $P > 0.05$), magazines with alcohol advertisements (OR = 1.12, $P > 0.05$) and exposure to in-store advertisements (OR = 1.06, $P > 0.05$) did not. Weekly television viewing, controlled for alcohol advertisement exposure, was inversely related to the onset of drinking, explained as a 'babysitter' effect, whereby youth who watch more TV have fewer opportunities to drink. Seventy-seven percent of 1905 grade 7 drinkers consumed alcohol in the previous year at grade 9. Exposure to beer concession stands at sports or music events predicted the frequency of drinking amongst existing drinkers in the previous 12 months (coefficient = 0.09, $P < 0.05$), as did exposure to magazines with alcohol advertisements (coefficient = 0.10, $P < 0.05$), whereas exposure to TV beer adverts (coefficient = −0.01, $P > 0.05$) and exposure to in-store advertisements (coefficient = 0.02, $P > 0.05$) did not.

Snyder *et al.* (2006) studied the impact of alcohol advertising expenditures and the degree of exposure to alcohol advertisements (TV, radio, outdoor advertising and magazines) on alcohol use amongst 15- to 26-year olds in 24 Nielsen local geographical media markets (a company that tracks media

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exposure) in USA. Individuals were randomly sampled within households and households within media markets. Local geographical markets were systematically selected from the top 75 media markets in the US representing 79% of the population. For those aged <21 years, each additional alcohol advertisement seen increased the number of drinks consumed in the previous month by 1% (event rate ratio = 1.01, 95% CI: 1.001–1.021). Each additional dollar per capita spent on alcohol advertisements increased the number of drinks consumed in the previous month by 2.8% (event rate ratio = 1.028, 95% CI: 1.002–1.056). Seeing more or fewer advertisements in a particular month than he or she typically saw was a predictor of drinking (event rate ratio = 1.002, 95% CI: 1.001–1.003). The study has been criticized for the attrition in the study sample (from 1872 at wave one to 588 at wave four), and for confusing correlation with causality (Schultz, 2006; Smart, 2006). However, attrition was greatest among the heaviest drinking segment of the sample, suggesting under-estimation in the findings, and although the study provided associational, prospective evidence on alcohol advertising effects on youth drinking, it addressed limitations of other research, particularly the unreliability of exposure measures based on self-reporting (Snyder and Slater, 2006).

Sargent *et al.* (2006) conducted a randomized school-based cross-sectional survey, with longitudinal follow-up amongst 2406 non-drinkers at baseline 12–26 months later, to evaluate the impact of exposure to alcohol use in popular contemporary movies and incident alcohol drinking. Baseline median exposure to alcohol use in 601 movies was 8.6 h, [inter-quartile range (IQR) = 4.6–13.5]. Out of 2406 students, 357 (15%) initiated drinking alcohol. Exposure predicted the use of alcohol during the follow-up period (OR = 1.15, 95% CI: 1.06–1.25). The analysis with quadratic exposure effect (OR = 0.996, 95% CI: 0.992–0.999) showed that the relationship between exposure of alcohol use in motion pictures and initiation of alcohol use was stronger among adolescents in lower exposure categories.

Collins *et al.* (2007) carried out a school-based longitudinal survey that evaluated the impact of exposure of alcohol marketing on beer use amongst 1786 grade 6 students (11- to 12-year olds) 1 year later. Seventeen percent reported past year beer drinking at grade 7. The odds ratios (95% CI) for beer drinking were ESPN cable network (an American cable television network dedicated to broadcasting and producing sports-related programming 24 h a day) 1.08 (0.83–1.42); other sports beer ads 1.19 (1.01–1.40); other TV beer ads 1.13 (0.95–1.34); magazine reading 0.96 (0.87–1.06); radio listening 1.17 (1.00–1.37); beer concessions 1.01 (0.91–1.13); in-store beer displays 1.03 (0.92–1.14); beer promotional items 1.76 (1.23–2.52). The joint effect of exposure to advertisements from all sources: $F(8, 28) = 8.36$, $P < 0.0001$, and from three TV sources: $F(3, 33) = 3.35$, $P < 0.05$. Twenty percent of youth in the 75th percentile of alcohol marketing exposure at grade 6 reported past year beer drinking at grade 7, compared with 13% in the 25th percentile.

Fisher *et al.* (2007) conducted a non-random, prospective cohort study to investigate the impact of ownership of or willingness to use an alcohol promotional item on the initiation of alcohol use and binge drinking (five or more alcohol drinks over a few hours at least once over the past year). Out of 3283 girls, 611 (19%) and of 2228, 384 boys (17%) initiated alcohol use. The odds ratio of alcohol initiation during the 12-month period was 1.74 (1.37–2.19) for girls and 1.78 (1.36–2.33) for boys for those who owned or were willing to use an alcohol promotion item compared with those who did or would not. Out of 611 drinking girls, 149 (24%) and out of 384 drinking boys, 112 (29%) engaged in binge drinking. The odds ratio of binge drinking amongst drinkers was 1.79 (1.16–2.77) for girls and 0.87 (0.51–1.48) for boys for those who owned or were willing to use an alcohol promotion item compared with those who did or would not.

Pasch *et al.* (2007) investigated the impact of exposure of outdoor alcohol advertisements within 1500 feet (457 m) of 63 Chicago school sites of 61 schools that were part of Project Northland Chicago, a randomized controlled trial of an alcohol use prevention programme. On average, each school site had 14.8 alcohol advertisements within 1500 feet (457 m). Out of 2586, 2027 (78%) students followed up were non-users of alcohol at baseline, but initiation of alcohol use was not reported. The exposure to alcohol advertisements at sixth grade did not predict alcohol behaviour amongst sixth grade alcohol users and non-users at eighth grade, but, amongst sixth grade non-users, did predict at eighth grade intentions to use (e.g. 'do you think you will be drinking alcohol in the next month'), $f = 6.29$, $P = 0.01$; and outcome expectancies, $f = 4.62$, $P = 0.03$.

Henriksen *et al.* (2008) used a non-random longitudinal survey to investigate the influence of alcohol advertising and promotions on the initiation of alcohol use amongst 1080 non-drinking students. Twenty-nine percent of never drinkers at baseline had initiated alcohol use at follow-up. Brand recognition, OR = 1.15 (1.02–1.29); brand recall, OR = 1.16 (1.05–1.29); and high receptivity to alcohol marketing, OR = 1.77 (1.27–1.48) predicted initiation. When receptivity to alcohol marketing was controlled, recall and recognition no longer statistically significantly predicted alcohol initiation.

Hanewinkel and Sargent (2008) studied the impact of exposure to alcohol use in movies on initiation of alcohol use amongst 3432 never drinking German adolescents. Estimated mean movie alcohol exposure was 3.2 h, subsequently divided into four quartiles. One-third (33%) of students initiated drinking without parental knowledge and 14% initiated binge drinking (five or more drinks within 2 h) over 12- to 13-month follow-up. Compared with quartile 1, the adjusted RRs (95% CI) for drinking without parental knowledge were 1.42 (1.16–1.74) for Q2, 1.94 (1.65–2.28) for Q3, and 2.0 (1.69–2.37) for Q4; and for binge drinking 1.44 (0.96–2.17) for Q2, 1.95 (1.27–3.0) for Q3, and 2.23 (1.48–3.37) for Q4. The un-adjusted dose–response curve showed that the response was greatest for relatively low exposure adolescents. Adjusting for covariates accentuated this effect, because the attenuation was larger for the highly exposed adolescents; this was probably due to risk factors for alcohol use tending to cluster among the high exposure adolescents who are at risk for alcohol use for reasons other than their excessive media exposure. In another study, Hanewinkel *et al.* (2008) found a positive dose–response relationship between lack of parental movie restriction and risk of initiation of binge drinking amongst the same sample.

Wills *et al.* (2008) studied the impact of exposure to alcohol use in movies on ever use of alcohol, binge drinking and alcohol-related problems amongst a random sample of 6522 US 10- to 14-year olds. A previous survey had shown that 83% of movies viewed by the sample, including 57% of movies rated

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as acceptable for child viewing, depicted alcohol use, with over half (52%), including one in five (19%) of child acceptable movies, containing at least one alcohol brand appearance, exposing the adolescents on average to 5.6 h of movie use and 244 alcohol brand appearances (Cin *et al*., 2008). In the impact study, viewed alcohol use in movies averaged 31 min at baseline, 34 min at 8-month follow-up, and 30 minutes at 16-month follow-up. Movie alcohol exposure at baseline predicted alcohol use at 8 months (coefficient = 0.1). Movie alcohol exposure between baseline and 8 months did not predict alcohol use at 8 months (coefficient = −0.03) but did predict alcohol problems at 16 months (coefficient = 0.13). Movie alcohol exposure between 8 and 16 months predicted alcohol use at 16 months (coefficient = 0.08). At all times, alcohol use predicted alcohol problems and there were significant indirect and independent effects of movie exposure at baseline, 8 and 16 months on alcohol problems at 24 months. Using the same cohort, McClure *et al*. (2008) studied the impact of ownership of alcohol branded merchandise (ABM) on initiation of alcohol use and binge drinking. ABM ownership increased from 11% at baseline [the 8-month measurement period reported by Wills *et al*. (2008)] to 20% 16 months later. Ten percent of adolescents tried drinking for the first time and 5% tried binge drinking during each of the two 8-month periods. There was a reciprocal relationship between susceptibility to alcohol use (three survey items that assessed response to peer offers, intentions and positive expectancies) and ABM ownership. The ownership of ABM at baseline did not have a significant direct impact on alcohol initiation at 8 months (HR = 1.41, 95% CI: 0.98–2.01), nor on alcohol initiation between 8 and 16 months (HR = 1.57, 95% CI: 0.99–2.5), but did on initiation of binge drinking at 8 months (HR = 1.80, 95% CI: 1.28–2.54), but not on initiation of binge drinking between 8 and 16 months (HR = 1.44, 95% CI: 0.90–2.31). New ownership of ABM at 8 months had a significant direct impact on alcohol initiation at 16 months (HR = 2.31, 95% CI: 1.6–3.35) and initiation of binge drinking at 16 months (HR = 2.22, 95% CI: 1.49–3.32).

DISCUSSION

This review identified 13 longitudinal studies that have investigated the relationship between adolescent exposure to alcohol advertising and promotion and drinking. Twelve of the thirteen studies found evidence that such exposure predicts both the onset of drinking amongst non-drinkers and increased levels of consumption among existing drinkers. In each case, researchers controlled for key confounding variables, including family and peer drinking, and relevant demographic variables. The study that did not find an effect on behaviour examined the impact of exposure to outdoor advertising placed within 453 metres of schools (Pasch *et al*., 2007). This study found an impact of exposure on intentions to drink in the next month.

Seven (Robinson *et al*., 1998; Ellickson *et al*., 2005; Sargent *et al*., 2006; Hanewinkel and Sargent, 2008; Henriksen *et al*., 2008; Wills *et al*., 2008) of the eight studies that measured the impact of exposure on initiation of drinking included an interval or continuous level exposure measure, and all seven studies found a dose–response relationship. For example, in the study by Hanewinkel and Sargent (2008), there was a dose–response relationship between hours of movie alcohol exposure and initiation of drinking without parental knowledge and binge drinking, steeper for low hours of exposure than higher; the study by Sargent *et al*. (2006) found a linear association between movie exposure portraying alcohol use and onset of alcohol use from zero incidence at zero exposure to an incidence of 20% when exposure reached 11 h. Two (Robinson *et al*., 1998; Ellickson *et al*., 2005) of the three studies that measured the impact of exposure on maintenance of drinking amongst baseline drinkers included an interval level exposure measure, one of which (Ellickson *et al*., 2005) found a dose–response relationship with the frequency of drinking. Six of the seven studies (Connolly *et al*., 1994; Stacy *et al*., 2004; Van den Bulck and Beullens 2005; Sargent *et al*., 2006; Snyder *et al*., 2006; Pasch *et al*., 2007) on alcohol use of the total sample of non-drinkers and drinkers at baseline included an interval level exposure measure, and all studies found a dose–response relationship. For example, in the study by Stacy *et al*. (2004), each one standard deviation increase in alcohol advertising exposure was associated with a 44% increase in odds of beer drinking, a 34% increase in odds of wine/liquor drinking and a 26% increase in odds of consuming three or more drinks on one occasion during the previous 30 days; in the study by Snyder *et al.* (2006) of US individuals aged 15–26 years, for each additional advertisement seen, the number of drinks consumed increased by 1%, and for each additional dollar spent per capita on alcohol advertisements, the number of drinks consumed increased by 3%; in the study by Collins *et al*. (2007), youth in the 75th percentile of alcohol marketing exposure at grade 6 were 50% more likely to be drinking at grade 7 than youth in the 25th percentile; finally, in the study by Pasch *et al*. (2007), the greater the exposure to outdoor advertising near schools, the greater the intention to drink (although, this study found no impact on drinking behaviour, possibly due to a lack of statistical power). It is clear, therefore, that longitudinal studies demonstrate that alcohol advertising, amongst other factors, encourages youth drinking.

As explained in the introduction, this review focused on longitudinal studies because the dimension of time makes them a particularly powerful way of untangling cause and effect. Nonetheless, cross-sectional studies, although only providing a snapshot of advertising exposure and levels of drinking, have consistently reported correlations between increased exposure and greater likelihood of current drinking (see Kuo *et al*., 2003; McClure *et al*., 2006; Hanewinkel *et al*., 2007; Hurtz *et al*., 2007). For example, the cross-sectional study of Hanewinkel *et al.* (2007) found a dose–response relationship between exposure to alcohol use from popular contemporary movies and alcohol use without parental knowledge and binge drinking in Germany. Therefore, despite their inherently weaker design, cross-sectional studies do corroborate the effects found by longitudinal studies. Advertising influences youth drinking.

Furthermore, both cross-sectional and longitudinal studies are likely to underestimate any effects, because they focus principally on advertising, which is only a part of the promotional effort that is put behind alcohol products. As noted in the introduction, for instance, the most recent estimate for expenditure on alcohol advertising in the UK is actually only a quarter of that for alcohol promotion as a whole. While some of the selected studies looked at promotion (e.g. merchandising) as well as advertising, none looked at the cumulative impact that

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a coherent and fully fledged 'marketing communications mix' (Kotler *et al*., 2005) may have. This communication effort is, in turn, only part of a company's marketing strategy that also includes price promotions, packaging, distribution and product design.

Three limitations should be considered in interpreting the results of this review. First, it included 13 studies that are comparatively heterogeneous. We controlled for quality by including only longitudinal studies that followed a cohort of individuals. We did not attempt to quantify the quality of other study characteristics. One of the limitations of observational studies is the relationship between the variables of interest and other confounding factors. Whilst all the studies to some extent, measured and controlled for other variables likely to be associated with drinking uptake, it is impossible to know if all relevant variables were measured and adjusted for, and thus not possible to know if residual confounder influenced the analysis.

Second, there is a possibility that publication bias may have affected the studies identified for inclusion. Other cohort studies that examined the relationship between advertising exposure and youth drinking but found no association may not have been published or may have been published with no reference to advertising and so would not be retrieved by our search strategy.

Third, the way in which exposure to advertising was operationalized varied across studies (e.g. receptivity, influence and awareness). An important methodological challenge in evaluating evidence on the effect of advertising on drinking behaviour of adolescents is to achieve standardization and consistency in measuring of exposure to alcohol advertising (for an example of standardization, see Jernigan and Ross (2007)).

CONCLUSION

This review found consistent evidence to link alcohol advertising with the uptake of drinking among non-drinking young people, and increased consumption among their drinking peers. This evidence comes from high quality longitudinal studies and is corroborated by weaker cross-sectional ones. Because it focuses on mass media advertising, it almost certainly underestimates the impact of wider alcohol promotion and marketing. These findings are not surprising: exactly the same conclusions have emerged from reviews of the impact of tobacco (Lovato *et al*., 2003) and food (Hastings *et al*., 2003) marketing on young people.

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Does alcohol advertising promote adolescent drinking? Results from a longitudinal assessment

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ABSTRACT

Aims To examine the relationship between exposure to different forms of alcohol advertising and subsequent drinking among US adolescents and assess whether exposure to an alcohol and drug prevention program mitigates any such relationship.

Design Regression models with multiple control variables examined the relationship between exposure to alcohol advertising in grade 8 and grade 9 drinking for two groups of South Dakotan adolescents: (1) seventh-grade non-drinkers ($n = 1206$) and (2) seventh-grade drinkers ($n = 1905$). Interactions between the intervention program and the significant advertising predictors were tested.

Setting Forty-one middle schools in South Dakota, USA.

Participants A total of 3111 seventh-graders followed through grade 9.

Measurements Advertising variables were constructed for four types of alcohol advertising—television, in-store displays, magazines and concession stands. Other predictors tested included measures tapping social influences, social bonds, problem behavior, alcohol beliefs, television exposure and demographics.

Findings For seventh-grade non-drinkers, exposure to in-store beer displays predicted drinking onset by grade 9; for seventh-grade drinkers, exposure to magazines with alcohol advertisements and to beer concession stands at sports or music events predicted frequency of grade 9 drinking. Although exposure to television beer advertising had a significant bivariate relationship with alcohol use for grade 7 non-drinkers, it was not a significant predictor of drinking for either group in multivariate analyses. Participation in the prevention program, ALERT Plus, reduced future drinking for both groups and counteracted the effect of in-store beer displays.

Conclusions Several forms of alcohol advertising predict adolescent drinking; which sources dominate depends on the child's prior experience with alcohol. Alcohol prevention programs and policies should help children counter alcohol advertising from multiple sources and limit exposure to these sources.

KEYWORDS Adolescent health, alcohol, media.

INTRODUCTION

Alcohol is the drug of choice among adolescents in the United States. Slightly over 50% have tried alcohol as early as grade 8; by the end of high school, 80% have tried it and 50% are current drinkers (Johnston *et al.* 2002). These statistics cause concern because adolescents are particularly susceptible to several of the negative consequences associated with drinking—motor vehicle crashes (Zador, Krawchuk & Voas 2000), sexually transmitted diseases (Bailey *et al.* 1999), suicide, death and disability (US Public Health Service 1991; American

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Academy of Pediatrics, Committee on Substance Abuse 1995).

Many observers believe that alcohol advertising contributes to the widespread social acceptability of drinking and thereby fosters both initial and continued use (American Public Health Association Governing Council 1993; Federal Trade Commission 1999; AMA 2002). Television advertising, which is banned in the United States for cigarettes but not for alcohol, is cited as a major source of alcohol advertising available to young people (American Public Health Association Governing Council 1993; AMA 2002). Large numbers of American youth are exposed to television advertisements for alcohol, particularly beer (Morgan *et al.* 1990; Grube & Wallack 1994). Young people typically see these advertisements on sports and certain late night programs popular with youth (Madden & Grube 1994; American Public Health Association Governing Council 1993). Youth exposure to advertising in additional venues, as well as through other promotional activities, is also substantial (Taylor 1990; Center on Alcohol Marketing and Youth 2002). In the United States, most young people are exposed to alcohol advertising in such common locations as supermarkets and corner stores (Center for Disease Control and Prevention 2003); many also see alcohol advertising in magazines and at concerts and sports events (AMA 2002; Center on Alcohol Marketing & Youth 2002).

