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[Intervention Review]

Impact of tobacco advertising and promotion on increasing adolescent smoking behaviours

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ABSTRACT

Background

The tobacco industry denies that their marketing is targeted at young nonsmokers, but it seems more probable that tobacco advertising and promotion influences the attitudes of nonsmoking adolescents, and makes them more likely to try smoking.

Objectives

To assess the effects of tobacco advertising and promotion on nonsmoking adolescents' future smoking behaviour.

Search methods

We searched the Cochrane Tobacco Group specialized register, the Cochrane Central Register of Controlled Trials, MEDLINE, the Cochrane Library, Sociological Abstracts, PsycLIT, ERIC, WorldCat, Dissertation Abstracts, ABI Inform and Current Contents to August 2011.

Selection criteria

We selected longitudinal studies that assessed individuals' smoking behaviour and exposure to advertising, receptivity or attitudes to tobacco advertising, or brand awareness at baseline, and assessed smoking behaviour at follow ups. Participants were adolescents aged 18 or younger who were not regular smokers at baseline.

Data collection and analysis

Studies were prescreened for relevance by one reviewer. Two reviewers independently assessed relevant studies for inclusion. Data were extracted by one reviewer and checked by a second.

Main results

Nineteen longitudinal studies that followed up a total of over 29,000 baseline nonsmokers met inclusion criteria. The studies measured exposure or receptivity to advertising and promotion in a variety of ways, including having a favourite advertisement or an index of receptivity based on awareness of advertising and ownership of a promotional item. One study measured the number of tobacco advertisements in magazines read by participants. All studies assessed smoking behaviour change in participants who reported not smoking at baseline. In 18 of the 19 studies the nonsmoking adolescents who were more aware of tobacco advertising or receptive to it, were more likely to have experimented with cigarettes or become smokers at follow up. There was variation in the strength of association, and the degree to which potential confounders were controlled for.

Authors' conclusions

Longitudinal studies consistently suggest that exposure to tobacco advertising and promotion is associated with the likelihood that adolescents will start to smoke. Based on the strength and specificity of this association, evidence of a dose-response relationship, the consistency of findings across numerous observational studies, temporality of exposure and smoking behaviours observed, as well as the theoretical plausibility regarding the impact of advertising, we conclude that tobacco advertising and promotion increases the likelihood that adolescents will start to smoke.

PLAIN LANGUAGE SUMMARY

Does tobacco advertising and promotion make it more likely that adolescents will start to smoke

Advertising is the use of media to create positive product imagery or associations. Promotion or marketing is the mix of activities designed to increase sales. There are no trials of the impact of tobacco advertising and promotional activities on people taking up smoking. However, there are studies following nonsmokers and their exposure to advertising (such as the number of tobacco advertisements in the magazines they read). The review found that in all these studies, nonsmoking adolescents who were more aware of or receptive to tobacco advertising were more likely to become smokers later.

BACKGROUND

The tobacco industry maintains that the sole purpose of tobacco advertising is to maintain and increase market shares of adult consumers. Yet there is research evidence that adolescents are aware of, recognize, and are influenced by tobacco advertising. The U.S. Surgeon General's 1994 comprehensive review of the tobacco marketing literature concluded that advertising and promotional activities influence key risk factors for tobacco use among adolescents (USDHHS 1994). The U.S. Food and Drug Administration's 1995 review of available tobacco industry documents concluded that "cigarette manufacturers know that young people are vital to their market and that they need to develop advertising and other promotional activities that appeal to young people" (FDA 1995). These documents reveal that companies conducted extensive research on campaigns of new brands that were launched with youth as the target. More recent reviews confirm this (Pollay 2000; Cummings 2002; Ling 2002). Furthermore, Article 13 of the World Health Organization's (WHO) Framework Convention on Tobacco Control stipulates a comprehensive ban on tobacco advertising, promotion, and sponsorship (WHO 2003).

Advertising can be defined as the use of media to create positive product imagery or positive product associations or to connect the product with desirable personal traits, activities or outcomes. Promotion, also called marketing, can be defined as the mix of all activities that are designed to increase sales (Saffer 2000). Tobacco companies are amongst the top 10 advertisers in 21 out of 50 countries in Europe, Asia and the Middle East (Saffer 2000). In the United States cigarette companies are required to report their expenditure on advertising and promotion annually to the Federal Trade Commission. The most recent data available (US FTC 2009) indicates that in 2006 the tobacco industry spent US $0.3 billion on advertising in newspapers, magazines, outdoor, transit and point of purchase. Promotional items given free with the purchase of cigarettes are included under the heading of 'retail value added' which includes offers such as 'buy one get one free'. This category accounts for US$1.4 billion of expenditure. The industry spent almost US$10.1 billion on 'promotional allowances'. This includes payments to ensure prominent shelf space and discounts to retailers in order to reduce the price for consumers, for example.

The purpose of tobacco marketing is to associate a product with psychological and social needs that the consumer wants to fulfil. This is accomplished through a restructuring of social reality that the advertising itself provides (Wakefield 2003). Tobacco marketing, including advertising and promotion, targets key concerns of adolescents such as social approval, peer bonding, autonomy, self-image and adventure seeking. These approaches are intended to influence behaviour both cognitively and affectively by suggesting that there are benefits to using the product and by setting up a positive attitude about the product. Images, rather than information, are used in tobacco marketing to portray the attractiveness and function of smoking. The images portrayed in advertisements appeal to adolescents and are remembered by them (IOM 1994). It is logical to conclude that because tobacco marketing capitalizes upon issues that are of great importance to adolescents, it is likely that adolescents are influenced to smoke cigarettes. Some tobacco control advocates argue that there is sufficient evidence from internal tobacco company documents to show that companies target marketing at minors and that this is effective. They argue that efforts to prove a causal link between advertising and smoking are unnecessary (Chapman 1989; Chapman 1993). Given, however, that tobacco companies still attempt to deny this, and challenge attempts to control advertising in the courts, there remains a need to examine the evidence that there is a relationship between advertising and smoking uptake.

Randomized controlled trials of the effects of advertising would be unethical and impractical. In addition, advertising strategies and their effects are very complex. Even if true experiments were ethically possible with randomisation of exposure to advertising and promotion, they could not capture the vast array of marketing strategies that are employed by tobacco companies such as event sponsorship, and portrayal of smoking in movies, television programmes and popular music. Any true experiment might underestimate the overall effects of tobacco marketing because only a limited number of key factors could be studied at once.

Since experimental studies addressing this question cannot be conducted, we have to rely on observational studies. Susser 1991 identifies criteria for evaluating causality of a suspected agent from epidemiological studies:
(1) it must clearly precede the hypothesized effect;
(2) the association is strong;
(3) the association is consistent;
(4) the association is specific;
(5) it should be expected from theory.
Properly conducted longitudinal studies that examine the relationship between exposure to marketing approaches and subsequent changes in smoking behaviours, while controlling for possible confounding factors, can provide evidence supporting the causal links between tobacco marketing and smoking behaviour. Longitudinal studies are particularly valuable because they capture what happens to individuals over time and can demonstrate whether individuals who differ in their exposure to advertising when they are not smoking, then differ in their future smoking behaviour. Bringing together the results of such research that supports or refutes an association between a measure of exposure to advertising and smoking among adolescents will be useful to policy and decision-makers responsible for developing and implementing population-based approaches to tobacco control.

OBJECTIVES

The aim of this review was to examine the influence of tobacco industry advertising and promotion on smoking behaviours among adolescents who are 18 years of age or younger. We asked the following question:
Is prior exposure to tobacco industry advertising and promotion associated with future smoking among adolescents?
Our logic model was that exposure to tobacco industry advertising and promotion increases awareness of cigarettes and engenders positive attitudes towards smoking that in turn lead to increased uptake. Our hypotheses were that
(a) exposure to tobacco advertising and promotion will predict future smoking behaviour;
(b) mediating variables that are on the causal pathway between exposure and behaviour such as brand awareness, receptivity, and positive attitudes towards advertising and promotion will predict future smoking behaviour.

METHODS

Criteria for considering studies for this review

Types of studies

We considered studies that examined the association between tobacco advertising and promotion, and adolescent smoking. We included only longitudinal studies in which individuals' smoking behaviour and exposure to advertising, receptivity or attitudes to tobacco advertising, or brand awareness were measured at baseline and individuals' smoking behaviours were then measured in one or more follow ups. Cross-sectional and time-series or econometric studies were excluded from this review. The rationale for this is presented in the Discussion section.