Does such advertising actually foster drinking among adolescents? To date the answer is unclear. In a review of econometric, survey and experimental studies more than a decade ago, Smart (1988) concluded that 'the evidence indicates little impact of alcohol advertising on alcohol sales or drinking'. However, because advertising's impact may be cumulative over time and thus not apparent for years, he also noted the difficulties of detecting substantial effects on drinking. More recent research focused on children and adolescents has not altered Smart's conclusion. One study found no relationship between advertising and actual drinking behavior (Wyllie, Zhang & Casswell 1998), while others have suggested a positive relationship between advertising exposure (Grube & Wallack 1994) or positive responses to alcohol advertisements (Wyllie, Zhang & Casswell 1998) and intentions to drink as an adult. However, these and earlier studies use cross-sectional data and thus are vulnerable to a reversed causality interpretation—that the relationship exists because drinkers (or probable drinkers) are predisposed to view and remember alcohol advertisements, not because alcohol advertisements promote drinking. In addition, intentions to drink as an adult tap the child's expectations of engaging in an activity that is normative and legal for adults; they are far removed from the child's actual drinking behavior or expectation of drinking while under age.

We know of only one longitudinal examination of advertising exposure during adolescence and subsequent alcohol consumption, a study in which 667 New Zealand adolescents were interviewed at ages 13, 15 and 18 years (Connolly *et al.* 1994). That analysis, which examined whether recalled exposure to alcohol advertising at ages 13 and 15 predicted alcohol consumption at age 18, found mixed results: males who recalled more alcohol advertisements at age 15 consumed more beer at age 18 than those who recalled fewer advertisements, but females who recalled more alcohol advertisements at age 13 drank beer less frequently as 18-year-olds. There were no effects of recalled advertisement exposure at age 13 for males or at age 15 for females, nor were there any effects of recalled exposure on wine and spirits consumption. Overall, therefore, the research to date yields limited evidence that alcohol advertising contributes to adolescent drinking.

Even less understood is whether prevention programs that help adolescents identify and counter persuasive advertising appeals actually dampen their effects. Although several programs include such activities in their curricula (Botvin *et al.* 1995; Perry *et al.* 1996; Ellickson *et al.* 2003), none have examined whether they actually reduce the potential impact of various types of advertising on adolescent drinking. If alcohol advertising does promote drinking, such programs could be important components of policies aimed at curbing adolescent alcohol use.

This study seeks to clarify these issues by examining the impact of alcohol advertising on subsequent drinking in a large sample of seventh-graders drawn from multiple communities in South Dakota and by testing whether ALERT Plus, a drug prevention program delivered to 51% of the seventh-graders in these communities, mitigated any such effects. The analysis is designed to overcome many of the weaknesses associated with earlier research. First, it is prospective, rather than cross-sectional, asking whether seventh-graders who do not drink but are exposed to television and other forms of alcohol advertising as eighth-graders drink in the following year (grade 9), and whether seventh-grade drinkers who are exposed to alcohol advertising as eighth-graders use alcohol more frequently the following year. Secondly, we focus on actual underage drinking, as opposed to drinking intentions. While intentions to drink in the next 6 months or year do predict future drinking, and frequently do so over several years (Stacy, Widaman & Marlatt 1990; Sher *et al.* 1996), many adolescents who drink do not forecast their behavior and many who say they expect to drink in the next 6 months or year do not actually do so. Moreover, intentions to drink as an adult are particularly distal from adolescent drinking and may also reflect a conceptually distinct cognition (i.e. intent to drink when one is legally

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allowed to do so). Thirdly, we sought to rule out other explanations of a longitudinal relationship between alcohol advertising and subsequent drinking. We did so by controlling for numerous variables previously identified as important precursors of adolescent alcohol use. Prior studies have controlled for only a subset of these factors. Fourthly, we assess the effects of several different types of alcohol advertising—on TV, in magazines, in stores and at concerts or sports events. Although multiple advertising sources have been linked to adolescent smoking (Schooler, Feighery & Flora 1996), studies of alcohol advertising effects have focused primarily on television advertisements. Finally, we test whether exposure to the ALERT curriculum dampens any observed advertising effects.

METHOD

Sample

The sample includes 3111 seventh-graders drawn from 41 South Dakota middle schools. The middle schools are participating in the ALERT Plus field trial, designed to test the effectiveness of the ALERT (middle school) and ALERT Plus (middle plus high school) drug prevention curricula. Schools in that study were assigned randomly to one of three treatment conditions, control (no ALERT or ALERT Plus training), ALERT only or ALERT Plus. Restricted randomization enhanced pre-treatment equivalence of the experimental groups in the field experiment, and students in all experimental groups have similar baseline characteristics. Details on the randomization and the baseline comparison of students are found in Ellickson *et al.* (2003). The current study controls for participation in the ALERT Plus program (grades 7–9) and allows us to ask whether such participation moderates the effect, if any, of advertising on drinking behavior.

A total of 3780 students met the eligibility criteria for the current study. Students were eligible if: (1) they were enrolled in an ALERT Plus or control school before the start of the field trial and (2) their parents had not refused permission to participate in the study (90% gave consent). To be included in the analysis sample, each eligible student also needed to complete a survey at all three data collection points—the Grade 7 ALERT Plus Survey (source of baseline drinking information), the Grade 8 Media Survey (source of information on exposure to alcohol advertising and television viewing styles) and the Grade 9 ALERT Plus Survey (source of grade 9 measure of past-year drinking). Of the 3780 eligible students, 484 (12.7%) failed to complete a survey at one or more of the three data points and were excluded from the study. An additional 184 (4.9%) were excluded because they had a missing value for one of the outcome variables. The final analysis sample of 3111 adolescents was 50% female, 88% white, 6.3% Native American and 5.4% other race/ethnicity. Approximately one in five of these adolescents reported grades of C or below at baseline. A comparison of the eligible and analysis samples showed significant differences in participation rates by gender, race/ethnicity (white versus other), and grades (C or below versus other). However, these differences had a minimal impact on the make-up of the analysis sample relative to the eligible sample. The gender, race/ethnicity and grade distributions differed between the samples by just 1.2, 1.9 and 3.4%. To account for any impact of attrition, each of these variables was included as a control in the multivariate analyses.

Data collection

Students completed an in-school paper-and-pencil survey at each of the three time-points. Surveys were administered by trained staff, with parental consent solicited via procedures approved by RAND's Human Subjects Protection Committee. Students were asked to assent at each survey administration. To reduce attrition attributable to school absence or moving, we conducted make-up survey sessions in school and mailed surveys to the movers and chronic absentees.

Prevention curriculum

ALERT Plus seeks to motivate students against using drugs and to give them the skills they need to translate that motivation into effective resistance behavior, an approach that is widely viewed as state-of-the-art in drug prevention (Hansen 1992; Gerstein & Green 1993; Botvin *et al.* 1995; Sussman *et al.* 1995; Drug Strategies 1996; Perry *et al.* 1996). The curriculum seeks specifically to change students' beliefs about drug norms and the social, emotional and physical consequences of using alcohol and other drugs; to help them identify and resist pro-drinking, pro-drug pressures from the media, parents, peers and others; and to build resistance self-efficacy, the belief that one can successfully resist pro-alcohol (other drug) influences (Ellickson & Bell 1990). Specific media lessons focus on identifying different types of advertising (e.g. television commercials, billboards, in-store displays, advertising at special events, promotional items, print media), countering the persuasive appeals used by alcohol advertisers, understanding how pricing, promotion and packaging are designed to affect use, and learning how advertisers have used appeals for targeting different groups over the years. In a recent evaluation, the middle school program was shown to curb alcohol misuse among eighth-graders, including the high-risk early drinkers (Ellickson *et al.* 2003).

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Measures

Drinking status

We measured baseline drinking status after students started grade 7 (fall of 1997), classifying adolescents who indicated that they had never drunk alcohol, even just a few sips, as non-drinkers; those who indicated they had already tried alcohol were classified as drinkers. We obtained the drinking outcome data during the spring of 2000, asking grade 9 survey participants to indicate how often they had used alcohol in the past year (none, one to two times, three to 10 times, 11–20 times, more than 20 times).

Exposure to alcohol advertising

Exposure to television beer advertising was measured with responses to the Grade 8 Media Survey administered during the spring of 1999. To tap this concept, we asked students about the frequency with which they had seen televised sports and late night programs that air beer advertisements, weighting their responses by the Nielsen Monitor-Plus data indicating the number of beer advertisements appearing on each of these programs during the 7-month period (September–March) before administration of the Grade 8 Survey. Based on the Nielsen data and previous literature (Madden & Grube 1994; Snyder *et al.* 2000), we determined that beer advertisements were aired most frequently during professional football and basketball games. Our South Dakota focus groups, conducted prior to survey development, confirmed that our population most often saw advertisements in these venues. Students were asked how often they had watched televised professional football and basketball 'since school started this fall: never or almost never (0–10%), some of the times it's on (about 25%), half of the times it's on (about 50%), most of the times it's on (about 75%) and almost all of the times it's on (90–100%)'. Four late-night shows aired beer advertisements frequently and were mentioned as favorite programs during focus groups: 'The Tonight Show with Jay Leno', 'Late Night with Conan O'Brien', 'The Late Show with David Letterman' and 'Saturday Night Live'. Using similar questions, we asked how often students had watched each of the first three shows between 7 p.m. and bedtime. The question on 'Saturday Night Live' viewing asked about viewing the show on Saturday evenings. Each of the sports and late-night items was then multiplied by the relevant Nielsen Monitor Plus score and all six items were summed to create a single measure of exposure to television beer advertising. To improve its distribution, we used the square root of the measure in our analyses. This parsimonious measure, which reflects the methods of prior research, had a correlation of 0.99 with a broader exposure index that included 10 additional sports (covering 68% of all sports advertisements on cable and network television during the relevant period) and several additional comedy/drama programs. We did not measure exposure to hard liquor or wine advertisements because the former were not aired during the relevant period and the latter were shown seasonally and infrequently.

Other advertising exposure items included frequency of reading magazines that advertise alcohol and frequency of seeing beer concession stands and in-store beer displays. Exposure to alcohol advertising in magazines was measured with the sum of six items. Respondents reported how often in the past year they had looked at *Rolling Stone*, *Sports Illustrated*, *People*, *Playboy*, *Field and Stream* and *Newsweek* on five-point scales (from 'never' to '10 or more times' for monthly magazines, and 'never' to '31 or more times' for weekly magazines). The first four magazines were among the top 10 in recent alcohol advertising (Center on Alcohol Marketing & Youth 2002); *Newsweek* was fifth in distilled spirits advertising in 1997 (Snyder *et al.* 2000). Focus-group data from male and female South Dakota eighth-graders indicated that, among magazines with alcohol advertisements, *Field and Stream* (along with the other five magazines) was one of the most frequently read in our population. It included a substantial number of alcohol advertisements in the months preceding our survey. Recalled exposure to beer concessions was assessed with a single item accompanied by a photograph of a beer concession (such as those at sports events and concerts) that prominently displayed brand names and prices. Respondents reported the number of times they had seen such a place in the past year, on a seven-point scale ranging from 'never' to 'three or more times a week'. Recalled exposure to in-store beer displays was tapped with a parallel item accompanied by a photograph from the refrigerator section of a store that showed stacks of beer and large signs advertising the prices and brands. In previous research, we found that each of these exposures was a strong predictor of adolescents' ability to list beer brands, match brands with slogans and name products in masked beer advertisements (Collins *et al.* 2003). We did not study alcohol advertising on the web because exposure to it was extremely limited in our sample.

Control variables

Television habits. To control for any confounding between viewing programs with beer advertisements and television viewing more generally (which contains portrayals of people drinking), we assessed weekly TV viewing. Eight items asked about the number of hours spent watching television at various times of the day and days of the week (range = 'zero' to 'five hours or more'); these were

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averaged. To control for television viewing that may tap a desire to be more mature and thus might contribute to drinking behavior, we measured separately viewing of specific shows that focus on socially precocious behavior, dating or being 'hip' ('MTV', 'Jerry Springer' and 'Loveline'). None of these aired beer or other alcohol advertisements during the relevant period.

Other drinking predictors. To control for other risk factors typically associated with adolescent drinking (Colder & Chassin 1999; Ellickson *et al.* 2001), we included variables tapping exposure to adults or peers who drink or approve of doing so; weak bonds with family, school or religion; impulsivity and prior behavior that might predispose one to drink; beliefs about alcohol consequences; and socio-demographic factors. These risk factors represent variables highlighted in several different theories of adolescent drug use or other problem behavior (Bandura 1977; Jessor & Jessor 1977; Hawkins & Weis 1985; Bandura 1986; Ajzen 1991). With the exception of religiosity and parental monitoring, the risk factor measures were drawn from the grade 7 ALERT Plus Survey; data on these two variables came from the grade 8 ALERT Plus Survey.

Social context. Four measures of exposure to pro-drinking social influences were included: alcohol use by the most important adult to the respondent (four-point scale from 'never' to '4–7 days a week'), perceived parent approval if they found out the respondent used alcohol (four-point scale, from 'very upset' to 'not at all upset'), peer alcohol use [best friend uses (yes/no) combined with how often the adolescent is with 'kids who are drinking alcohol', alpha = 0.59] and perceived peer approval if friends found out the respondent drank alcohol (four-point scale from 'stop being friends' to 'approve').

Bonds with family, school and religion. Several measures tapped the strength of the respondents' relationship with conventional institutions. Family bonds were measured by parental monitoring, a scale that averaged three five-point items (how often parents or guardians know where you are when you are away from home and tell you what time to be home plus how much free time respondent spends with parents/guardians; range from 0 = all the time to 4 = never, alpha = 0.49). Poor grades (from mostly As to mostly Fs) represented weak bonds with school and low religiosity averaged two items (religion is very important in my life, four-point range from 1 = strongly agree to 4 = strongly disagree; how much religious beliefs influence the way I live, five-point range from 1 = a great deal to 5 = not at all, alpha = 0.81). Although the alpha coefficient was comparatively low for parental monitoring, we included this measure as a control variable because it is an important protective factor against alcohol use.

Attitudes and behavior. To control for pro-drinking attitudes and behavior that might predispose one to drink, we included scales for alcohol beliefs, deviance and impulsivity. The first averaged six items tapping beliefs about the effects of drinking (e.g. relaxes you, slows reaction time, lets you have more fun; range from 1 = strongly agree to 4 = strongly disagree; alpha = 0.69). The second averaged the past-year frequency of six deviant behaviors: skipping school or class, stealing from a store, cheating, vandalism, being sent out of class and breaking and entering (range from not at all to 20 or more times, alpha = 0.81). The third averaged five items: how often respondent acts without thinking, does what feels good without thinking about the future, focuses on the short run, quits if things get too complicated, and gets what respondent wants (range from never to almost always, alpha = 0.80). Because playing team sports is associated frequently with drinking (Eccles & Barber 1999), we also included an indicator tapping participation in school team sports.

Demographics and treatment. Demographic variables included sex (female = 1) and race/ethnicity (white, Native American and other), with white being the omitted variable in the regression models. The treatment variable measured exposure to the grades 7, 8 and 9 lessons in the ALERT Plus curriculum. Table 1 provides descriptive statistics for the covariates and outcome variables by grade 7 drinking status.

Imputation

In multivariate analyses that require complete information for all included variables, even small amounts of missing data for each of the individual predictors can result in a sizeable sample reduction. To circumvent this problem, we imputed missing data using the Sequential Regression Imputation Method implemented in the IVEware application for the SAS software package. This procedure imputes sequentially one variable at a time, conditioning on the observed or imputed values of all other variables. To remove sequence effects, the process was repeated 25 times. We used this method, which allows for imputation of discrete and continuous variables (Raghunathan *et al.* 2001), to generate five completed data sets with missing values imputed by random draws from the sequential regression models.

Analysis

Because the effects of alcohol advertising may differ depending on one's prior experience with alcohol, we

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Table 1 Descriptive data for predictor and outcome variables by grade 7 drinking status.

	Grade 7 non-drinkers (n = 1206)			*Grade 7 drinkers (n = 1905)*		
Predictors	*Mean*	*Std*	*Range*	*Mean*	*Std*	*Range*
Alcohol advertisement exposure[a]						
TV beer advertisements	1158.43	827.00	0–3328	1255.00	816.04	0–3157
Magazines with alcohol advertisements	2.45	2.96	0–24	3.22	3.31	0–24
Beer concession stands	3.59	1.38	1–6	4.01	1.37	1–6
In-store advertisement displays[c]	4.55	1.25	1–6	4.83	1.09	1–6
Television viewing[a]						
Weekly TV viewing	1.86	0.67	0–4	1.87	0.66	0–4
'MTV'	1.94	1.56	0–4	2.37	1.55	0–4
'Jerry Springer'[d]	0.27	0.44	0–1	0.38	0.49	0–1
'Loveline'[d]	0.31	0.46	0–1	0.45	0.50	0–1
Social influences[b]						
Adult drinking	0.69	0.81	0–3	1.17	0.90	0–3
Adult approval of drinking	1.31	0.63	1–4	1.73	0.89	1–4
Peer drinking	0.11	0.29	0–2	0.52	0.61	0–2
Peer approval of drinking	1.72	0.71	1–4	2.30	0.80	1–4
Social bonds						
Poor grades[b]	1.81	0.84	1–5	1.94	0.88	1–5
Low religiosity[a,c]	2.22	0.99	1–4.5	2.51	1.03	1–4.5
Low parental monitoring[a,c]	0.98	0.64	0–4	1.28	0.65	0–4.4
Attitudes and behavior[b]						
Alcohol beliefs	1.36	0.49	1–3.9	1.64	0.61	1–4
Deviance	0.11	0.29	0–5	0.36	0.56	0–5
Impulsivity	0.63	0.59	0–4	1.06	0.74	0–4
Playing sports[d]	0.78	0.39	0–1	0.81	0.41	0–1
Demographics[b]						
Female[d]	0.47	0.50	0–1	0.54	0.50	0–1
Native American[d]	0.06	0.24	0–1	0.06	0.24	0–1
Other race/ethnicity[d]	0.05	0.22	0–1	0.06	0.23	0–1
Treatment[d]	0.57	0.49	0–1	0.57	0.49	0–1
Outcome variables[e]						
Any past year drinking[d]	0.48	0.50	0–1	–	–	–
Frequency of past year drinking	–	–	–	1.88	1.41	0–4

[a]Data from Grade 8 Survey (Spring 1999). [b]Data from Grade 7 Survey (Fall, 1997). [c]Untransformed. [d]Dichotomous variables. [e]Data from Grade 9 Survey (Spring 2000).

examined baseline drinkers and non-drinkers separately. For each group, we first assessed bivariate relationships between the predictors and the relevant ninth-grade drinking outcome (any use in the past year for baseline non-drinkers and past-year frequency of alcohol use for drinkers). We then conducted exploratory data analyses to test for non-linearities in the relationship between past-year drinking and the advertising exposure and control variables. These exploratory analyses revealed that, among non-drinkers, the relationships between subsequent drinking and low religiosity (low parental monitoring) were curvilinear for both scales. In the bivariate model, the probability of subsequent drinking was highest for low religiosity equal to 3 (on a scale ranging from 1 to 5) and for parental monitoring equal to 2 (on a scale ranging from 0 to 6), with lower rates of subsequent drinking at other scale values for both variables. Both relationships were approximated well by quadratic functions of the scales. The exploratory analyses among drinkers also revealed that, although the relationship between frequency of drinking at 7th grade and 9th grade was monotonic increasing, changes in 7th grade frequency below 10 days of past year use were associated with greater increases in 9th grade frequency than changes at higher baseline levels. Therefore, our model was piecewise linear for 7th grade drinking, with the pieces joining at scale values for 3–10 days of use per year.

To assess the impact of each source of alcohol advertising on drinking for baseline non-drinkers, we ran a series of logistic regressions with the dichotomous measure of past-year drinking as the dependent variable. The

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non-drinker models included random school effects and were fitted using approximate maximum likelihood methods implemented by the SAS GLIMMIX macro. For baseline drinkers, we used linear regression models with frequency of past-year drinking as the dependent variable. These models included random school effects and were fitted using maximum likelihood methods implemented in SAS Proc Mixed. The first model for each drinking group shows the relationship between future drinking and each of the advertising variables (television beer advertising, magazines with alcohol advertisements, in-store beer displays, beer concession stands), controlling for treatment. The second model for the non-drinkers adds the other control variables and tests whether treatment interacts with the one significant advertising source (in-store displays). This model tells us whether the relationships between specific types of alcohol advertising and alcohol use are sustained when we control for general and specific television exposure plus multiple risk factors identified as drinking predictors in previous research. It also shows whether exposure to ALERT Plus affected the non-drinkers' reactions to alcohol advertising in stores. The second model for the drinkers includes all the control variables (but does not include any interaction terms because the tests for program interactions with specific types of advertising were not significant for this group).

All test statistics accounted for possible dependence among outcomes for students from the same school (intraschool correlation) and for the imputation of missing values. To account for intraschool correlation, we included random school effects in our models (Raudenbush & Bryk 2002). However, analyses with imputed values will overstate the precision of the estimates unless standard errors account for imputation. To avoid such biased inferences, we created multiple imputations as described above and used variation between coefficient estimates from the five imputed datasets to adjust standard errors and test statistics (Little & Rubin 1987).

RESULTS

Forty-eight per cent of the non-drinkers in grade 7 qualified as past-year drinkers by the spring of ninth grade, indicating a substantial amount of initiation over the period examined. Among the baseline drinkers, 77% reported using alcohol in the past year at the grade 9 follow-up. For both groups, exposure to alcohol advertising was nearly universal. Over 90% reported seeing beer advertisements on television, being exposed to in-store beer displays and seeing beer concession advertising at sports or concert events. However, somewhat fewer looked at magazines with alcohol advertising (84% for non-drinkers, 81% for drinkers). Comparing mean exposure scores across the two groups shows that the baseline drinkers had significantly greater exposure than the non-drinkers to alcohol advertisements in magazines, in-store displays and at sports and music events.

Baseline non-drinkers: bivariate and multivariate predictors of drinking initiation

Table 2 shows the bivariate relationships between grade 9 drinking in the past year and all the earlier advertisement exposure and control variables for the baseline non-drinkers, controlling for exposure to ALERT Plus. Each form of advertising—television beer advertisements, magazines with alcohol advertisements, beer displays in stores and beer concession stands at concerts or sports events—had a significant relationship with alcohol use in the following year. Although television exposure was unrelated to drinking, exposure to particular programs did predict it: adolescents who watched 'Springer', 'MTV' or 'Loveline' during grade 8 were much more likely to use alcohol in the next year than those who did not. Each of the 7th-grade social influence variables—peer drinking and approval, adult drinking and approval—predicted past-year drinking in grade 9, as did each of the social bonding measures (low religiosity, poor grades and infrequent parental monitoring). In the attitude and behavior group of predictors, only beliefs about the consequences of drinking failed to predict future alcohol use: deviance, impulsivity and playing sports were all positively associated with subsequent drinking. Drinking was not more prevalent among males than females during this period of adolescence, but it was less prevalent among Native Americans compared to whites and other racial groups.

Table 2 also shows the two multivariate models that predict future drinking for the baseline non-drinkers. Model 1 indicates that more frequent exposure to magazine advertisements, in-store beer displays and concession stand advertising were all strongly associated with a higher probability of past-year drinking by the end of grade 9. However, when these other forms of advertising were included in the model, television beer advertising did not predict subsequent drinking. Exposure to ALERT Plus had a marginally significant and negative effect on drinking. In model 2, which includes all the control variables, only in-store beer displays predicted later drinking. Exposure to ALERT Plus predicted less drinking; as the negative interaction test shows, such exposure also counteracted the effect of in-store advertisements. Other significant predictors of subsequent drinking included watching 'MTV' and 'Loveline', exposure to parental role models who approve of drinking, poor grades, low parental monitoring and low religiosity. The latter two

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Table 2 Associations between grade 7/8 predictors and past-year drinking at grade 9 (for grade 7 non-drinkers).

	Grade 7 non-drinkers (n = 1206)		
		Multivariate models	
Grade 7/8 predictor	*Bivariate models (OR)*	*Model 1 (OR)*	*Model 2 (OR)*
Alcohol advertisement exposure[a]			
TV beer advertisements	1.25*	1.11	1.05
Magazines with alcohol advertisements	1.27*	1.16*	1.12
Beer concession stands	1.31*	1.16*	1.42*
In-store advertisement displays	1.36*	1.27*	1.06
Store X treatment			0.71*
Television viewing[a]			
Weekly TV viewing	0.96		0.78*
'MTV'	1.65*		1.32*
'Jerry Springer'	2.48*		1.39
'Loveline'	3.19*		1.72*
Social influences[b]			
Adult drinking	1.22*		1.11
Adult approval of drinking	1.63*		1.51*
Peer drinking	1.20*		1.08
Peer approval of drinking	1.19*		1.04
Social bonds			
Poor grades[b]	1.20*		1.21*
Low religiosity 1[a]	3.32*		2.64*
Religiosity 2[a,c]	0.84*		0.86*
Low parental monitoring 1[a]	1.97*		1.77*
Parental monitoring 2[a,d]	0.83*		0.80*
Attitudes and behavior[b]			
Alcohol beliefs	0.98		0.90
Deviance	1.19*		1.12
Impulsivity	1.26*		1.04
Playing sports	1.42*		1.28
Demographics[b]			
Female	1.00		1.21
Native American	0.57*		0.56
Other race/ethnicity	0.82		0.92
Treatment	0.77	0.78	0.59*

[a]Data from Grade 8 Survey (Spring 1999). [b]Data from Grade 7 Survey (Fall, 1997). [c]Religiosity 2 equals the square of the low religiosity scale. [d]Parental monitoring 2 equals the square of the low parental monitoring scale. *$P < 0.05$.

predictors exhibit a curvilinear relationship with grade 9 drinking as described above. In this multivariate model, weekly television viewing had a negative impact, perhaps reflecting a 'babysitter' effect whereby youth whose time is occupied by more television viewing have fewer opportunities to drink or engage in other risky behaviors (Collins *et al.* 2004). Non-advertising variables that were significant when examined individually but dropped out of the full multivariate model included the 'Jerry Springer Show', exposure to peers and adults who drink, peer approval of drinking, prior deviance, impulsivity, involvement in team sports and being Native American.

Baseline drinkers: bivariate and multivariate predictors of drinking frequency

Table 3 shows the bivariate relationships between grade 9 frequency of drinking in the past year and the predictor variables for adolescents who had already tried alcohol by grade 7. Among the advertising variables, exposure to magazines with alcohol advertising, in-store beer displays and beer concession stands predicted subsequent drinking frequency for prior drinkers. However, in this drinking-experienced group, exposure to television beer advertising was unrelated to future drinking at the bivariate level. All the control variables, except gender, race/

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Table 3 Associations between grade 7/8 predictors and drinking frequency by grade 9 (for grade 7 drinkers).

	Grade 7 drinkers (n = 1905)		
		Multivariate models	
Predictor	*Bivariate coefficients*	*Model 1 (coefficients)*	*Model 2 (coefficients)*
Alcohol advertisement exposure[a]			
TV beer advertisements	0.05	–0.06	–0.01
Magazines with alcohol advertisements	0.21*	0.19*	0.10*
In-store advertisement displays	0.11*	0.05	0.02
Beer concession stands	0.22*	0.19*	0.09*
Television viewing[a]			
Weekly TV viewing	–0.10*		–0.12*
'MTV'	0.29*		0.10*
'Jerry Springer'	0.72*		0.26*
'Loveline'	0.67*		0.21*
Social influences[b]			
Adult drinking	0.13*		–0.01
Adult approval of drinking	0.42*		0.22*
Peer drinking	0.44*		0.09*
Peer approval of drinking	0.33*		0.05
Social bonds[a]			
Poor grades	0.18*		0.04
Low religiosity	0.19*		0.05
Low parental monitoring	0.30*		0.10*
Behavior[b]			
Pre-drinking alcohol beliefs	0.35*		0.05
Deviance	0.27*		–0.03
Impulsivity	0.21*		0.03
Playing sports	0.26*		0.20*
Frequency of baseline drinking 1[c]	0.34*		0.18*
Frequency of baseline drinking 2[c]	–0.03		–0.08*
Demographics[b]			
Female	0.04		0.18*
Native American	0.02		–0.14
Other race/ethnicity	–0.07		0.24
Treatment	–0.15	–0.14	–0.23*

[a]Data from Grade 8 Survey (Spring 1999). [b]Data from Grade 7 Survey (Fall 1997). [c]The coefficient on frequency of baseline drinking 1 applies to drinking up to 10 times and the coefficient on frequency of baseline drinking 2 applies to drinking greater than 10 times at baseline. *$P < 0.05$.

ethnicity and treatment, had a significant bivariate relationship with frequency of alcohol use.

The multivariate models for baseline drinkers reaffirm the bivariate results regarding magazine and concession stand advertising (see Table 3). Model 1 shows that, although exposure to in-store displays dropped out of the model when all four types of advertising were included in the analysis, exposure to magazines with alcohol advertisements and beer concession stands at sports and music events remained significant predictors. Model 2, which adjusts for baseline drinking frequency and multiple control variables, has similar results, although the coefficients for magazine advertising and beer concessions stands were smaller when all the control variables were added (0.10 for magazines versus 0.19 in Model 1, 0.09 for concession stands versus 0.19 for Model 1). In addition, exposure to ALERT Plus dampened future alcohol use among these prior drinkers.

Other variables that predicted greater drinking frequency in the multivariate model included watching television shows that display unconventional behavior ('MTV', 'Jerry Springer' and 'Loveline'), exposure to pro-drinking social influences (adults who approve of drinking and peers who do it), weak social bonds (low parental monitoring), playing team sports, prior drinking and being female. As with the non-drinkers, weekly television viewing had a negative relationship with alcohol use for the baseline drinkers. Several of the significant (non-

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advertising) bivariate predictors dropped out of the full model for drinkers, including exposure to adult drinking, peer approval of drinking, poor grades, low religiosity, deviance, impulsivity and beliefs about the consequences of alcohol use.

CONCLUSIONS

These findings indicate that multiple modes of advertising influence subsequent drinking during mid-adolescence. For middle school youth who have not tried alcohol by grade 7, the likelihood of drinking during grade 9 increases with higher levels of exposure to in-store beer displays. However, adolescents who were exposed to ALERT Plus were less likely to drink and were less susceptible to the persuasive appeals of in-store advertisements. Among middle school youth who had already begun drinking by grade 7, future drinking is more likely to be influenced by exposure to alcohol advertising in magazines and at sports and music event concession stands. However, once we take into account other forms of advertising and other predictors of alcohol use, we find no evidence that exposure to television beer advertising affects subsequent drinking for either group.

Results of this study also suggest that no single form of alcohol advertising dominates for all youth. Instead, for middle school adolescents, the relationship between drinking and advertising differs according to prior experience with alcohol. Advertising in common venues such as supermarkets, convenience and corner stores predicts future drinking among prior non-initiates; advertising in less common venues such as magazines and sports and music events predicts more frequent alcohol use among those with previous drinking experience. These findings accord with developmental expectations. Adolescents who have tried drinking by age 12 or 13, and thus have already exhibited a tendency to emulate adult behavior, may be more likely to pay attention to alcohol advertisements in sports, music, adult and news magazines. The same logic applies to concession stand advertising at music concerts and sports events. In contrast, youth who have not started drinking by grade seven appear more likely to be influenced by alcohol advertising in venues such as supermarkets and 'Mom and Pop' stores, places that are encountered during the course of everyday life. Overall, these results are consistent with a process in which adolescents start to drink in response to advertising and other influences in their everyday environment and continue to drink in response to advertising in specialized venues (as well as in response to other environmental and personal factors).

The results for ALERT Plus indicate that exposure to a drug prevention program can dampen future drinking among high school youth who have already tried alcohol, as well as among those who have not. These results show that extending this prevention program into high school prolongs its effectiveness in curbing drinking behavior. In addition, exposure to ALERT Plus weakened the relationship between in-store advertising and drinking, the type of advertising appeal that best predicted subsequent drinking among youth who had not started drinking by grade 7. However, it did not appear to counteract the types of advertising that best predicted subsequent drinking among the previous drinkers.

This research also reinforces and extends earlier findings that certain kinds of television shows foster adolescent drinking or signal an interest in activities that foster drinking. Earlier studies have documented a relationship between 'MTV' viewing and drinking, which may reflect seeing alcohol use modeled on this program (Robinson, Chen & Killen 1998); we find that the likelihood of future drinking increases with more frequent viewing of 'Loveline' and the 'Jerry Springer Show', as well as 'MTV'. The two former shows do not model drinking. Thus the mature content of these programs, whether or not they contain portrayals of drinking, may also be a stimulus to drinking for impressionable youth. Alternatively, youths who are interested in the mature content of these shows might also be interested in mimicking adult behaviors through drinking.

The results also highlight other non-advertising variables that predict drinking. For both groups, adult approval of drinking and insufficient parental monitoring were important risk factors. For those who had not yet started drinking by grade 7, weak bonds with other key socializing agents, such as school and religion, were also important. The drinkers, on the other hand, were comparatively more susceptible to social influences associated with peers who use alcohol, their own prior drinking experiences and participation in sports. These results are consistent with research that stresses the importance of strong social bonds in curbing initiation (Hawkins, Catalano & Miller 1992), the greater likelihood of exposure to pro-drug influences among drinking initiates (Farrell & Danish 1993; Engels *et al.* 1999) and adolescents' differential response to adult attitudes toward drugs as compared to adult use of those drugs (Ellickson *et al.* 2003).

Overall, our findings suggest that alcohol prevention programs should foster media awareness by taking into account the multiple sources of alcohol advertising to which young people are exposed. Most adolescents go to the supermarket or corner food store on their own or with their parents or other adults; in many states, they also see alcohol linked with the necessities of life. Others see alco-

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hol promotions in liquor stores, when they participate in 'good time' outings such as sports events and music concerts, and when they read sports, news, music and other magazines. Helping children become aware of and able to counter these forms of advertising should be an important component of alcohol prevention programs. Future research should focus on identifying ways to counter the impact of 'special venue' advertising on youth who have already started drinking.

Strengths of this study include its prospective design, focus on drinking behavior (versus intentions to use), assessment of different forms of advertising, use of multiple control variables to rule out alternative explanations of the effects and examination of how exposure to school-based drug prevention affects susceptibility to alcohol advertising. A limitation is our reliance on self-reports for the alcohol outcome and most of the predictors (Embree & Whitehead 1993). However, we note that longitudinal checks on adolescent self-reports for life-time drinking have found little inconsistency over time (Ellickson & Bell 1990; Ellickson *et al*. 2003). A second limitation is that our data come from a single state, South Dakota, and may not be generalizable to other geographic locations, particularly those with low rates of alcohol misuse. South Dakota ranks among the top 10 states in rates of alcohol and drug dependence and binge drinking among adolescents and young adults (Office of Applied Studies 2000).

Our finding that exposure to television beer advertising does not predict future drinking for this age group should not be construed to mean that such advertisements have no impact on adolescent alcohol use. Television advertising might have a weak effect that we were unable to detect with our measure of exposure. Like other studies, we have focused on exposure to alcohol advertisements aired on sports and late-night shows, the two venues that account for a majority of television alcohol advertising seen by adolescents. Unlike those studies, we have used Nielsen data to weight the respondents' viewing patterns and thereby take into account how often alcohol advertisements were shown on the relevant programs. We believe this measure provides a more accurate picture of adolescent exposure to alcohol advertising on television, but recognize that we may have missed participant exposure to advertising in other sports or cable programming. As noted above, however, our exposure index is highly correlated with a more comprehensive measure. We also note that we did not assess the effect of advertising on beer drinking and almost all the television advertising during our measurement period focused on beer. In addition, adolescents who are exposed to alcohol advertising may drink in greater quantities when they reach the legal age for drinking. Although we could not explore this possibility, such a finding would be consistent with earlier studies of advertising and intentions to drink as an adult (Grube & Wallack 1994). Of particular importance is the fact that we have not examined the impact of television advertising on elementary school children who, because they are younger and less cognitively sophisticated, may be more vulnerable than middle school adolescents to the persuasive appeals of television advertising; nor have we been able to assess the cumulative effect of exposure to television advertising year after year. Future studies should address these gaps in our understanding.

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ARTICLE

Effects of Alcohol Advertising Exposure on Drinking Among Youth

Leslie B. Snyder, PhD; Frances Fleming Milici, PhD; Michael Slater, PhD; Helen Sun, MA; Yuliya Strizhakova, PhD

Objective: To test whether alcohol advertising expenditures and the degree of exposure to alcohol advertisements affect alcohol consumption by youth.

Design: Longitudinal panel using telephone surveys.

Setting: Households in 24 US media markets, April 1999 to February 2001.

Participants: Individuals aged 15 to 26 years were randomly sampled within households and households within media markets. Markets were systematically selected from the top 75 media markets, representing 79% of the US population. The baseline refusal rate was 24%. Sample sizes per wave were 1872, 1173, 787, and 588. Data on alcohol advertising expenditures on television, radio, billboards, and newspapers were collected.

Main Exposures: Market alcohol advertising expenditures per capita and self-reported alcohol advertising exposure in the prior month.

Main Outcome Measure: Self-reported number of alcoholic drinks consumed in the prior month.

Results: Youth who saw more alcohol advertisements on average drank more (each additional advertisement seen increased the number of drinks consumed by 1% [event rate ratio, 1.01; 95% confidence interval, 1.01-1.02]). Youth in markets with greater alcohol advertising expenditures drank more (each additional dollar spent per capita raised the number of drinks consumed by 3% [event rate ratio, 1.03; 95% confidence interval, 1.01-1.05]). Examining only youth younger than the legal drinking age of 21 years, alcohol advertisement exposure and expenditures still related to drinking. Youth in markets with more alcohol advertisements showed increases in drinking levels into their late 20s, but drinking plateaued in the early 20s for youth in markets with fewer advertisements. Control variables included age, gender, ethnicity, high school or college enrollment, and alcohol sales.

Conclusion: Alcohol advertising contributes to increased drinking among youth.