Types of participants

Studies that included adolescents 18 years of age or younger were reviewed. Studies that included a broader age range were excluded if the results for adolescents under 18 years of age could not be separated out. We focused on results for participants who were nonsmokers at baseline.

Types of interventions

The 'intervention' is tobacco mass media advertising by the industry, including tobacco promotion. Mass media channels of communication include advertising delivered through television, radio, newspapers, billboards, posters etc. Tobacco promotion includes give-aways such as T-shirts and other items bearing tobacco 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. Indices of receptivity to advertising which use measures such as having a favourite advertisement, and ownership of or willingness to own promotional items could be used as indicators of exposure.

Types of outcome measures

- Self-reported smoking status (nonsmoker, current smoker, ex-smoker).
- Self-reported consumption of specific brands

Search methods for identification of studies

Computerized bibliographic databases searched include the Tobacco Addiction Group database, the Cochrane Central Register of Controlled Trials, MEDLINE, Sociological Abstracts, PsycLIT, ERIC, WorldCat, Dissertation Abstracts, ABI Inform and Current Contents. The most recent searches for this update were run in August 2011.

Medline (Ovid) Search strategy
1 smoking/ or tobacco/ or (smok: or tobacco or cigarett: or nicotine).tw.
2 (smoking adj3 behav:).tw.
3 (cigarett: adj3 (advert: or promotion:)).tw.
4 tobacco industry/
5 television/ or motion pictures/ or radio/ or newspapers/
6 (movie: or radio: or poster: or billboard: or tv or television: or televised).tw.
7 (mass adj media).tw. or mass media/ or telecommunications/
8 advertising/ or communication/ or persuasive communication/
9 adolescent behavior/ or adolescence/ or exp child/
10 (child: or juvenile: or girl: or boy: or teenager: or adolesc: or minors:).tw.
11 1 or 2 or 3 or 4
12 5 or 6 or 7 or 8
13 9 or 10
14 11 and 12 and 13
Similar strategies were used for the other databases.

Data collection and analysis

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 tobacco advertising or promotion on adolescent smoking 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 the second reviewer checked these data.
4. Studies were combined using qualitative narrative synthesis. We used narrative synthesis because there was heterogeneity among study designs, type of 'intervention', and outcomes measured.

RESULTS

Description of studies

Study Participants

We identified 19 studies that met the inclusion criteria. These 19 studies included a variety of different age groupings that ranged between eight and 18 years of age at baseline Gilpin 2007 Gritz 2003. The youngest study participants represented were eight years old at baseline (Sargent 2000). The studies by Sargent 2000, and Hanewinkel 2011 included the broadest age range; in these studies participants ranged from eight to 17 years and 10 to 17 years, respectively. Gilpin 2007 assessed advertising exposure in adolescents under 18 years of age at baseline; follow up occurred when participants were between 18 and 21 years of age (Gilpin 2007). Gritz 2003 included participants ranging from grades 5 through 12, possibly including some youth who were 18 years and older; however, age was not reported. Eleven studies were conducted in the United States (Pierce 1998; Pucci 1999; Biener 2000; Sargent 2000; Gritz 2003; Audrain-McGovern 2006; Weiss 2006; Gilpin 2007; Sargent 2009b; Pierce 2010; Henriksen 2010) two in Australia (Alexander 1983; Armstrong 1990), two in England (Charlton 1989; While 1996), two in Germany (Sargent 2009a; Hanewinkel 2011) and two in Spain (Diaz 1998; Lopez 2004). The years during which data were collected ranged between 1983 and 2008.

Study Design

In 11 of the studies a cohort of adolescents was followed up once after baseline. The timing of follow up for these studies ranged between four months and six years after baseline. One study used a four-month follow up (Charlton 1989); one used a nine-month follow up (Hanewinkel 2011); five used a 12-month follow up (Alexander 1983; Diaz 1998; While 1996; Gritz 2003; Sargent 2009a), one used between one to two years for follow up (Sargent 2009b) and one used a three-year follow up (Pierce 1998). Two studies followed up adolescents four years after baseline (Biener 2000;

Pucci 1999). The remaining eight studies we reviewed included more than one observation point following baseline. Lopez 2004 measured outcomes at six, 12 and 18 months, Pierce 2010 included follow ups at eight, 16, 24 and 32 months, Sargent 2000 included follow ups at 12 months and 18 months, Weiss 2006 included follow ups at 12 and 24 months, Henriksen 2010 included follow ups at 12 and 30 months, Audrain-McGovern 2006 included follow ups at 12, 24 and 36 months, Armstrong 1990 included follow ups at 17 months and 30 months, and Gilpin 2007 included follow ups at three and six years.