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THE CAUSES OF ALCOHOL USE among youth, including older children, adolescents, and young adults, are a major public health concern. Drinking among youth can result in a panoply of negative consequences, including poor grades, risky sex, alcohol addiction, and car crashes.[1-4] Drinkers younger than 21 years, who consume approximately 20% of all alcoholic drinks,[5] imbibe more heavily than adults per drinking episode[6] and are involved in twice as many fatal car crashes while drinking.[7] The problem is getting worse, with youth initiating drinking at an earlier age on average than they did in the past.[8]

There is much public policy debate about whether alcohol advertising is partially responsible for youth consumption levels. The alcohol industry is not subject to federal restrictions on their advertising practices but has voluntary advertising codes created by the major alcohol trade groups. Even when the alcohol industry adheres to a code requiring that at least 70% of the audience (50% before fall 2003) for print, radio, and television advertisements consist of adults of legal drinking age, many youth are exposed to alcohol advertisements.[9,10] There are often greater concentrations of alcohol advertisements in media aimed at youth than at adults.[10-13] However, studies of advertising content and youth exposure rates have not assessed the impact of advertising on youth. In 1997, the US Congress asked the National Institutes of Health for more scientific evidence on the relationship between advertising and alcohol use among those younger than the legal drinking age.[14]

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The most important question regarding alcohol advertising effects is whether the association between alcohol advertising and use is causal.[14] Cross-sectional sur-

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veys have found small, statistically significant, positive correlations (mean $r=0.19$) between self-reported alcohol advertising and youth drinking,[15-19] but they cannot establish causality.[20] Cumulative exposure to alcohol advertising and some effective advertising campaigns may change the way youth think about alcoholic beverages[21-27] and may increase drinking. Recently, exposure to some forms of alcohol advertising has been linked to drinking onset.[28] On the other hand, drinkers like alcohol advertisements more than nondrinkers like the advertisements,[24,26] have greater brain responses to alcohol advertisements,[29] and may remember them better.[25,30] An association between advertising exposure and drinking may therefore be due in part to drinkers reporting greater exposure than nondrinkers. It is also possible that advertisements induce drinkers to drink more. Another approach to research on alcohol advertising has shown that bans lead to a reduction in aggregate alcohol consumption,[31,32] but it is unknown how bans would affect youth.

We examined a national cohort of youth longitudinally to assess the effects of alcohol advertising on drinking amounts over time. The first hypothesis was that youth who reported greater exposure to alcohol advertising would have increased alcohol use over time. The second hypothesis concerned the effect of living in an environment with comparatively greater or fewer alcohol advertisements. By examining market-level measures of advertising expenditures per capita, we avoid the potential self-reporting bias among drinkers. We predicted that greater alcohol advertising expenditures per capita are correlated with greater youth drinking.

METHODS

A random sample of youth aged 15 to 26 years from 24 US Nielsen media markets were interviewed 4 times during 21 months. Interviews were conducted in April through July 1999, December through January 2000, May through June 2000, and December through January 2001, using computer-aided telephone interviewing.

SAMPLING

Twenty-four media markets were sampled to enable comparisons of advertising incidence across markets. Industry data on advertising were available for the 75 largest Nielsen media markets[33] in the United States, representing the 79% of the US population that lives in markets with populations of more than 957 000. To select markets, we conducted a cluster analysis in each of 6 US census geographic regions based on population size; population ethnic and religious composition; average income; annual state consumption of beer, wine, and liquor; state laws prohibiting sales of beer and liquor for off-premise consumption from restaurants, bars, grocery stores, gas stations, or drugstores; and percentage of households with cable television.[33-35] Markets were sampled from the identified clusters so that each geographic region in the sample was proportional to the number of top 75 markets within the region. Priority was given to markets with industry data on radio and billboard advertising, but otherwise selection was random. The selected 24 markets in the aggregate were not statistically different from the markets not selected on any of the measured criteria.

Households within markets were systematically sampled from a list of randomly selected households with telephones in the selected markets.[36] The list was purchased from Genesys Sampling Systems.[37] Within a household, the youth with the most recent birthday was selected. The mean ± SD response rate across markets at baseline was 27% ± 12%, and the refusal rate was 24% ± 7%, with many households of unknown eligibility not reached after 20 callbacks.[38] The sample sizes per wave were 1872, 1173, 787, and 588. The mobility of the 18- to 26-year-old segment of the population contributed greatly to sample attrition. Only 19% of the attrition at the second interview was due to a refusal to participate, compared with 68% due to disconnected numbers or respondent no longer in residence. Compared with youth who remained in the sample, youth who dropped out by the fourth interview were slightly older (20.2 vs 19.7 years), less likely to have been in high school (27.6% vs 42.3%), less likely to have been living at home (58.8% vs 70.7%), and drank more alcohol as of baseline (23.6 drinks per month vs14.9 drinks per month). Having greater attrition among drinkers is similar to other longitudinal youth alcohol use studies.[39] To minimize the effects of sampling and attrition, participants contributed as much data as was collected for them in the analysis (no cases were dropped), and the variables related to attrition were controlled statistically in the analyses.

The data were weighted at baseline by age, gender, and market to reflect the US population aged 15 to 26 years in the top 75 media markets. Weighting to a known population distribution adjusts for sampling fluctuations, nonresponse, and noncoverage.[36] The weighted data produced similar coefficients to the unweighted analyses.

The study received approval from the University of Connecticut institutional review board. Study participants and the parents of study participants younger than 18 years gave their oral consent before the baseline interview.

OUTCOME MEASURE

Respondents were asked 3 questions about alcohol use: "On how many days did you drink any alcoholic beverage in the past 4 weeks" (frequency), "When you drank alcohol, how many drinks, glasses, bottles, or cans did you have per day, on average" (average quantity), and "What is the maximum number of alcoholic drinks, glasses, bottles, or cans you had on one occasion" (maximum quantity). Alcohol use was computed by multiplying drinking frequency by the mean of the average and maximum quantity of drinking. For example, if a respondent reported drinking 5 times in the past month, having 2 drinks on average, and a maximum quantity on one occasion of 4, we multiplied 5 by $(2+4)/2$ for a final score of 15. Thus, the measure estimated the number of alcoholic drinks consumed in the past month.

ADVERTISING MEASURES

Advertising exposure was measured using 2 questions that assessed self-reported beer or liquor and premixed drink (eg, Smirnoff Ice) advertising exposure in the past month on each of 4 media (television, radio, magazines, and billboards) for a total of 8 items. The 8 items were summed to make an index. The question format was, "How many times in the past 4 weeks have you seen (media) ads for (beer/liquor or premixed drinks)?" To standardize across response formats on different surveys, "none" was coded as 0, "a few" and responses of 1 to 3 were coded as 2, "some" and responses of 4 to 6 were coded as 5, and "many" and responses of 7 or greater were coded as 10. (Ten was the modal response for the continuous response format for answers of 7 or greater.)

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MARKET ALCOHOL ADVERTISING EXPENDITURES PER CAPITA

Industry data on the amount spent on alcohol advertisements (in thousands) on television, radio, newspaper, and outdoors (mostly billboards) in each market in 1999 and 2000 were purchased from TNS Media Intelligence (formerly, Competitive Media Reporting).[40] The figure was divided by the market adult population size[33] to create an expenditures-per-capita index.

OTHER MEASURES

Data collection took place for several months for each wave. Time of the interview per individual and per wave was measured as the number of months past the start of the study (April 1999) that the interview took place. Thus, for someone interviewed in December 1999, the time was 8 months.

ALCOHOL SALES PER CAPITA

The total number of beer, wine, and liquor cases (in hundreds) sold per 1000 adults in each state in 2000 was purchased from an industry source.[41] It is important to control for total alcohol consumption levels because markets with greater sales may attract more alcohol advertising from brands competing to sell in markets with more heavy drinkers. In addition, adults who consume more on average may have an influence on youth drinking through tolerant attitudes and modeling. It is estimated that four fifths of all alcoholic beverages are consumed by adults.[5]

DEMOGRAPHICS

Age was an individual's age in years beyond 15 years measured at baseline. Other demographic variables included the dummy variables of female, gender, current school status (in high school, in college, or not in school), and ethnicity (African American, Hispanic, or neither).

STATISTICAL ANALYSIS

We used multilevel modeling to handle the complex sample and repeated-measures design.[42] There were 3 levels of analysis: (1) 4418 observations, accounting for the repeated measures within individuals, (2) 1858 individuals, and (3) 24 markets. The software used was HLM 6.01.[43] Because the outcome variable was count data (number of drinks) with many zeros (nondrinkers), we conducted nonlinear analysis using a Poisson sampling model with a log-link function.[42,44-46] The weights were applied at level 2. Analysis of the unconditional model showed that the largest share of the variance in alcohol use was within individuals (81%), reinforcing the importance of examining alcohol use within individuals.

We modeled growth in drinking over time by including month of interview in the model at level 1.[47] Since youth often increase their drinking as they age, we allowed growth to vary by age by including an interaction term between time and age.

The model examined the impact on alcohol use of alcohol advertising at the 3 levels: differences within individuals over time in advertising exposure, differences between individuals in advertising exposure, and market-level advertising expenditures. Alcohol advertising exposure at level 1 was centered on the individual's mean alcohol advertising exposure across all observations. Centering around an individual's mean is recommended when the aggregate of the level 1 predictors has a separate and distinct relationship with the outcome variable compared with variations within an individual.[42,45,47] The individual's mean advertising exposure was added as an independent variable at level 2, and market-level advertising expenditures were added at level 3. We added an interaction term between time and age and market advertising expenditures to test for differential growth in drinking over time by differences in market advertising expenditures and as youth age.

The model controlled for several potential confounders, including gender, age, ethnicity, and school status, all of which are known to vary with alcohol use.[48] Since school status could vary over time, 2 dummy variables for school status (high school, college, and no school) were entered at level 1. Another potential confounder, alcohol sales per capita, was entered at level 3. Alcohol sales, market advertising expenditures, time, and age were centered around the grand mean to aid in interpretation of the coefficients. Centering is particularly useful when dealing with interaction terms.[49] Error terms were included for all variables at level 3. Among the level 1 variables, the intercept and time were allowed to randomly vary. (If more than 2 factors were treated as randomly varying, the model would not converge.) The model tested was as follows:

$$\eta = \gamma_{000} + \gamma_{001}\,(\text{Alcohol Sales per Capita}) + \gamma_{002}\,(\text{Market Advertising Expenditures per Capita}) + \gamma_{010}\,(\text{Female}) + \gamma_{020}\,(\text{Age}) + \gamma_{030}\,(\text{Black}) + \gamma_{040}\,(\text{Hispanic}) + \gamma_{050}\,(\text{Mean Advertising Exposure}) + \gamma_{100}\,(\text{Time}) + \gamma_{110}\,(\text{Time}\cdot\text{Age}) + \gamma_{101}\,(\text{Time}\cdot\text{Age}\cdot\text{Market Advertising Expenditures per Capita}) + \gamma_{200}\,(\text{Advertising Exposure, Within Individual}) + \gamma_{300}\,(\text{High School}) + \gamma_{400}\,(\text{College}) + r_0 + r_1\,(\text{Time}) + u_{00} + u_{01}\,(\text{Female}) + u_{02}\,(\text{Age}) + u_{03}\,(\text{Black}) + u_{04}\,(\text{Hispanic}) + u_{05}\,(\text{Mean Advertising Exposure}) + u_{10}\,(\text{Time}) + u_{11}\,(\text{Time}\cdot\text{Age}) + u_{20}\,(\text{Advertising Exposure, Within Individual}) + u_{30}\,(\text{High School}) + u_{40}\,(\text{College}) + e$$

where η is the log-link function for drinking, γ is the estimated coefficient, e is the level 1 (observation) random effect, r is the level 2 (individual) random effect, and u is the level 3 (market-level) random effect.

The analysis was repeated for the subset of the sample younger than 21 years because of the importance of underage drinking. The sample sizes were 2286 at level 1, 1094 at level 2, and 24 at level 3. The intercept was the only random factor among the level 1 variables. The results show the unit-specific models and the event rate ratios. The event rate ratio, which for a Poisson model is the exponential of a coefficient, can be interpreted as the percentage change in the dependent variable associated with an increase of 1 unit in the independent variable, holding other factors constant.[42]

RESULTS

Sixty-one percent of the sample had at least 1 drink in the past month at baseline (**Table 1**). Drinkers consumed 38.5 total drinks on average in the past month at baseline (95% confidence interval [CI], 34.3-42.7), imbibing an average of 4.5 drinks per episode (95% CI, 4.3-4.8). Drinkers younger than 21 years had 29 drinks on average at baseline, with 4.5 drinks on average each drinking session (95% CI, 4.1-4.8). The market alcohol advertising spending ranged from $78 000 (Tulsa, Okla) to $88 750 000 (Los Angeles, Calif) during 1999 and 2000, with a mean of $14 800 000 worth of alcohol advertising (95% CI, $13 800 000-$15 800 000). Per capita spending ranged from $0.20 to $17.3, averaging $6.8 (95% CI, 6.6-7.0). Individuals reported seeing an average of 22.7 alcohol advertisements per month at baseline.

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Table 1. Demographics, Alcohol Advertisement Exposure, and Market Alcohol Advertisement Expenditures by Mean Alcohol Use and Changes in Alcohol Use Over Time

Characteristic	% of Sample	Mean Baseline Alcohol Use in Prior Month (95% CI)	Mean Change in Alcohol Use From Baseline to Time 4 (95% CI)
Total	100.0	23.4 (20.7 to 26.1)	2.4 (–1.6 to 6.4)
Drinkers (any drink in past month baseline)	60.8	38.5 (34.3 to 42.7)	1.2 (–6.3 to 8.7)
Drinkers younger than 21 y	49.3*	29.0 (23.9 to 34.0)	17.5 (6.1 to –28.8)
Gender			
Male	51.2	36.7 (37.8 to 41.5)	1.9 (–5.8 to 9.7)
Female	48.8	9.8 (8.0 to 11.6)	2.7 (0.5 to 5.1)
Race/ethnicity			
Hispanic	8.2	24.2 (21.3 to 27.1)	–.2 (–6.9 to .5)
Black	11.4	25.6 (22.6 to 28.6)	2.6 (–0.9 to 6.1)
White	69.9	17.9 (13.4 to 22.4)	3.1 (–2.1 to 8.2)
Education, baseline			
In high school	28.0	6.5 (4.3 to 8.8)	6.7 (3.6 to 9.9)
In college	31.0	27.6 (22.6 to 32.5)	13.6 (3.0 to 24.1)
Not in school	41.0	32.9 (27.6 to 38.2)	–11.6 (–19.4 to –3.8)
Age, y			
15-21, baseline	60.0	14.3 (11.7 to 17.0)	9.5 (4.7 to 14.3)
<18	27.0	8.5 (5.4 to 11.6)	4.8 (1.9 to 7.7)
18 (<21)	25.0	20.4 (16.1 to 24.8	17.1 (5.7 to 28.5)
21 (<23)	16.0	42.1 (31.5 to 52.7)	–8.8 (–23.4 to 5.7)
23-26	32.0	29.1 (24.3 to 33.8)	–6.8 (–14.3 to 0.6)
Television market advertising expenditures per capita			
<2	20.9	24.3 (18.0 to 30.6)	–5.4 (–13.4 to 2.7)
2-5.9	29.0	24.4 (18.8 to 30.0)	–2.3 (–9.7 to 5.1)
6-9.9	25.0	18.4 (14.4 to 22.4)	5.3 (–0.3 to 11.0)
≥10	25.1	26.3 (20.9 to 31.8)	12.7 (1.7 to 23.7)
Advertising exposure, baseline			
<8	15.7	18.5 (11.2 to 25.9)	.7 (–8.4 to 9.9)
8-29	55.6	23.3 (19.8 to 26.8)	1.2 (–3.3 to 5.6)
30-51	24.1	24.6 (19.4 to 29.8)	8.0 (–3.5 to 19.5)
≥52	4.6	34.9 (17.7 to 52.1)	–5.2 (–24.9 to 14.5)

Abbreviation: CI, confidence interval.
*Among those younger than 21 years.

The results in **Table 2** show that advertising exposure was positively related to an increase in drinking. Holding other factors constant, individuals who saw 1 more advertisement average than other individuals had 1% more alcoholic drinks per month (event rate ratio, 1.01; 95% CI, 1.01-1.02). Within-individual variation in advertising exposure was not a statistically significant factor in drinking, so whether a youth saw more or fewer advertisements in a particular month than he or she typically saw was not as important a determinant of drinking as that person's average level of advertising exposure over time.

Market advertising expenditures per capita were related to drinking levels and to growth in drinking over time. For every additional dollar per capita spent on advertising in the market, individuals consumed 3% more alcoholic beverages per month (event rate ratio, 1.03; 95% CI, 1.01-1.05), holding constant other factors, including time. There was an interaction effect between time and age and market advertising expenditures. In markets with high levels of advertising expenditures per capita, growth in drinking over time is steepest among older youth, reaching close to 50 drinks a month for 25-year-olds (**Figure 1**). In markets with low levels of advertising expenditures per capita, the initial drinking rates were lower than in markets with high levels of advertising expenditures per capita (**Figure 2**). Younger age groups show an increase in drinking over time but at a slower rate than peers in markets with high levels of advertising expenditures per capita. Around the age of 22 years, growth flattens out, with little increase in drinking over time. Above age 23 years, drinking declines over time in the markets with low levels of advertising expenditures per capita, declining most steeply in older age groups. (The figures depict growth curves, assuming mean levels of continuous factors and zero values for dummy variables, including male, not in school, not black, and not Hispanic.)

To better illustrate the effects of the main variables of interest, **Figure 3** depicts the relationship among alcohol use, mean levels of advertising exposure, advertising expenditures per capita, and gender. We held constant the other factors in the model; therefore, the figure shows predicted drinking levels for a 20-year-old who is not currently a student, neither African American nor Hispanic, and living in a market with an average amount of alcohol sales per capita measured at the mean date of the study and who reported, in the prior month, exposure to his or her average number of advertisements. The results indicate that

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Table 2. Hierarchical Linear Modeling Parameter Estimates Predicting Alcohol Use for the Total Sample

	Event Rate Ratio (95% CI)
Intercept	9.56 (7.21 to 12.67)
Alcohol sales per capita	1.002 (0.999 to 1.006)
Market-level advertising expenditures per capita	1.027 (1.010 to 1.045)
Female	0.49 (0.41 to 0.59)
Age	1.07 (1.03 to 1.12)
African American	0.23 (0.12 to 0.44)
Hispanic	0.47 (0.21 to 1.06)
Mean advertising exposure	1.01 (1.01 to 1.04)
Time	1.02 (1.01 to 1.04)
Time × age	1.00 (0.99 to 1.00)
Time × age × market advertising expenditures per capita	1.001 (1.000 to 1.001)
Advertising exposure, within individual	1.00 (1.00 to 1.00)
High school student	0.46 (0.2 to 0.73)
College student	0.99 (0.86 to 1.13)

Abbreviation: CI, confidence interval.