In five studies the cohort was part of a randomised controlled trial of a school-based tobacco prevention programme (Alexander 1983; Armstrong 1990; Sargent 2000; Lopez 2004; Weiss 2006) and in one, the cohort was the control group for a substance abuse programme (Diaz 1998). Pierce 2010 studied a cohort that was part of a randomised trial on parenting practices. Charlton 1989, Sargent 2009a and Hanewinkel 2011 surveyed a random sample of schools in regions, Sargent 2009b surveyed a random sample of middle schools and used telephone interviews at follow up, While 1996 administered surveys to students in selected schools as did Gritz 2003, Henriksen 2010 surveyed all three middle schools in a small city, and Audrain-McGovern 2006 surveyed all students from five high schools (only students that had a special classroom placement were ineligible). Five of the studies were based on data from national (Pierce 2010) or state-wide (Pierce 1998; Pucci 1999; Biener 2000; Gilpin 2007) surveys that used probability samples of housing units with telephone numbers drawn using random-digit-dial (RDD) techniques.

The 'Intervention': Assessment of Advertising and Promotion

Three main types of methods were used by studies in this review to assess tobacco advertising and promotion: receptivity to advertising; exposure to advertising; and perception of advertising.

Receptivity to Advertising

Receptivity to tobacco advertising or promotional marketing was assessed in 11 of the reviewed studies (Pierce 1998; Biener 2000; Sargent 2000; Sargent 2009b; Audrain-McGovern 2006; Gilpin 2007; Charlton 1989; Lopez 2004; Sargent 2009a; While 1996; Pierce 2010). Receptivity to advertising was operationalized in two ways: (1) being able to name a brand or favourite advertisement, or (2) owning or being willing to own a tobacco promotion item. Five studies (Biener 2000; Audrain-McGovern 2006; Gilpin 2007; Pierce 1998; Sargent 2009b) assessed receptivity by asking participants to both name a brand or favourite advertisement and if they own or are willing to own a promotion item. For example, Gilpin 2007 defined high receptivity as owning or being willing to own a promotional item and moderate receptivity as naming a favourite brand, with low receptivity being unwilling to own a promotional item and being unable to name a favourite brand. Five studies (Charlton 1989; While 1996; Lopez 2004; Sargent 2009a; Pierce 2010) assessed receptivity solely by asking participants to name a brand or favourite advertisement. In contrast, Lopez 2004 used number of brands recognized from three local billboard advertisements to measure awareness. One study (Sargent 2000) assessed receptivity to advertising solely by asking participants if they owned or were willing to own a tobacco promotional item. An example of a survey item used to assess promotional items is Biener 2000 who used the item; "Some tobacco companies make clothing, hats, bags or other things with the brand on it. Do you have a piece of clothing or other thing that has a tobacco brand name or logo on it?"

Two studies (Pierce 1998; Gilpin 2007) focused on magazine and billboard advertisements. In eight of the studies (Charlton 1989; Armstrong 1990; While 1996; Biener 2000; Audrain-McGovern 2006; Sargent 2009a; Sargent 2009b; Pierce 2010) survey items asked about advertising in general. For example, Biener 2000 asked, "Of all the cigarette advertisements you have seen, which brand's ads do you think attract your attention the most?"