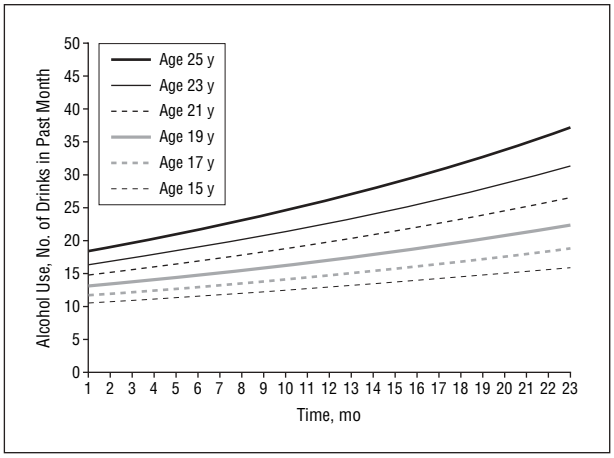

Figure 1. Alcohol use over time by age in markets with high alcohol advertising expenditures per capita.

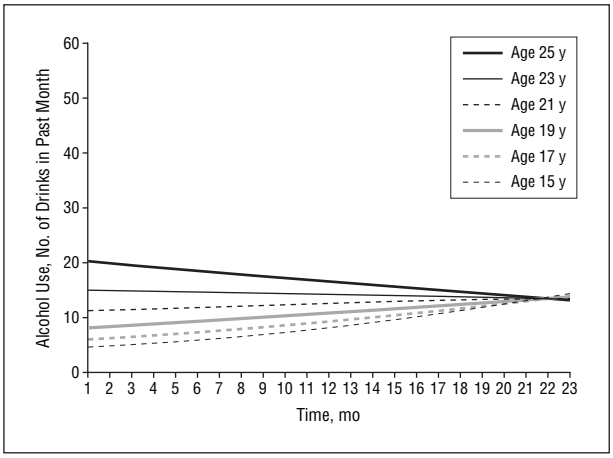

Figure 2. Alcohol use over time by age in markets with low alcohol advertising expenditures per capita.

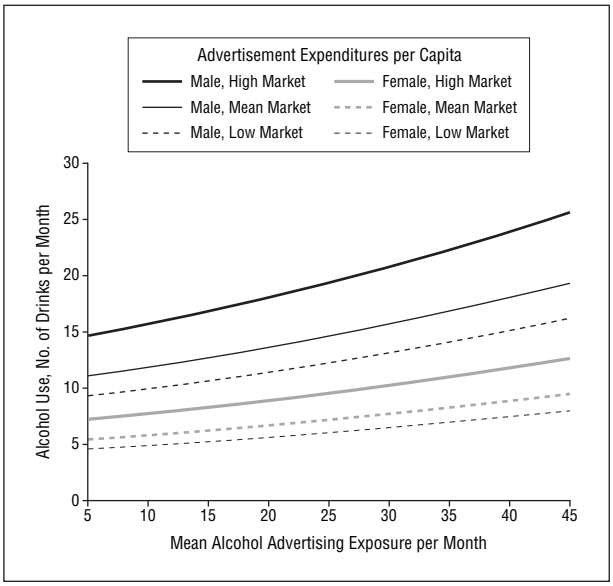

Figure 3. Alcohol use by mean advertising exposure, market advertising expenditures per capita, and gender.

a 20-year-old man who saw few alcohol advertisements (5) and lived in a market with minimal alcohol advertising expenditures per capita was predicted to have 9 alcoholic drinks in the past month compared with 16 drinks if he saw many advertisements (45). A man with the same profile but living in a market with the highest advertising spending per capita was predicted to have 15 drinks if he reported little advertising exposure and 26 drinks if he saw many advertisements.

We tested the same hierarchical linear model for the subset of the sample younger than the legal drinking age. The results were similar to those for the sample as a whole. Drinking was greater among underage youth who reported higher mean levels of alcohol advertising exposure (**Table 3**). Each additional average advertisement exposure was associated with an increase of 1% in drinks consumed in the past month (event rate ratio, 1.01; 95% CI, 1.001-1.021), holding constant other factors. Drinking levels were higher among underage youth living in markets with greater per capita advertising expenditures (event rate ratio, 1.03; 95% CI, 1.00-1.06), holding constant other factors. A 3-way interaction effect still occurred among time, age, and market advertising expenditures, following similar growth curves to those in Figure 1 and Figure 2.

COMMENT

The results of the present large-scale national longitudinal study provide evidence that the amount of advertising expenditures in 15- to 26-year-olds' media environment and the amount of advertising recalled related to greater youth drinking. Youth younger than the legal drinking age displayed a similar pattern of advertising effects as the entire age range, which is important because there is often a greater policy interest in protecting underage youth from harmful communications than in protecting youth older than 21 years.

Greater alcohol advertising expenditures in a market were related to both greater levels of youth drinking and steeper increases in drinking over time. Youth who lived

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in markets with more alcohol advertising drank more, increased their drinking levels more over time, and continued to increase drinking levels into their late 20s. Youth who lived in markets with less alcohol advertising drank less and showed a pattern of increasing their drinking modestly until their early 20s, when their drinking levels started to decline. The results are consistent with findings from studies of advertising bans[31,32] and extend them by linking alcohol advertising expenditures per capita directly with individual youth behavior. The effect of market advertising spending on youth drinking was not attributable to differences in alcohol sales, which was controlled for statistically in the model.

The relationship between market-level advertising expenditures and youth drinking is all the more striking because it assesses the effect of the "added value" of advertising in a market, over and above national advertisements appearing in all markets. Of the more than $1 billion a year spent on alcohol advertising at the time of the study, approximately one fifth was placed on local television, radio, and billboards.[50] To the extent that additional communication produces diminishing returns, the added value of market-level advertising may underestimate the total effect of alcohol advertising.

The results are consistent with theories of cumulative effects of media exposure. Youth reporting greater amounts of exposure to alcohol advertising over the long term drank more than youth who saw fewer ads. Alcohol consumption was less sensitive to short-term differences in alcohol advertising exposure than to the long-term effects of exposure.

Given that there was an impact on drinking using an objective measure of advertising expenditures, the results are inconsistent with the hypothesis that a correlation between advertising exposure and drinking could be caused entirely by selective attention on the part of drinkers. The results also contradict claims that advertising is unrelated to youth drinking amounts: that advertising at best causes brand switching, only affects those older than the legal drinking age, or is effectively countered by current educational efforts. Alcohol advertising was a contributing factor to youth drinking quantities over time.

The strength of the study was the relatively large national sample, the use of an objective measure of advertising expenditures to complement the subjective measure of advertising exposure, and the matching of expenditure data with individual behavior. The study was limited by the industry data used to measure advertising exposure, which largely reflects the most expensive medium for advertising—television. During this period, data on outdoor advertising was spotty and may have been incomplete in some markets. It is also possible that using a measure of likely advertising exposures (such as gross rating points) would increase effects. There may also be variation in the national advertising expenditures in markets, through differences in cable systems and presence of national stations or programming, that were not measured. Note, too, that other forms of marketing were not included here (such as product placements in programming, promotions, sports sponsorships, and stadium advertising) that could affect youth drinking. Future research could examine the impact of different forms of advertising and the consumption of various alcoholic products. Other limitations of the study were the sample attrition and the fact that those who drank more at baseline were more likely to drop out of the study. Future research should also control for the effects of parent and peer influences on drinking. Finally, the study does not explain the process by which advertising affects youth.

Table 3. Hierarchical Linear Modeling Parameter Estimates Predicting Alcohol Use Among 15- to 20-Year-Olds

	Event Rate Ratio (95% CI)
Intercept	8.69 (4.01 to 18.49)
Alcohol sales per capita	1.001 (0.996 to 1.006)
Market-level advertising expenditures per capita	1.028 (1.002 to 1.056)
Female	0.56 (0.41 to 0.76)
Age	1.30 (1.16 to 1.44)
African American	0.19 (0.07 to 0.53)
Hispanic	0.37 (0.18 to .75)
Mean advertising exposure	1.01 (1.001 to 1.021)
Time	1.04 (1.01 to 1.06)
Time × age	1.00 (0.99 to 1.00)
Time × age × market advertising expenditures per capita	1.002 (1.001 to 1.003)
Advertising exposure, within individual	1.002 (1.001 to 1.003)
High school student	0.53 (0.27 to 1.02)
College student	0.95 (0.56 to 1.59)

Abbreviation: CI, confidence interval.

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Exposure to Televised Alcohol Ads and Subsequent Adolescent Alcohol Use

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***Objective*: To assess the impact of televised alcohol commercials on adolescents' alcohol use. *Methods*: Adolescents completed questionnaires about alcohol commercials and alcohol use in a prospective study. *Results*: A one standard deviation increase in viewing television programs containing alcohol commercials in seventh grade was associated with an excess risk of beer use (44%), wine/liquor use (34%), and 3-drink episodes (26%) in eighth grade. The strength of associations varied across exposure measures and was most consistent for beer. *Conclusions*: Although replication is warranted, results showed that exposure was associated with an increased risk of subsequent beer consumption and possibly other consumption variables.**

***Key words*: alcohol, advertising, adolescence, longitudinal**
***Am J Health Behav.* 2004;28(6):498-509**

The prevalence of alcohol use increases dramatically during the middle school years. The most rapid increase in prevalence occurs between 12 and 15 years of age.[1] The present study investigates one of the many possible precursors of this problem health behavior by evaluating the hypothesis that exposure to alcohol commercials in youth predicts subsequent drinking.[2,3]

Most research on this issue has not been prospective. When prospective findings have been available, interpretation still has not always been clear-cut. In one important longitudinal study, recall of alcohol commercials predicted later beer consumption in male but not female youth.[4] However, no reports were provided on effects adjusting for previous levels of alcohol consumption in these data. In a second important longitudinal study from the same population, liking of alcohol advertising and brand allegiance were found to predict later alcohol consumption in young adults, adjusting for effects of previous alcohol consumption.[5] However, liking for alcohol commercials and brand preference could imply product liking, exposure to others who drink, or intentions for future behavior that promote future alcohol consumption, without implying that alcohol commercials themselves influence consumption.

A scientific approach to this topic must explicitly address fundamental methodological issues in assessment, confounding, and alternative interpretations. Only then can public health policy be shaped by reasoned arguments, one way or the other. Regarding assessments of exposure to

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alcohol commercials, there are simply no "gold standards." The primary difficulty with exposure assessments involves intertwined problems of construct validity and confounding. That is, existing exposure assessments may assess something else in addition to, or instead of, exposure to alcohol commercials, underlying any apparent effects on consumption over time. One recourse is to evaluate the predictive effects of multiple measures of exposure, varying in assessment method. Systematic biases in assessment (confounding) may be limited across a pattern of findings, if the methods of exposure assessment differ enough to minimize common method-related (systematic) biases.[6] Another related strategy is a more focused attempt at adjusting for likely confounders of exposure assessments. With such efforts, inferences about potential effects of exposure to alcohol commercials on consumption in youth may be improved substantially. At minimum, such an attempt would contribute by investigating previously untested alternative hypotheses.

Addressing Fundamental Prerequisites for Inference

There has been much debate about assessments of exposure to alcohol commercials,[7,8] a central issue for inference. The present study uses multiple, distinct assessments as predictors, examines the pattern of findings across assessments, and takes into account the different meanings and limitations of the measures in interpreting the pattern of findings. The authors focus on this approach rather than alternatives on the basis of the rationale for multiple methods of assessment as well as on Strickland's criticism of some other available approaches.[8] The present approach avoids combining fairly heterogeneous constructs into composite scales or factors, which can make interpretation of the meaning of exposure factors difficult; the present approach also uses assessments differing in methods and likely biases.

This study's multiple exposure assessments can be classified as *opportunity-based* and *memory-based* measures. Opportunity-based measures assess adolescents' self-reported behaviors that increase their likelihood of being exposed to alcohol advertisements, such as viewing TV programs that contain numerous alcohol advertisements. Most memory-based measures, in contrast, assess adolescents' recall or recognition of specific elements of specific alcohol advertisements or their memory of seeing alcohol advertising in general.

One type of *opportunity-based* measure focuses on exposure to television programs that show alcohol commercials. One influential example addresses viewing of televised sports events.[9,10] Exposure to televised sports is a promising assessment, but it is not without limitations. For example, greater exposure could imply a greater interest or participation in team sports (itself a risk factor for alcohol use[11-13]), a greater exposure to drinking role models in the home who also view these events, or variation on other possible third-variables that may co-occur both with exposure to commercials and with alcohol consumption. Longitudinal research needs to investigate third-variable explanations and also use some assessments that do not share the same limitations.

Another example of a viable opportunity-based assessment is a weighted index that samples exposure to many different types of television programs.[14] Viewing frequency of television programs is assessed, and the index weights each program with respect to the frequency with which that program showed alcohol commercials. One of the distinctive features of this type of index is that it may help limit the plausibility of certain alternative explanations, such as some of the third-variable confounders of viewing televised sports. However, it also is not a panacea, because any measure of program exposure measures only the opportunity to be exposed to the target commercials,[10,15] not verified commercial exposure or processing.

The *memory-based* assessments of exposure are quite different. Although memory is sometimes seen as an intermediate (intervening) variable,[10] the present simpler use of memory tests is appropriate for a 2-wave prospective analysis that views different measures of advertising processing as imperfect indexes of exposure. The 2 memory tests used in the present study are based on quite different methods that each test for memory and include steps that minimize false positives. A third memory-based assessment is best described as an index

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of "meta-memory" because it asks respondents to self-report frequency of observations of commercials. Each measure of memory has somewhat different strengths and limitations, but perhaps the most likely limitation of the recall measures concerns false negatives. For example, some respondents may be exposed to ads even though their responses to memory tests do not reveal an ability to name, draw, or recognize specific messages, characters, or scenarios from the ads. The "Method" section outlines additional support for use of various assessments of exposure as well as possible confounders, which also must be investigated.

The present study investigates the effects of televised alcohol commercials on the subsequent use of alcohol in a cohort of adolescent public school students, focusing on 2 time points that are critical for understanding influences on early consumption patterns: 7th to 8th grade. Assessments using divergent methods and measures of multiple confounders help address a variety of alternative explanations.

METHOD

Study Sample

The baseline respondents were 2998 seventh-grade students in 20 middle schools in the Los Angeles area in the spring of 2000. The schools were selected randomly from a list of all public middle schools in Los Angeles County. All seventh-grade students in the selected schools were invited to participate in the survey. Fewer than 3% of the students or their parent declined participation. One year later, students were invited to participate in the follow-up survey; 2250 (75%) of the students participated. These students compose the analytic sample. The sample was 51% female, 55% Hispanic, 19% Asian, 14% non-Hispanic white, 2% African American, 1% Pacific Islander, 1% Native American, 5% multi-ethnic, and 3% did not report their ethnic background. This ethnic distribution is similar to the ethnic composition of Los Angeles County Public Schools, which in 2000 was 59% Hispanic, 10% Asian, 19% non-Hispanic white, 11% African American, 1% Pacific Islander, and <1% Native American. Students were an average of 12.5 years old at baseline.

Procedure

Respondents completed paper-and-pencil questionnaires in school during their regularly scheduled classes. Students received, randomized by school, one of 2 questionnaire forms that were identical in content with the exception of one section that contained alternative versions of ad-recall memory tests (described below). Prior written or phone-log-verified verbal parental consent was required for each participating student. Student assent at the time of testing was also required. The study protocol and survey contents were approved by the University of Southern California's Institutional Review Board and by the schools' research committees.

Measures of Advertising Exposure

Watched TV shows index. Respondents were given a list of 20 popular television series and asked to indicate how many times they watched each program during the past month on a 6-point scale from "never" to "every day." The shows, such as *Friends* and *The Drew Carey Show*, were chosen on the basis of the number of advertisements aired on the program during the 6-month interval prior to survey administration and teen audience size per program, as determined by data from Nielsen Media research. Following Strickland's strategy,[14] viewing frequency responses for each show were weighted by the show's average monthly alcohol advertising frequency. For example, if a specific television program showed 5 alcohol ads per month, the respondents' viewing frequency score for this program would be multiplied by 5. The number of alcohol ads aired per month varied widely across the television programs in the scale, ranging from a low of 0.8 alcohol ads per month (*That 70's Show*) to a high of 68.9 alcohol ads per month (*Behind the Music* on VH1). Thus, the weights applied to the respondents' self-reported watching frequencies also ranged from 0.8 to 68.9. The weighted frequency scores were then averaged to create an overall index, similar to the method used by Strickland.[14] The mean score on the weighted index was 15.7, with a standard deviation of 9.6 (median=14.1, interquartile range=11.1).

Watched TV sports index. Because televised alcohol advertising occurs much more frequently during televised sporting events than serial television shows,[9,10] a separate scale was constructed to reflect exposure to televised sports. Using items

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adapted from Bloom et al,[16] respondents were asked how frequently they watched televised professional baseball, college and professional basketball, professional soccer and hockey, and ESPN SportsCenter in the last month. Football was not included in the list of sports because the study was conducted in the springtime, not during football season. Respondents rated each of these items on a 6-point scale ranging from "never" to "every day." As with the watch-TV shows index, viewing frequency responses were weighted with the average monthly alcohol advertising frequencies per event type and averaged together to create an index. The monthly ad airing frequencies ranged from 32.1 for professional soccer to 542.5 for ESPN SportsCenter. The weighted scale mean was 238.3 with a standard deviation of 258.9 (median=145.1, inter-quartile range=333.6).

Self-reported frequency. Three questions adapted from Schooler et al[17] were used to assess self-reported frequency of exposure to alcohol commercials: "In the past week, how many TV commercials have you seen for alcohol drinks, like beer, wine, or liquor?"; "About how often did you see a beer commercial on TV in the last 6 months?"; and "About how often did you see wine or liquor advertised on TV?" Responses were rated on 7-point Likert-type scales. The mean of the 3 items represented the respondent's score (Cronbach's alpha=.79). The scale mean was 5.05, and standard deviation was 1.68.

Cued-recall memory test. One of the most common measures of the memorability of an advertisement is cued recall.[18] Approximately two thirds of the distributed questionnaires contained a memory-based cued-recall measure. Students were shown 13 still pictures of scenes electronically captured from 13 different television commercials. Nine of the commercials were beer commercials known to have been aired with relatively high frequency on programs popular with teens during the 3 to 6 months prior to testing. The remaining 4 commercials were control ads consisting of 3 current soft drink ads (beverage controls) and one nonbeverage product (a product control). For each commercial, respondents were asked to write the type of product being advertised. Product responses were computer coded for variations on the words *beer* or *alcohol* (yes/no). A cued-recall index for beer ads was computed as the number of recent beer commercials correctly identified as beer commercials (0-9). The mean of this scale was 2.7 (SD=2.0), and the Cronbach's alpha was .69. Analysis involving the cued-recall index contained 2 additional adjustment (potential confounder) variables in the models outlined below: one for false positive identification of control ads as alcohol ads and the other for individual differences in memory ability. Control-ad product responses were coded yes/no for false positive beer or alcohol responses and summed as a false-positives index (0-4). The measure of individual differences in memory (ie, better memory for advertisements in general) was the number of nonalcohol ads that the respondent identified correctly (0-4).