Exposure to Advertising

Studies that measured exposure to advertising focused on magazines, billboards, other print advertisements, television, radio, and advertising in retail outlets. Pucci and colleagues (Pucci 1999) focused their study on magazine advertisements, Weiss 2006 focused on television and small store retail advertisements, while Henriksen 2010 focused on retail advertising only. Gritz 2003 focused on messaging from major media sources (television, radio, billboards, posters and magazines/newspapers). To measure exposure to advertisements, three studies used recall (Gritz 2003; Weiss 2006; Hanewinkel 2011), one used a combination of recall and observation (Henriksen 2010) and one used recall and analysis of magazine data (Pucci 1999). The measure used by Hanewinkel 2011 tested the specificity of cigarette advertisements by asking participants to identify the brand and how often they had seen the advertisement from a series of masked images of cigarette and other consumer advertisements. The measure used by Pucci 1999, although indirect, had the advantage of avoiding recall bias. In this study, Pucci 1999 developed an index of 'gross impressions' derived from baseline reports of exposure to specific titles and number of pages devoted to cigarette advertising in those magazines. Henriksen 2010 used three measures of exposure: (1) perceived exposure to cigarette advertising; (2) shopping frequency in stores most likely to contain cigarette advertising; and (3) a detailed item about how often students visited stores near the school, combined with observations conducted at those stores, to calculate estimated number of cigarette brand impressions per week.

Perceived Influence or Approval of Advertising

Armstrong 1990 asked about the perception of influence that tobacco advertisements had on decisions to smoke and Alexander 1983 measured approval of cigarette advertising. Diaz 1998 asked a single question; whether the student agreed or disagreed with the statement "I accept tobacco publicity".

The Outcome: Assessment of smoking and nonsmoking at baseline and follow-up

Smoking status was measured at baseline in all studies. At follow up, smoking behaviour was analysed for respondents who were not identified as smokers at baseline, except for Gilpin 2007 who examined non-established smokers at baseline who progressed to established smokers at follow up and Weiss 2006 who examined non-susceptible nonsmokers at baseline who became susceptible to smoking (including any lifetime smoking) at follow up.

Nonsmoking was defined in a variety of ways based on the timing of any smoking experience and the number of cigarettes consumed. Four studies (Charlton 1989; While 1996; Gritz 2003; Henriksen 2010) used the strictest cut off for nonsmokers, with nonsmoking

based on never having tried a cigarette, even one puff. whereas six studies (Audrain-McGovern 2006; Gilpin 2007; Sargent 2009a; Sargent 2009b; Pierce 2010; Hanewinkel 2011) defined nonsmokers as never having tried a cigarette, even a few puffs. In addition to never smoking, Gilpin 2007 used three additional questions to assess a strong commitment not to smoke.

The timeframe for questions regarding smoking behaviours ranged from the past four weeks (e.g. Alexander 1983) or past 30 days (e.g. Audrain-McGovern 2006 to lifetime (e.g. While 1996; Sargent 2009b; Hanewinkel 2011). Armstrong 1990 defined nonsmoking as no puff in the previous 12 months. Alexander 1983 defined it as no puff in the previous four weeks. Diaz 1998 did not define nonsmoking precisely, but divided smokers into experimental, weekly and daily. Analyses in this study considered both progression to any smoking and to regular (weekly or daily) smoking. One study used a different cut off between smoking/nonsmoking at baseline and follow up; Pucci 1999 operationalized baseline smokers as those who had smoked even a puff, and at follow up classified smokers as those reporting at least one cigarette in the previous 30 days. Lopez 2004 classified nonsmokers as those who had never smoked a cigarette, smoked less than one cigarette per week, or were an ex-smoker. Biener 2000 classified as nonsmokers both never-smokers and early experimenters who reported having even a puff or a single cigarette. At follow up they reported associations with progression to established smoking, defined as more than 100 cigarettes smoked, for both nonsmokers and the subgroup of never-smokers. Pierce 1998 distinguished between never-triers, experimenters who had smoked fewer than 100 cigarettes, and established smokers. Those who had never tried even a puff were further divided into susceptible and non susceptible groups. Nonsusceptible nonsmokers were those who responded "no" to the question "Do you think that you will try a cigarette anytime soon", and "definitely not" when asked if they would smoke if best friend offered a cigarette, and if they thought they would smoke a cigarette during the next year. At follow up the outcome was progression in smoking status, focusing on nonsusceptible nonsmokers at baseline. Sargent 2000 used a similar scheme to Pierce and colleagues (Pierce 1998) for distinguishing susceptible and non susceptible never-smokers. They included a puffer category that had tried a cigarette, and subdivided a 2 -100 cigarettes experimenter group into those who had and had not smoked a cigarette in the previous 30 days. Baseline nonsmokers, puffers and experimenters were included in follow-up analyses using progression on the smoking index as the dependent variable. Weiss 2006 dichotomized participants into two categories, nonsusceptible nonsmokers and all others, including experimenters and past 30-day smokers. If respondents reported lifetime smoking or susceptibility to smoking at follow up, they were classified as susceptible to smoking. Smoking susceptibility is thought to be a more sensitive measure than actual smoking among children and young adolescents (Weiss 2006) and has been previously validated by Pierce 1996.

At follow up, 11 studies (Alexander 1983; Charlton 1989; Armstrong 1990; While 1996; Pucci 1999; Gritz 2003; Lopez 2004; Sargent 2009b; Pierce 2010; Henriksen 2010; Hanewinkel 2011) used a simple dichotomization between smokers and nonsmokers for analytic purposes. Pucci 1999 also asked about specific brands smoked and Gritz 2003 also examined susceptibility to smoking at follow up. Gilpin 2007 dichotomized non-established smokers and established smokers, while Weiss 2006 dichotomized nonsusceptible nonsmokers and those susceptible to smoking (reported any lifetime smoking or susceptibility to smoking). Five other studies used a more detailed classification of smokers (Pierce 1998; Biener 2000; Sargent 2000; Audrain-McGovern 2006; Sargent 2009a). Of these Pierce 1998, Biener 2000 and Audrain-McGovern 2006 used progression on a smoking index (puffer, experimenter, regular smoker) as the outcome rather than change from nonsmoker to smoker.

All but two studies used the same smoker/nonsmoker definition at baseline and follow up; Pucci 1999 identified baseline smokers as those who had smoked even a puff, and at follow up classified smokers as those reporting at least one cigarette in the previous 30 days, and Sargent 2009a assessed life-time smoking at baseline and used a combined variable of life-time and current smoking at follow up.

Excluded Studies

The reasons for excluding 96 studies are described in the Characteristics of excluded studies table. Excluded studies were mainly cross-sectional studies measuring advertising and smoking-related variables at a single point in time. We also excluded longitudinal studies using cross-sectional samples in which changes in an individual's behaviour were not tracked. We excluded five prospective study reports. In one the primary outcome was future intention to smoke at follow up, and the results did not distinguish between nonsmokers and current smokers at baseline or follow up (Aitken 1991). A second longitudinal study investigated curiosity to smoke among baseline never smokers as a predictor of future smoking and did not measure exposure to tobacco advertising in the longitudinal analysis (Pierce 2005). We did not include, as a separate study, a paper that used the same data sources and methods as Pierce 1998, but focused on the subset who were already experimenters at baseline (Choi 2002). These results are described briefly with those of Pierce 1998. We also did not include Pierce 2002, which uses the same data sources as Gilpin 2007, to report the relationship between receptivity to tobacco advertising and smoking initiation by more/less authoritative parenting style, and Audrain-McGovern 2004, which uses the same data sources as Audrain-McGovern 2006, to examine characteristics of adolescent smoking trajectories.

Risk of bias in included studies

Studies varied in methodological quality. Measurement validity and reliability, adjustment for confounding, follow-up rates and sample representativeness are discussed in detail below.

Validity of Measures

Tobacco advertising was assessed using self-report in all studies versus actual measures of exposure, thus there is a risk of self-reporting bias. If participants were reluctant to report smoking, this could have resulted in a failure to detect smoking or in misclassification of smoking status. There is evidence that self-report data is reasonably accurate (Dolcini 2003). Eleven studies (Audrain-McGovern 2006; Charlton 1989; Diaz 1998; Lopez 2004; Pucci 1999; Sargent 2009b; While 1996; Alexander 1983; Armstrong 1990; Biener 2000; Hanewinkel 2011) did not report on validity and/or reliability of the advertising measure used.

Ten studies used some combination of favourite tobacco advertisement, owning a promotional item, and naming the

brand of a favourite advertisement as a measure of receptivity (Audrain-McGovern 2006; Biener 2000; Charlton 1989; Gilpin 2007; Pierce 1998; Pierce 2010; Sargent 2000; Sargent 2009a; Sargent 2009b; While 1996). These could be viewed as weak indicators of receptivity to advertising; it is possible that more direct measures of exposure would show stronger effects on smoking onset. For example, one study used a more objective measure of advertising by collecting data directly from magazines that participants reported they had read in the last 30 days (Pucci 1999).The study by Armstrong 1990 measured the perceived influence of cigarette advertising. Such a measure is problematic because it assumes that children appreciate the influence of advertising when the nature of this influence is almost certainly oblique and partially subconscious. In addition it assumes that children would be willing to admit being influenced by advertising (Chapman 1989) and that perceptions about influence are independent of smoking behaviour. Admitting to being influenced may be determined by perceptions of the social acceptability of the behaviour promoted by the advertising. Young people who deny being influenced by advertising may do so because they consider smoking less socially acceptable, and this may reduce their likelihood of becoming smokers (Borzekowski 1999).