Draw-an-Event memory test. As an alternate form of memory-based ad-recall measurement, we used a series of 3 "draw-an-event" tests in which students were instructed to think of the first TV commercial that came to mind and to draw a sketch of it.[19] Students also were asked to label the product featured in the imagined ad, and the product response words were computer coded as indicating a student's self-report of recalling/intending to draw an ad for an alcohol product (yes/no) if the words contained variations on the words *beer* or *alcohol* and/or beer or alcohol brand names.

Two additional draw-an-event tests instructed respondents to think quickly of the first 2 *alcohol* commercials that came to mind and draw them. The 2 questions were, respectively, "Can you think of an alcohol commercial you saw on TV?" and "Try to think of a *different* TV commercial about alcohol; does a different one come to mind?" Students circled "yes" or "no." The draw-an-event score was the number of alcohol ads the student could recall (0-3) across these 3 tests. The mean of this scale was 1.64, with a standard deviation of 0.67.

Measures of Alcohol Use

Current alcohol use. The alcohol use questions were preceded by the following definition: "The next questions ask about drinking alcohol. This includes drinking beer, wine, wine coolers, and liquor such as rum, gin, vodka, or whiskey. For these questions, drinking alcohol does not include drinking a few sips of wine for religious purposes." In line with Kann,[20]

Table 1
Alcohol Use Prevalence in 7th and 8th Grade

	Beer		Wine/Liquor		3-Drink Episodes	
	7th grade N (%)	8th grade N (%)	7th grade N (%)	8th grade N (%)	7th grade N (%)	8th grade N (%)
Never used	1259(55%)	1070(48%)	1427(63%)	1161(52%)	1919(85%)	1740(77%)
Used but not in past month	640(28%)	772(34%)	479(21%)	644(29%)	151(7%)	237(11%)
Used in past month	351(16%)	408(18%)	344(15%)	445(20%)	180(8%)	272(12%)

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current use of beer, wine, and liquor at eighth grade were assessed with the following items, each with same stem: "During the last 30 days, on how many days did you….", "…have at least one drink of beer?", …and "... have at least one drink of wine or liquor?" In most surveys of high school students and adults, binge drinking is defined as 5 or more drinks on one occasion.[20] Because this study assessed alcohol use in eighth grade, we set a lower criteria of 3 drinks per occasion as a measure of heavy drinking episodes. The question on binge drinking from the Youth Risk Behavior Surveillance Survey[20] was modified to read, "During the last 30 days, on how many days did you have 3 or more drinks of beer or wine or liquor in a row, that is, within a couple of hours?" This modified measure was labeled "3-drink episodes," even though for the lower weight (and hence blood alcohol level) of this age group it is essentially synonymous with binge drinking. The word *drink* was defined in the instructions as a typical serving size. Responses were given as the number of days (0 to 30), but were recoded to binary as 0 vs 1 or more for the present analysis because the distributions were extremely skewed toward zero.

Prior alcohol use. Prior use of beer, wine, and liquor, and 3-drink episodes were assessed with 3 indexes containing the full scale responses to the current use items above, plus similar questions about the frequency of alcohol use in the last 6 months and lifetime. Cronbach's alphas were .85 (beer index), .88 (wine/liquor), and .91 (3-drink episodes).

Measures of Confounders

In addition to the memory covariates already outlined, psychosocial and behavioral variables that have been associated with advertising exposure and/or alcohol consumption in previous studies were included as covariates. These included general television viewing frequency,[10,21-23] participation in team sports,[17,22] perception of friends' alcohol use,[14,21] perceived peer approval of alcohol use, intentions to use alcohol, perceptions of adults' alcohol use,[25] gender,[4,26-28] ethnicity, and school.

Follow-up propensity. Because the students lost to attrition may differ in risk-behavior profiles from those who are followed up successfully, we included a follow-up propensity score[29] as an additional adjustment variable. The propensity score was predicted in a logistic regression from baseline alcohol use and all other confounding variables listed above and is included in all analyses.

Data Analysis

To determine the effects of alcohol advertising exposure on subsequent alcohol use, a series of logistic regression models were used. The models predicted each of the three eighth grade current alcohol use variables from: (a) each of the seventh-grade advertising exposure measures alone (the "unadjusted" model); and (b) advertising exposure, prior use, and all potentially confounding variables listed above (confounder adjusted model). A third set of models examined the 2-way interactions between exposure and prior alcohol use, gender, and ethnicity, in the context of the confounder adjusted model. Exposure measures and all confounders with the exception of demographic variables were standardized to a mean of 0 and a standard deviation of 1 to allow for comparison of coefficients across exposure measures.

RESULTS

Prevalence of Alcohol Use

The prevalence of lifetime and past-

Table 2
Correlations Among Measures of Alcohol Advertising Exposure

	Watched TV Shows Index	Watched TV Sports Index	Self-reported Frequency	Cued-Recall Memory Test	Draw-an-Event Memory Test
Watched TV Shows Index	1	.29*	.10*	-.03	.03
Watched Sports	.33*	1	.07*	.13*	.00
Self-reported Frequency	.19*	.14*	1	.24*	.29*
Cued-Recall Memory Test	.01	.22*	.27*	1	a
Draw-an-Event Memory Test	.08*	.08*	.32*	a	1
N	2250	2250	2250	1433[a]	817[a]

Note.
Unadjusted correlations appear in the lower half of the matrix. Partial correlations, partialling all listed confound variables, appear in the upper half of the matrix.
*** P<.05**
a These exposure measures cannot be correlated because they appeared on alternate versions of the questionnaire.

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month alcohol use is shown in Table 1. In seventh grade, 16% of the respondents reported drinking beer in the past month, 15% reported drinking wine in the past month, and 8% reported 3-drink episodes in the past month. By eighth grade, these prevalence rates had increased to 18% for beer, 20% for wine, and 12% for 3-drink episodes.

Correlations Among Exposure Measures

Table 2 shows the correlations among the various measures of alcohol advertising exposure. Although some of the correlations were statistically significant, most were modest (all $\leq$.33). Because each measure had unique variance and was conceptually distinct, the measures were investigated as separate independent variables rather than combined into an index.

Relevance of Potential Confounders

To assess the relevance of potential confounders of our exposure measures, we computed the Pearson correlation coefficients between each exposure measure and each set of confounders. As shown in Table 3, with few exceptions the measures of TV alcohol ad exposures have modest, but significant, concurrent associations with prior alcohol use and intentions (range -.02 to .17), peer and familiar adult use (range .00 to .23), peer norms (range .03 to .14), and the activities of general TV viewing and sports participation (range .06 to .44). The cued-recall memory test measure exhibited the least amount of confounding among this set, with 7 of the 13 correlations being nonsignificant.

Males had higher levels of ad exposure as measured by TV sports watching (r=.31) and higher scores on the memory-based exposure measures (r=.23 with cued-recall test, .09 with the draw-an-event test) than those of females. Hispanics appeared to have higher levels of ad exposures than non-Hispanics as measured by all but the draw-an-event memory test (range .09 to .15), whereas non-Hispanic whites had higher levels of ad exposure as measured only by the draw-an-event test (r=.10). Asians tended to have *lower* levels of ad exposures than others as measured by all but the draw-an-event test (range -.08 to -.15). Other ethnic groups, including multi-ethnic youth, did not show any evidence of differential ad exposures on any of the measures (range -.05 to .03).

Logistic Regressions of Alcohol Use on Advertising Exposure

Odds ratios, confidence intervals, and p-values for ad exposure measures in the various logistic regression models are provided in Table 4. Because the expo-

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Table 3
Correlations Between Measures of Televised Alcohol Ad Exposures and Potentially Confounding Variables

	Self-reported Frequency	Watched TV Shows Index	Watched TV Sports Index	Cued-Recall Memory Test	Draw-an-Event Memory Test
Confounder					
Prior Beer Use	.14*	.11*	.08*	.01	.13*
Prior Wine/Liquor Use	.13*	.09*	.06*	-.01	.11*
Prior 3-drink episodes	.09*	.07*	.06*	-.01	.10*
Intentions to Drink	.17*	.13*	.07*	.09*	.14*
General TV Viewing	.20*	.21*	.08*	.14*	.06*
Sports Participation	.15*	.21*	.44*	.11*	.10*
Peer Alcohol Use	.21*	.17*	.10*	.00	.13*
Adult Alcohol Use	.23*	.16*	.10*	.05	.14*
Drinking Norms	.14*	.12*	.09*	.03	.12*
Male (vs female) Gender	.02	.00	.31*	.23*	.09*
White (vs Nonwhite) Ethnicity	-.03	-.02	-.02	-.02	.10*
Hispanic (vs Non-Hispanic) Ethnicity	.11*	.15*	.09*	.13*	-.03
Asian (vs Non-Asian) Ethnicity	-.12*	-.15*	-.08*	-.10*	-.02
Mixed (vs Non-Mixed) Ethnicity	.01	-.02	-.00	-.01	.00
N	2250	2250	2250	1433[a]	817[a]

Note.
*** P<.05**
a These exposure measures appeared on alternating forms.

sure measures were standardized, the odd ratios represent changes in odds for one standard deviation unit increase, relative to the average exposure.

Opportunity-based exposure measures. The watched TV shows exposure index showed a consistent association with subsequent alcohol use across levels of confounder adjustment and types of outcome. In the fully adjusted model, each one standard deviation increase in alcohol advertising exposure as measured by the watched TV shows index was associated with a 44% increase in odds of beer drinking (95% CI=27%-61%), a 34% increase in odds of wine or hard liquor drinking (95% CI=17%-54%), and a 26% increase in odds of 3-drink episodes (95% CI=8%-48%). The watched TV sports index was associated only with subsequent beer drinking in the fully adjusted models, with a 20% (95% CI=5%-37%) estimated increase in odds per standard deviation unit. Prior use and confounder variable adjustments had relatively little impact on the estimates of the opportunity based ad exposure measures, with the possible exception of the association between watched TV sports and subsequent 3-drink episodes where the unadjusted model showed a small but significant association, but the coefficients in adjusted models were not significant.

Memory based exposure measures. The self-reported frequency of alcohol TV ads measure showed significant associations with all 3 subsequent alcohol use measures in the unadjusted models (odds ratio range 1.22 to 1.47), but only with subsequent beer drinking in the fully adjusted model (OR=1.21, 95% CI=1.04–

Table 4
Logistic Regression Results Predicting 8th Grade Alcohol Use from Seventh-Grade Alcohol Ad Exposures

Exposure Measure	Beer Use OR	(95%CI)	P	Wine/Liquor Use OR	(95%CI)	P	3-drink Episodes OR	(95%CI)	P
Watched TV Shows Index									
Unadjusted	1.46	(1.30,1.66)	<.001	1.34	(1.21,1.47)	<.001	1.33	(1.18,1.49)	<.001
Confounder Adjusted	1.44	(1.27,1.61)	<.001	1.34	(1.17,1.52)	<.001	1.26	(1.08,1.48)	.002
Watched TV Sports Index									
Unadjusted	1.22	(1.10,1.35)	<.001	1.05	(0.94,1.16)	.339	1.14	(1.01,1.28)	.028
Confounder Adjusted	1.20	(1.05,1.37)	.006	1.00	(0.88,1.15)	.910	1.07	(0.91,1.26)	.383
Self-reported Frequency									
Unadjusted	1.47	(1.30,1.66)	<.001	1.32	(1.19,1.49)	<.001	1.32	(1.15,1.52)	<.001
Confounder Adjusted	1.21	(1.04,1.41)	.012	1.18	(0.98,1.32)	.081	1.06	(0.89,1.27)	.464
Cued-Recall Memory Test									
Unadjusted	1.15	(1.00,1.31)	.068	1.13	(0.99,1.29)	.059	1.20	(1.02,1.41)	.022
Confounder Adjusted	1.17	(0.97,1.38)	.106	1.07	(0.91,1.26)	.406	1.17	(0.91,1.44)	.109
Draw-an-Event Memory Test									
Unadjusted	1.01	(0.90,1.13)	.856	0.99	(0.88,1.10)	.862	1.00	(0.88,1.15)	.895
Confounder Adjusted	0.86	(0.75,0.99)	.036	0.92	(0.81,1.03)	.226	0.91	(0.78,1.06)	.265

Note.
The most conservative, *a priori* analysis is shown. An anonymous reviewer suggested an analysis of a composite of the 2 opportunity-based measures. Because of Strickland's[8] concerns about this practice and the lack of strong evidence that they should be combined, the primary analysis did not rely on a composite score. Nevertheless, a supplementary analysis of this composite score showed that it was a significant, positive predictor of all three dependent variables, revealed in both unadjusted and confounder-adjusted results (odds ratios in adjusted results ranged from 1.20 to 1.40).

1.41), although the association with wine/liquor use was only trivially smaller (OR=1.18) but did not achieve statistical significance (P=.081). In general, self reported frequency of ad exposure appears to be confounded with other predictors of subsequent alcohol use as evidenced by the reductions in exposure coefficients when confounders were added to the models.

The cued-recall memory test measure showed a different pattern across models and outcomes to that seen with self-reported frequency. Exposure coefficients were less affected by adjustments, indicating less confounding between this exposure measure and the adjustment variables. The cued-recall measure was clearly insensitive to subsequent wine/liquor use (OR=1.07, p=.406) and 3-drink episodes (OR=1.17, P=.106). The magnitude of association to beer drinking for the cued-recall measure (OR=1.17) was similar to that of self-reported frequency measure (OR=1.21), but was not statistically significant (P=.106) in the fully adjusted model.

The draw-an-event memory test showed no relationship to subsequent wine/liquor use or 3-drink episodes in any of the models (odds ratio range .092 to 1.00). For beer use, the odds ratios in unadjusted models were also nonsignificant (OR of 1.01,P=.856). However, in the fully adjusted model, an odds ratio of 0.86 (95% CI, 0.75-0.99, P=.036) indicated that those who scored one standard deviation above the mean on this exposure measure were 14% *less* likely to subsequently drink beer a year later.

Interactions of Advertising Exposure With Gender, Ethnicity, and Prior Alcohol Use

All potential variations in the level of association between the alcohol advertising exposure measures and subsequent alcohol use across gender, ethnicity, and level of prior alcohol use were tested by entering interaction terms between these variables to the fully adjusted models above. None of the interaction terms were

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significant at P<.10, indicating there was no evidence of reliable variation in the odds ratios reported in Table 4 across these subgroups.

DISCUSSION

This study investigated predictive effects of a diversity of measures of exposure to televised alcohol commercials, as well as a host of potential confounders of the association between exposure and adolescent alcohol use. Any possible measure of exposure has some limitations. Thus, the assessment strategy used measures diverging in limitations such as likelihood of false positives and confounding. The present research is one of the most comprehensive prospective studies on this issue to date, because of the range of measures and confounders investigated. Such an approach is necessary for improved inference.

Inferences about effects in any observational study must take into account the overall pattern of findings, as well as limitations and confounders involved in each of the different exposure assessments. First, when predictive effects of exposure on consumption variables were uncovered, it is clear that they occurred primarily for beer consumption and more rarely for wine/liquor consumption and 3-drink episodes. This general pattern is consistent with several observations from the literature. Most televised alcohol commercials are for beer,[9] and beer is a more frequent alcoholic beverage of choice for youth.[30] Also, binge drinking in eighth grade is a relatively rare event.[31]

Both of the opportunity measures of exposure predicted subsequent beer consumption. These measures assessed the likelihood of exposure to alcohol commercials on the basis of television viewing habits targeting either sports events or popular shows weighted by probability of appearance of alcohol commercials. Importantly, the effects of likely confounders of these assessments were adjusted in the analysis, including sports activity and general levels of television viewing. The analysis also adjusted for numerous other confounders, including prior alcohol use, intentions, peer and adult alcohol use, and other variables. Although in some instances the prospective effects of exposure were slightly diminished, they were still statistically significant and similar in magnitude. The same pattern of findings was obtained for the self-reported frequency, meta-memory measure of exposure, with significant prospective effects on beer consumption even when effects of all confounders were adjusted for. Predictive effects of the 2 recall tests of exposure were nearly always nonsignficant in confounder-adjusted analyses, except for one counterintuitive instance in which exposure predicted *less* beer consumption. In advertising research, memory for specific commercials has a far less than perfect association with brand choice.[32] Less is known about memory for commercials across a product class, although some tests have shown reliability and convergent validity in alcohol advertising research.[19]

One of the exposure measures, the watched TV shows index, showed significant predictive effects on all consumption variables, even when adjusting for all confounders. This index was similar in rationale and design to that first found effective by Strickland.[14] It is important to note that this is an indirect measure that does not ask respondents directly about alcohol commercials. It merely assesses frequency of viewing popular television programs and weights these scores by the number of commercials shown on these programs. It is hard to explain a predictive effect of this variable through such alternative explanations as hypothesis guessing or demand characteristics. It is also difficult to imagine more proximal confounders of this relationship that were not already controlled for in the analysis, such as previous use, intentions, peer use, adult use, or general television viewing.

Another feature of the general pattern of results is that a great majority of the odds ratios were positive, even though most for wine and liquor consumption and 3-drink episodes were not significant. Taken together, the findings argue for effects on beer consumption and trends toward effects on wine and liquor consumption and 3-drink episodes in most comparisons. This is a somewhat mixed picture, but nevertheless it leans toward the view that alcohol commercials have some effects on alcohol consumption in this age group.

In the confounder-adjusted model, the draw-an-event memory was associated with a lower odds ratio of subsequent monthly beer drinking. Although specu-

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lative, one possibility is that this nonverbal sketch test is more than a memory assessment. In addition to revealing nonverbal images of remembered scenes, the test may engage the student in beneficial, image-based elaborative processing of the commercial—that is, students who provide sketches of an ad may process its content in some ways that have preventive effects in the future. Nonverbal processing and memory constitute a fundamental area of basic memory research and cognitive neuroscience that is very seldom applied to health behavior or prevention.[33] Because links to preventive effects were not considered beforehand in the present study and have not been evaluated in previous research, this post hoc explanation should be considered tentative but worthy of evaluation in future research.

These results should be judged in the context of several limitations of the current study. First, it is probably impossible for any observational study to assess every possible confounder that might explain away effects of assessed exposure. This is the major limitation of an observational design. Although the authors believe that most unmeasured variables would have operated through the confounders that were assessed, future research might evaluate several possibilities. For example, future studies might assess adolescents' involvement in prosocial extracurricular activities in general, which may be associated with fewer opportunities to watch TV and associated with a lower risk of alcohol use; however, at least one type of activity (involvement in sports) was assessed in the present study. Similarly, antisocial activities or general propensity toward deviance (problem proneness) needs to be considered in future investigations, although these variables also may be manifested in our confounder set (eg, previous alcohol use, intentions, hours of TV watched); in any case, the link between deviance and alcohol commercial exposure has not been demonstrated prospectively to our knowledge. Other potentially confounding variables uncontrolled for here include depression and parental monitoring practices, which also are likely to be mediated through the variables in the confounder set (eg, hours of TV watched) if they have effects on exposure. The present study did adjust for the strongest known longitudinal predictors of future alcohol consumption, including previous consumption, peer use, intentions, and other proximal variables that should at least partially index the omitted variables.

Second, the study is limited in generalizability, because the sample is only from adolescents in public school from only one region of the United States. Compared with the overall US population, this sample was more ethnically diverse and contained a larger proportion of Hispanic students. Nevertheless, the complete absence of interactions of obtained effects with major demographic variables such as gender and ethnicity shows the results are generalizable at least across some diverse groups. Third, these findings are based on adolescents' self-reports of alcohol use; biochemical validation was not conducted. Finally, although the results show some consistent patterns, not all measures of exposure converge on the same findings. This was particularly true of the differences in findings between the memory-based measures and the opportunity-based measures. The present state of the validation literature on exposure assessment does not show which tests are optimal. Although the limited generalizability of the sample and inherent uncertainties in observational designs imply that results should be replicated, the present findings are consistent with conclusions from previous longitudinal studies.

Effects of advertising have implications for the prevention of alcohol use among adolescents. Although alcohol marketing efforts ostensibly target an adult audience, these findings indicate that young adolescents have numerous opportunities to view alcohol advertisements on television; and youth do notice and recall these advertisements. Furthermore, adolescents who are exposed to alcohol advertisements may have a higher risk of experimenting with alcohol in subsequent years. Although the magnitude of the association between alcohol-ad exposure and alcohol use varied according to the ad exposure measure used, the weight of the evidence from this study is consistent with that of some other studies suggesting that exposure to alcohol advertising increases the risk of subsequent alcohol use.[4,7,9,10,14] Even if the risk attributable to advertising is small relative to other in-

fluences such as peers and social norms, limiting adolescents' exposure to proalcohol media messages could be an important part of a comprehensive strategy to prevent adolescent alcohol use. Given the potential public health benefits of reducing adolescent alcohol use, increased attention to this issue is warranted.

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The effect of alcohol advertising, marketing and portrayal on drinking behaviour in young people: systematic review of prospective cohort studies

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Abstract

Background: The effect of alcohol portrayals and advertising on the drinking behaviour of young people is a matter of much debate. We evaluated the relationship between exposure to alcohol advertising, marketing and portrayal on subsequent drinking behaviour in young people by systematic review of cohort (longitudinal) studies.

Methods: studies were identified in October 2006 by searches of electronic databases, with no date restriction, supplemented with hand searches of reference lists of retrieved articles. Cohort studies that evaluated exposure to advertising or marketing or alcohol portrayals and drinking at baseline and assessed drinking behaviour at follow-up in young people were selected and reviewed.

Results: seven cohort studies that followed up more than 13,000 young people aged 10 to 26 years old were reviewed. The studies evaluated a range of different alcohol advertisement and marketing exposures including print and broadcast media. Two studies measured the hours of TV and music video viewing. All measured drinking behaviour using a variety of outcome measures. Two studies evaluated drinkers and non-drinkers separately. Baseline non-drinkers were significantly more likely to have become a drinker at follow-up with greater exposure to alcohol advertisements. There was little difference in drinking frequency at follow-up in baseline drinkers. In studies that included drinkers and non-drinkers, increased exposure at baseline led to significant increased risk of drinking at follow-up. The strength of the relationship varied between studies but effect sizes were generally modest. All studies controlled for age and gender, however potential confounding factors adjusted for in analyses varied from study to study. Important risk factors such as peer drinking and parental attitudes and behaviour were not adequately accounted for in some studies.

Conclusion: data from prospective cohort studies suggest there is an association between exposure to alcohol advertising or promotional activity and subsequent alcohol consumption in young people. Inferences about the modest effect sizes found are limited by the potential influence of residual or unmeasured confounding.

Background

The influence of alcohol marketing and advertising on the drinking behaviour of young people is a matter of much debate, mostly focused on the question of whether advertising increases consumption and risky drinking by young people. On the one hand the International Center for Alcohol Policy (ICAP) reported in 2003 to a World Health Organisation (WHO) meeting [1] that there is no compelling evidence of an association between advertising and drinking patterns or rates of abuse among young people, noting that:

> *"The industry does not condone promotion and advertising of beverage alcohol to those under the legal minimum purchase age. Yet it should be acknowledged that young people are inevitably exposed to beverage alcohol advertising, as they are to advertising for any other consumer product. They are aware of it, and are able to identify and distinguish between alcohol brands, just as they are able to discern brands of other consumer goods. However, the evidence does not support the notion that such awareness increases consumption by young people."* (point 30, page 9)

On the other hand, healthcare researchers and workers have shown associations between exposure to alcohol advertising and drinking behaviour in cross-sectional surveys [2-5], and it has been argued that an increased awareness of alcohol messages amongst young people might lead to earlier drinking, higher consumption and increased harm, and should be addressed through stronger marketing regulation [6]. Alongside this, macro-level analyses comparing advertising coverage with drinking consumption has been used to provide a rationale for imposing limits on alcohol advertising. One study, drawing on data from Organisation for Economic Co-operation and Development (OECD) countries, reported that total expenditure on alcohol advertising is linked to higher consumption and argued that advertising bans could result in significant reductions in consumption [7]. Similarly, an economic analysis in the United States assessed the effects of alcohol advertising on youth drinking behaviours by comparing federally reported levels of youth drinking with detailed reports on alcohol advertising in local markets during the same years. The analysis concluded that a complete ban on alcohol advertising could reduce monthly levels of youth drinking by 24% and youth binge drinking by about 42% [8]. Correspondingly, in the United States the Institute of Medicine has called for stronger regulation of alcohol marketing [9].

However, causal relationships cannot be directly inferred from these studies and this limits the conclusions that can be drawn about the potential impact of advertising bans. Moreover, the alcohol and advertising industry have used data from econometric studies to argue that advertising bans have little impact on overall alcohol consumption [10-13].

Whether young people are directly targeted by alcohol advertisers or not, they are exposed to alcohol advertising on television, in print media, and on radio. A first question to be answered through rigorous research, therefore, is whether alcohol advertising does have an impact on alcohol consumption amongst young people. This question is best addressed through large prospective cohort studies that examine the relationship between baseline early exposure to alcohol advertising and subsequent consumption and misuse. Helpfully, several such studies have recently been published [14-22].

The aim of our systematic review was to evaluate the likelihood that exposure to alcohol advertising, marketing and portrayal of alcohol increases self-reported alcohol use in young people. We have specifically focused on substantive behavioural outcomes – alcohol use – rather than surrogate outcomes such as brand awareness, or attitudes or intentions towards drinking as the exact causal relationship between surrogate outcomes and subsequent drinking behaviour is unclear. Substantive outcomes provide a more robust basis for evidence based decision making.

Several reviews of the literature on the association of advertising exposure and drinking in young people or, more generally, the effects of media on the behaviour and lifestyles of young people have previously been published [23-31]. However, none use explicit, transparent methodology and they generally lack critical appraisal of individual study weaknesses in relation to any likelihood of bias. These reviews also tend to include weaker study designs, do not clearly distinguish cross-sectional and longitudinal study evidence [4,5,32], focus on clinical/public health aspects rather than methodological detail, and draw major conclusions based on predominantly cross-sectional studies. Our review differs in aim from previous reviews which focused on evaluating the association between media effects and expectancies of drinking or drinking behaviour. Another important difference in our review is the detailed description of our systematic and rigorous approach to the topic, consistent with best methodological practice in systematic reviews of prospective cohort studies, in particular an assessment of the likelihood of bias of reviewed studies [33]. Furthermore, although previous reviews have referenced some of the studies we have included in our review, none have covered all the studies that we have included. Therefore, we provide an update to previous reviews focusing on findings from longitudinal study designs.

Methods

Eligibility criteria

We considered studies that evaluated the relationship between alcohol advertising or marketing and alcohol use in young people. We included prospective cohort (longitudinal) studies where young people's exposure to alcohol advertising or attitudes to alcohol advertising and alcohol drinking behaviour were evaluated at baseline and alcohol drinking outcomes were again evaluated after a given period of time. The rationale for restricting the review to prospective cohort studies is that they provide the highest level of evidence that is available for evaluation of advertising and marketing exposure and subsequent drinking behaviour. If such studies are well designed, conducted and analysed they can provide supportive evidence for a causal association between a particular exposure and an outcome. Randomised controlled trials (RCTs), the best design for inferring causality, have not been conducted in this area and are unlikely to be in the future as they are impractical, and it may be unethical to randomise participants or communities to specific advertising and/or marketing strategies in order to evaluate potentially harmful effects.

We excluded experimental studies which evaluated a single exposure to advertising of one form or another and examined immediate effects on either attitude or liking for the advertisements or drinking behaviour. Whilst experimental studies have advantages in that they offer better control over the intervention that participants are exposed to so that the intervention can be more accurately described and causality more confidently inferred; they do not reflect the complexity of the advertising and commercial milieu that people are exposed to in their daily lives, and only evaluate effects post-exposure at a single timepoint, so results are not applicable to a broader context. We have also excluded cross-sectional, time-series and econometric studies. Cross-sectional surveys measure the association between a particular exposure such as alcohol advertising and drinking behaviour, but do not show whether the exposure preceded the outcome. Reverse causality cannot be ruled out, whereby young people who drink or misuse alcohol are more receptive to alcohol advertising. Time-series studies are also not ideal for showing temporal relationships due to a greater risk of confounding. One other weakness of the time-series studies is that they measure exposure and outcomes at a population level, rather than in individuals, and therefore include all age groups and are not exclusively focused on young people. Variation in effects in different age groups may be obscured when looking at aggregate population data. Econometric or ecological studies, which may also use time-series data, use data from different sources and statistical modelling to examine relationships between exposure (advertising expenditure) and outcome (alcohol sales). Again these studies are not ideal for this review as they do not specifically look at drinking behaviour in young people but report aggregate alcohol consumption across the population. The observed effect is also highly dependent on the choice and source of factors that are used for the statistical model.

To be included in our review, cohort studies were required: (i) to evaluate young people of school or college age. Studies of participants including young people were excluded if results were not presented separately by age groups or if young people constituted less than 75% of the overall sample; (ii) to evaluate conventional advertising and marketing practices including above and below the line activity, as well as alcohol portrayal in broadcast and print media, for example product placement and depiction of alcohol use. This includes advertising appearing on television, radio, newspapers, billboards, posters, or depiction of alcohol use in movies, TV programmes, music videos and song lyrics, promotional activities including give-aways such as t-shirts and other items bearing alcohol brand logos. Portrayals of alcohol use are particularly prevalent in prime-time programming [34], music videos [35], and during television coverage of sports events [36]; and (iii) to evaluate any alcohol consumption outcome which included: self-reported alcohol use; frequency quantity measures; and self-reported use of specific brands of alcohol or type of alcohol e.g. beer, wine or spirits. We excluded studies reporting only intention to drink as an outcome, or attitude to drinking. Studies only reporting awareness and that did not measure any effects on drinking were also excluded.

Identification of studies

Electronic databases searched were Medline and Embase from their inception to October 2006. Search terms included free text and MESH terms for drinking behaviour and advertising and marketing. The exact search strategies are shown in Table 1 (see Additional file 1) Reference lists of retrieved reviews and primary studies were also scanned for additional relevant studies. There was no restriction to language of publication.

Study selection and synthesis

Potentially relevant studies were identified by screening titles and abstracts of retrieved references from the electronic databases. Articles were not selected unless the title or abstract focused on effects of alcohol advertising, marketing or portrayals and on drinking behaviour in young people. Where this was not clear, the full text of the articles was retrieved for further screening. Each retrieved article was screened for review inclusion according to the eligibility criteria described above. Data from included studies were extracted and summarised as a narrative synthesis. Threats to internal and external validity were

appraised for each study using the Newcastle-Ottawa Quality Assessment Scale for cohort studies adapted for this review [37]. Quality components assessed were:

External validity

1. Was the sample a consecutive sample or a random sample of the population?

2. Did at least 80% of all eligible participants agree to participate?

Internal validity

3. Performance bias – was ascertainment of exposure by structured interview?

4 Detection bias – a) was ascertainment of outcome by structured interview? b) Were investigators blind to exposure status or data collected independently?

5. Attrition bias – a) were all participants followed up for the same length of time? b) Were at least 80% of participants included in the final analysis or was the description of those not included unlikely to introduce bias?

6. Control of confounding: a) age or school grade; b) gender; c) ethnicity; d) social influences;

e) social bonds; f) attitudes and behaviour; g) treatment group (participants in an RCT of drug prevention programme); h) TV or other media use; i) parental education; j) school performance; k) self esteem; l) rebelliousness; m) sensation seeking; n) parenting style 0) smoking; p) drinking at baseline q) puberty; r) alcohol sales per capita; s) school status; t) propensity score (accounts for attrition); u) team sport participation; v) = school; w) = living situation; y) = socioeconomic situation.

Studies were awarded an asterix if the component was adequately addressed. For the confounding factors a-y in the selection bias/control of confounding factors section, an asterix indicates that the groups were either balanced or matched for at study start or the variable was adjusted for in an analysis.

Studies not eligible for inclusion were tabulated with reason for exclusion. Screening, selection, data extraction and narrative synthesis were undertaken by one systematic reviewer.

Results

The electronic searches identified 915 potentially relevant articles. After screening the titles and abstracts, 115 potentially relevant articles were obtained as full text publications. An additional six articles were identified from screening the reference lists of retrieved articles. After screening each full text article for review eligibility, 112 were excluded leaving nine articles reporting on seven studies for review inclusion, Figure 1. Many studies were excluded mainly because they were secondary reports: reviews, letters or editorials on media effects. We found five foreign language publications without English abstracts requiring translation to determine eligibility but this was beyond the scope of this systematic review. Other articles were excluded mainly due to ineligible study designs: cross-sectional surveys, experimental, time-series or econometric studies. We excluded three articles because although data were taken from a prospective cohort study, these data were from a cross-sectional analysis focusing on just one time point [4,5,38].

Description of included studies

Nine publications reporting on seven prospective cohort studies were identified that met the review inclusion criteria [14-22]. The seven studies provided data on 13,255 participants aged 10 to 26 years old. Characteristics of the included studies are shown in Table 2 (see Additional file 2). Five were conducted in the USA [16-19,21], one in Belgium [20] and one in New Zealand [14,15,22]. In one study [16] the cohort was part of an RCT of a school-based drug prevention programme, and in another [15] the cohort was a sub-set of a larger cohort study recruited in 1972 and followed through childhood to early adulthood evaluating growth and development.

The age of participants at baseline interview was 12 to 13 years (7th grade) in three studies [15,16,18], 14 to 15 years (9th grade) in one [19], one study [17] recruited a broader age group of youth, 15 to 26 year olds, one [20] used a mixed age group of first (aged 11 to 12 years) and fourth year (aged 14 to 15 years) secondary school students and one [21] used 10 to 14 year olds (5th to 8th grade).

In five studies participants were followed up once after baseline. Time to follow-up was one year [18,20], 18 months [19], 30 months [16] and 13 to 26 months [21]. One study reported outcomes at multiple time-points, six years and nine years and 14 years [14,15,22]. One study evaluated participants at four time points and present results for follow-up after 21 months taking the multiple time points into account in the analysis [17].

Each study used disparate measures of exposure; all relied on self-reported measures. One generated a composite score to reflect the amount of exposure to TV beer advertising, magazine alcohol advertising, beer concession stands and in-store advertising displays [16]. One measured exposure to any alcohol advertising in the past month on each of four media, TV, radio, billboards and magazines [17]. Another classified exposure as watched TV show index to quantify exposure to alcohol ads in spe-

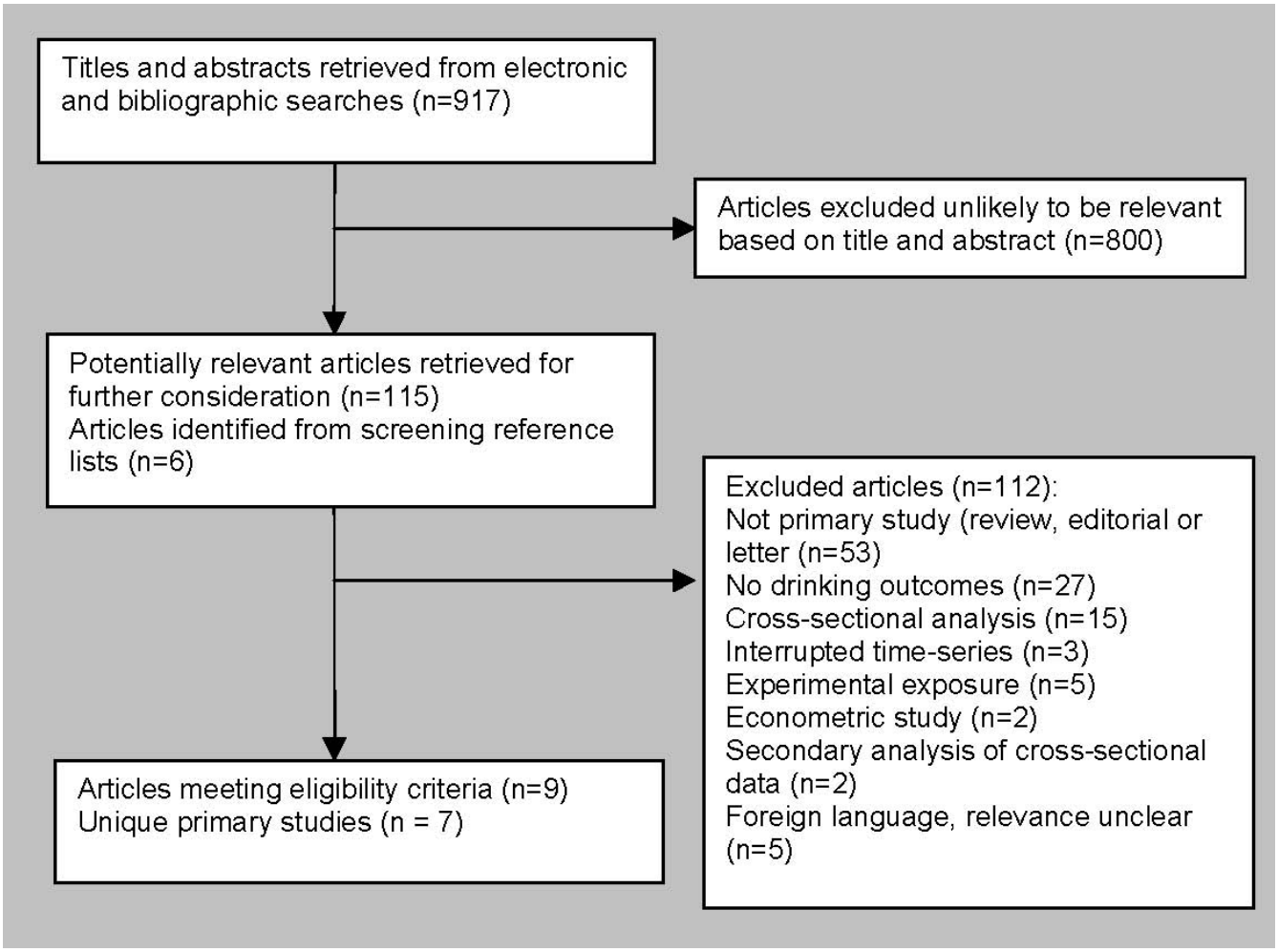

Figure 1
Results of searches of electronic databases and hand searching.

cific TV shows in addition to self-reported exposure to alcohol ads [18]. In the study by Connolly [15] recall of alcohol advertisements from different media, TV, radio, magazines, newspapers and films was evaluated. Two studies measured exposure as hours of TV and music video viewing [19,20], and one exposure to alcohol use in popular movies [21].

Drinking status was measured in all studies at follow-up. Two studies reported any alcohol use in the past month [17,18], one study reported alcohol use in the past year [16], one reported frequency of drinking at specific locations and average and maximum amount alcohol consumed on an occasion [15], one reported lifetime and past 30 days alcohol use [19], one alcohol use whilst going out [20], and one incident alcohol use without parental knowledge [21].

Methodological quality

One study used a random sample of youth [17] three randomly selected schools and all participants at those schools were invited to participate [18,20,21]; in one study [19] all participants at six schools were eligible to participate but how schools were selected was not described; one study used the original sample of participants selected for participation in an RCT but excluded those with missing data [16]; and one study consisted of a sub-sample of children who had exposure and outcome data available at all follow-up periods [15].

Ascertainment of exposure and outcome data were by self-reported questionnaires in four studies [16,18-20], by face-to-face interview in one [15] and computer-aided telephone interview in two [17,21]. None of the studies explicitly reported that interviewers were unaware of the exposure status of participants when outcome assess-

ments were conducted, however with participants independently reporting drinking outcomes via self-reported questionnaires there is little scope for detection bias on the part of the investigators. Not all children were non-drinkers at baseline. Two studies reported results for baseline drinkers and non-drinkers separately [16,19].

All studies suffered, to a greater or lesser extent, from potential attrition bias. Attrition rates were 33% [21] and 69% [17] in two surveys where data were collected by telephone; 18% [16], 25% [18], 39% [19] and 36% [20] in surveys conducted in schools, and 35% [15] for the survey with face-to-face interviews and questionnaires.

One study used imputation to account for missing data [16]; all other studies excluded participants with missing data from the analyses.

Statistical adjustments for measured confounding factors were performed by each study, but the number and type of confounders varied from study to study. The results of the overall quality assessment of each study are shown in Table 3 (Additional file 3).

Study findings

Connolly [15] investigated the relationship between alcohol consumption at 18 and alcohol-related mass media communications recalled at ages 13 and 15 years in a New Zealand cohort of young people. Among men, those who recalled more alcohol advertisements at age 15 drank significantly more beer at 18 years (average amount of beer consumption $p = 0.047$; maximum amount of beer consumption $p = 0.008$). In women a negative association of alcohol advertisement recall at age 13 years and frequency of drinking beer was found ($p = 0.029$). Multi-variate analyses were adjusted for potential confounders which were: media exposure, gender, current occupation, living situation, socio-economic status and peer approval of drinking. There was no significant effect on wine or spirit consumption in either women or men. Whilst significant relationships were detected, we cannot rule out the possibility they occurred due to chance. The authors reported results for more than 35 statistical tests and significant findings would be expected to occur due to chance. This coupled with the small sample sizes, 251 men and 184 women, cast some doubt on these findings being true effects. Longer follow-up from this same sample at age 21 and 26 years have been published [14,22]. In the group that were beer drinkers at 18 years, liking of alcohol advertising and brand allegiance had a positive impact on beer consumed at age 21 years; standardised coefficients were 0.26 and 0.36, respectively. At 26 years, those showing a liking for alcohol advertising at 18 years were more likely to be in a group of heavier drinkers.

Stacy [18] assessed the impact of exposure to TV alcohol advertisements on alcohol use in 2,250 12 to 13 years old school children in California followed up for a year. At baseline, 16% reported drinking beer in the past month, 15% reported drinking wine in the past month, and 8% reported three-drink episodes in the past month. At follow-up, prevalence was 18% for beer, 20% for wine and 12% for three-drink episodes. At one-year follow-up, each standard deviation increase in TV viewing of programmes with alcohol advertisements at baseline was associated with a significant increase (44%) in risk of beer use ((odds ratio (OR) 1.44 95% Confidence Interval (CI): 1.27 to 1.61)), wine/liquor use (OR 1.34; 95% CI: 1.17 to 1.52) and three-drink episodes (OR 1.26; 95% CI: 1.08 to 1.48), controlling for general TV viewing frequency, participation in team sports, perception of peer alcohol use, perceived peer approval of alcohol use, intentions to use alcohol, perceptions of adults alcohol use, gender, ethnicity and school, exposure memory covariates and a propensity score to adjust for differential risk profile of those lost to attrition. A watched TV sports index was only positively associated with beer drinking, (OR 1.20; 95% CI: 1.05 to 1.37) with adjustment for confounders, and self-reported frequency of exposure was significantly associated with increased risk of beer drinking, (OR 1.21; 95% CI: 1.14 to 1.41). Other exposure measures, cued-recall memory test and draw-an-event memory test, did not show significant relationships with any of the outcomes, though most showed effects in the direction of positive associations with one exception, participants scoring one standard deviation above the mean for draw-an-event memory test were significantly less likely to drink beer one year later (OR 1.14; 95% CI: 1.01 to 1.25).

Ellickson [16] examined the relationship between a range of advertisement exposures and subsequent drinking among US adolescents age 12 to 13 years. Forty-eight per cent non-drinkers at baseline (n = 1,905) initiated drinking by two-year follow-up. For baseline non-drinkers, exposure to in-store beer displays predicted drinking onset at follow-up, OR 1.42 ($p < 0.05$) adjusted for general TV viewing, social influences, social bonds, gender, ethnicity and attitudes and behaviour. Exposure to TV beer advertisements, magazines with alcohol advertisements, and in-store advertisement displays all showed positive associations, though none were significant in adjusted analyses, OR 1.05, 1.12 and 1.06, respectively. Confidence intervals were not reported for any of the ORs. Among baseline drinkers (n = 1,206), 77% reported alcohol use in the past year at follow-up. Exposure to magazines with alcohol advertisements and to beer concession stands at sports or music events predicted frequency of drinking at follow-up, regression coefficient 0.10 and 0.09, (p-value < 0.05), respectively. Exposure to TV beer advertising or in-store advertisement displays were not

significant predictors of drinking frequency in analyses adjusted for baseline drinking and multiple control variables regression coefficient -0.01 and 0.02, respectively.

Snyder [17] evaluated the relationship between self-reported advertising exposure to four media (TV, radio, billboards and magazines) and the prevalence of advertising in the same media sources and alcohol consumption in 15 to 26 year olds in 24 media markets in USA. Participants were followed up at four time-points over a 21 month period. Sixty-one per cent had at least one drink in the past month at baseline and consumed an average of 38.5 drinks a month. Participants reported seeing an average of 22.7 alcohol advertisements per month. For each additional advertisement seen, the number of drinks consumed increased by 1% Event Rate Ratio (ERR) 1.01 (95% CI: 1.01 to 1.02). Also for each additional dollar per capita spent on advertising the number of alcoholic drinks consumed per month increased by 3% ERR 1.03 (95% CI: 1.01 to 1.05). In the sub-group of participants aged less than 21 years (60% of sample), who were below the legal drinking age, similar patterns were seen, ERR 1.01 (95% CI: 1.0 to 1.02) and 1.03 (95% CI: 1.0 to 1.06) increase in number of drinks consumed per month for self-reported advertising exposure and advertising expenditure, respectively. All analyses were adjusted for gender, age, ethnicity, school status and alcohol sales per capita, however the high degree of attrition in this study (more than 50% for two of the four follow-up assessments) precludes firm conclusions on the basis of these findings.

Two studies evaluated exposure to TV and music videos and alcohol use in adolescents [19,20]. In the study by Robinson et al[19] the association between hours of TV, music video and videotape viewing, computer and video game use and subsequent alcohol use at 18 months follow-up was investigated in 1,533 14 to 15 year olds from six public high schools in California. During follow-up, 325 (36.2%) baseline non-drinkers began drinking and 322 (50.7%) drinkers continued to drink. In baseline non-drinkers (n = 898), onset of drinking was significantly associated with hours of TV viewing at baseline. For each additional hour of TV viewing per day the average increased risk of starting to drink during the next 18 months was 9% OR 1.09 (95% CI: 1.01 to 1.18), for each additional hour of music video viewing OR 1.31 (95% CI: 1.17 to 1.47). For each additional hour of videotape viewing the average risk decreased, 11% OR 0.89 (95% CI: 0.79 to 0.99) in analyses controlling for age, sex, ethnicity and other media use. Computer and video game use was not significantly associated with subsequent onset of drinking, OR 0.94 (95% CI: 0.84 to 1.05). In baseline drinkers (n = 635), there were no significant associations between baseline media use and maintenance of drinking. For each additional viewing hour per day the risk, OR (95% CI), of maintenance of drinking was: 1.01 (0.93, 1.11) for television, 1.05 (0.95, 1.17) for music videos, 0.97 (0.86, 1.10) for videos and 1.00 (0.89, 1.12) for computer or video games.

Van Den Bulck [20] examined the relationship between television viewing and music video exposure and subsequent alcohol consumption while going out one year later in 2,546 first and fourth year secondary school students in Flanders, Belgium. Only 65% of the original sample with complete data at both time-points was analysed. The majority of students (63.6%) watched music videos at least several times a week, about a third watched daily. Overall television viewing and music video viewing at baseline significantly predicted the amount of alcoholic beverages adolescents consumed while going out at follow-up. Results of a regression model controlling for gender, school year, smoking and pubertal status were reported: $R^2 = 0.568$ ($F = 230.374$; $df = 7$; $p < 0.0001$).

Sargent [21]evaluated the exposure to alcohol use in popular contemporary movies in a cross-sectional survey with prospective follow-up of never drinkers and recorded incident alcohol drinking 13 to 26 months later. Adolescents, 10 to 14 years old, were recruited from 15 randomly selected schools in New Hampshire and Vermont, USA. Never-drinkers at baseline were followed up (n = 2,406). Baseline median exposure to alcohol use in 601 movies was 8.6 hours, (inter-quartile range (IQR): 4.6 to 13.5). At follow-up, 14.8% reported having tried alcohol, which was significantly associated with alcohol exposure (viewing hours). For each additional hour of movie alcohol exposure the risk of initiating alcohol use was increased by 15%, OR 1.15 (95% CI: 1.06, 1.25) adjusted for school grade, school, gender, parent education, sensation seeking, rebelliousness, self-esteem, school performance, parenting style and smoking experimentation.

Discussion and conclusion

This systematic review of seven cohort studies on over 13,000 participants shows some evidence for an association between prior alcohol advertising and marketing exposure and subsequent alcohol drinking behaviour in young people. All seven studies demonstrated significant effects across a range of different exposure variables and outcome measures. These included exposure to direct advertising using broadcast and print media and indirect methods such as in-store promotions and portrayal of alcohol drinking in films, music videos and TV programmes. The consistency of effect across a heterogeneous group of studies may be considered a strength.

Notably, three studies showed that onset of drinking in adolescent non-drinkers at baseline were significantly associated with exposure. Robinson [19] showed that for

each additional hour of TV viewing per day the risk of starting to drink increased by 9% during the following 18 months. Sargent [21] found that for additional hour of exposure to alcohol use depicted in popular movies there was a 15% increase in likelihood in having tried alcohol 13 to 26 months later. Ellickson [16] showed that exposure to in-store beer displays significantly predicted drinking onset two years later. Effects were less clear in baseline drinkers, whilst greater exposure predicted greater drinking frequency, analyses adjusting for possible confounding factors failed to detect significant relationships.

In studies on mixed groups of drinkers and non-drinkers, increased frequency of TV viewing and music video viewing was highly significantly related to the amount of alcohol consumed while going out [20]. In the study by Snyder [17] of US individuals aged 15 to 26 years, for each additional advertisement seen the number of drinks consumed increased by 1%.

Of interest, to our knowledge, at least two more prospective cohort studies meeting our inclusion criteria have been published since our review was completed [39,40]. Since updating our searches for all new studies is beyond the original scope of the project, we have not incorporated these two studies into the main body of the review. Nevertheless, it is important to note that both of these studies also showed significant relationships between receptivity to alcohol marketing or alcohol advertising in young people. Eleven year olds in the highest centile of exposure to TV beer advertisements, alcohol ads in magazines, in-store beer displays and beer concessions, radio listening time and ownership of beer promotional items were 50% more likely to be drinkers than youth in the lowest centile of exposure one year later controlling for demographic and psychosocial factors and prior drinking [39]. In a sample of non-drinkers aged 11 to 15 years, those reporting high receptivity to alcohol marketing defined as owning or wanting to own alcohol branded promotional items were 77% more likely to initiate alcohol use one year later compared with youth reporting minimal receptivity adjusted for demographic and psychosocial factors and social influences to drink [40].

There are several limitations that should be considered when interpreting the results of this review. Whilst we made an *a priori* decision to only include and review cohort studies which potentially are less likely to suffer from systematic bias than less robust study designs such as cross-sectional surveys or interrupted time series studies, it is nonetheless important to note that cohort studies are also susceptible to bias if not designed and executed using rigorous standards. One of the biggest threats to the validity of observational studies such as cohort studies is the issue of confounding, whereby the outcome of interest is influenced by some other factor or factors in addition to the exposure of interest. Whereas all of the studies controlled for a variety of confounding factors possibly related to alcohol drinking behaviour, unmeasured or unknown confounders cannot be adjusted for and it is not possible to know if residual confounding influenced the analysis. For example, alcohol expectancies, family history, peer influence and personality characteristics may act as confounders in the relationship between exposure to advertising and marketing and subsequent alcohol use. Given the magnitude of the effect sizes shown in these studies, we cannot rule out the possibility that they were due to the effects of residual and unmeasured confounding [41]. However, previous work evaluating smoking exposure in movies and smoking behaviour in adolescents using a simulation model showed that effects of unknown or unmeasured confounders would need to be large in order to overturn the results [42]. Given that no observational study can control for all unmeasured or unknown confounders, researchers may wish to consider using similar approaches to determine the potential impact of such confounders.

Whilst these studies suggest that exposure to advertising and alcohol portrayal in the media increase likelihood of later alcohol consumption, they are unable to inform us how exposure brings about these changes, or what aspects of advertising and marketing are the active components. The extent to which psychological factors determine subsequent behaviours is a worthwhile topic for further study. One study [43] has examined how persuasive alcohol media messages were associated with concurring beliefs and behaviours among youth, concluding that existing exposure based studies do not adequately account for the complex psychological causal mechanisms that may moderate or mediate the relationship between exposure and outcome. However, this analysis is based on cross-sectional data; further studies with longitudinal analyses are desirable. If a better understanding of the relationship of the intermediate steps between exposure and subsequent behaviours can be obtained, then our understanding of the mechanisms of action of alcohol advertising and marketing would be improved. This question, together with lessons learned from the collective experiences of conducting cohort studies [44], should inform the design of future cohort studies.

One other serious threat to the validity of these studies was the degree of attrition in some of the studies. Losses to follow-up between assembly of the cohort and follow-up are inevitable but the aim is to keep this to a minimum as attrition bias may be introduced if reasons for missing data or loss to follow-up are related to exposure or outcome. If adolescents who were lost to follow up were more likely to be drinkers, or at high risk of drinking as

found in three of the studies [17,19,21], then this may then lead to underestimating the relationship between advertising and drinking. Generalisability of the results is also affected if losses are in one specific subgroup of participants, and the subsequent loss of power is also a problem with attrition. Of note, none of the studies reported how they estimated sample sizes required. In general, assessment of the design and conduct of the cohort studies reviewed was hampered by the lack of important methodological detail, and fell short of the current recommendations as set out in the STROBE statement [45].

We cannot rule out the possibility of publication bias, whereby studies failing to detect significant relationships were not published, or studies for which selective reporting of only positive associations were published. Of course it is also possible that studies showing positive associations, if sponsored by the alcohol industry or other commercial organisations with a vested interest in advertising or marketing of alcohol, have not been published. Therefore, it is not possible to predict the likely impact of unpublished data on the results of this review. It is also possible that published studies were not found by our search as a fully comprehensive search of databases other than Medline and Embase and other sources only covering the social science literature was not possible within the scope of the limited funding for this review. Attempts, however, were made to locate all available studies by supplementing searches of databases with hand searching reference lists of key reviews and primary studies, which identified many articles published in journals not covered by Medline and Embase.

The results of these cohort studies are supported by findings in cross-sectional surveys which consistently report associations between increased exposure to alcohol advertising or marketing and drinking behaviour [2-5], intentions to drink [46] or advertising awareness and liking [2,47-49]. Although, in one interrupted time-series study countries with advertising bans had lower levels of alcohol consumption and road traffic fatalities [50], others failed to demonstrate significant effects [51,52]. The rationale for the exclusion of these studies is outlined in the methods, and their exclusion would only be a concern if they generally showed a strong effect in the opposite direction.

One question that remains is whether early drinking behaviour shown in these cohort studies is predictive of risky or harmful drinking or alcohol-related problems in the future. Drinking onset at an earlier age has been shown to be associated with a greater likelihood of alcohol dependence in several cross-sectional studies [53-55]. More recently, prospective cohort studies have also shown clear and significant associations between age of onset of drinking and subsequent heavy drinking and alcohol-related problems [56-59].

Given the large budgets allocated to advertising and promotional activity by the alcohol industry, a paucity of research exists evaluating the effects of this advertising. Further research exploring the potential causal impact is warranted; the role of mass media as a potential source of influence on alcohol related knowledge and behaviour of young people has been neglected in many countries [60].

The data from these studies suggest that exposure to alcohol advertising in young people influences their subsequent drinking behaviour. The effect was consistent across studies, a temporal relationship between exposure and drinking initiation was shown, and a dose response between amount of exposure and frequency of drinking was clearly demonstrated in three studies [17,20,21]. It is certainly plausible that advertising would have an effect on youth consumer behaviour, as has been shown for tobacco [61] and food marketing [62].

Does this systematic review provide evidence that limiting alcohol advertising will have an impact on alcohol consumption amongst young people? Not directly: as we noted earlier we can not rule out that the effects demonstrated in these studies is due to residual confounding. Counter-advertising [30], social marketing techniques [63] or other prevention options such as parenting programmes [64], price increases and limiting availability may offer more potential to limit alcohol problems in young people. Nonetheless, we now have stronger empirical evidence to inform the policy debate on the impact of alcohol advertising on young people, and policy groups may wish to revise or strengthen their policy recommendations in the light of this stronger evidence [1,9].

Competing interests

Foxcroft has received funding from Diageo for a project to develop and evaluate a family-based prevention programme. Smith has not directly received funding from the alcohol industry although has benefited indirectly from the funding to Foxcroft.

Authors' contributions

DF helped frame the research question and scope of the systematic review. LS developed the protocol, undertook searching, study appraisal, data extraction and synthesis. LS drafted the paper and DF contributed additional material to the Introduction and Discussion sections. Both authors act as guarantors.

Additional material

Additional file 1

Table 1. *Systematic review search strategies.*
Click here for file
[http://www.biomedcentral.com/content/supplementary/1471-2458-9-51-S1.doc]

Additional file 2

Table 2. *Characteristics of prospective cohort studies included in the systematic review.*
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Additional file 3

Table 3. *Assessment of likelihood of bias of included prospective cohort studies.*
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