In all the studies, smoking behaviour was measured using self-report items. To limit self-reporting bias, two studies (Armstrong 1990; Sargent 2000) used the " bogus pipeline" technique, which has been shown to increase the validity of self-reports. In this technique, biochemical samples are collected and participants are told that their self-reports will be checked, but samples are not actually tested. Gritz 2003 also used a "pipeline" procedure to collect saliva for biochemical validation of self-reported smoking/smokeless tobacco use in the past 24 hours. With a cut off value of 25ng/ml, they correctly classified 97% (129/133) of non-users and 60% (3/5) of users. It should be noted that there is some evidence that biochemical validation is not valid in young adolescents who smoke intermittently (Dolcini 2003). Ten studies did not report any information on the reliability and/or validity of the smoking measure used (Alexander 1983; Biener 2000; Charlton 1989; Diaz 1998; Henriksen 2010; Lopez 2004; Pucci 1999; Sargent 2009b; While 1996; Hanewinkel 2011).

Confounding

There were no adjustments made for possible confounding factors in two studies (While 1996 and Pucci 1999). All of the remaining studies used methods of analysis which controlled for other factors likely to predict smoking uptake such as gender, age, ethnicity, socioeconomic status, smoking behaviour of parents and siblings, and smoking behaviour of friends.

Other covariates measured in studies included attitudes towards smoking (Armstrong 1990; Charlton 1989; Diaz 1998; Gritz 2003; Lopez 2004) school performance (Pierce 1998;Sargent 2000; Gritz 2003; Gilpin 2007; Sargent 2009a; Sargent 2009b; Pierce 2010; Henriksen 2010; Hanewinkel 2011), depression (Biener 2000; Gritz 2003; Audrain-McGovern 2006), rebelliousness (Biener 2000; Sargent 2009b; Hanewinkel 2011), sensation seeking (Sargent 2009a; Sargent 2009b; Hanewinkel 2011) and susceptibility to smoking (Gritz 2003; Pierce 2010). In addition, Gritz 2003 controlled for parents' marital status, number of suspensions/detentions, perceived smoking opinions of parents and peers, and cultural identity; Lopez 2004 controlled for self-efficacy; Audrain-McGovern 2006 controlled for novelty-seeking; Weiss 2006 controlled for immigration status and acculturation status; Sargent 2009a controlled for parenting style; Sargent 2009b controlled for self-esteem, maternal demandingness, maternal responsiveness, and parental disapproval of smoking; Pierce 2010 controlled for geographic region, and living in a single parent home; Henriksen 2010 controlled for unsupervised time after school, exposure to smoking in movies or on television and risk-taking propensity. Hanewinkel 2011 controlled for average television screen time.

Ten studies reported results adjusted for measured confounders (Armstrong 1990; Diaz 1998; Sargent 2000; Gritz 2003; Audrain-McGovern 2006; Gilpin 2007; Sargent 2009b; Henriksen 2010; Pierce 2010; Hanewinkel 2011) and seven studies (Alexander 1983; Charlton 1989; Pierce 1998; Biener 2000; Lopez 2004; Weiss 2006; Sargent 2009a) reported some results adjusting for measured confounders. Attitude to smoking was in part controlled for in Pierce 1998 and Sargent 2000 by limiting the sample to youths who did not think they were likely to take up smoking, and in Weiss 2006 by limiting the analysis to youth who had no intention to smoke at baseline.

Follow up and Attrition Rates

All but two studies had follow-up periods of 12 months or greater. The very short follow-up period (4 months) of one study (Charlton 1989) is likely inadequate to determine the full effects of advertising on smoking uptake. Survey response rates at follow-up ranged between 47% and 97%. Where possible we used attrition rates for members of the cohort who were baseline nonsmokers. Where these were not given separately we used overall rates.

State-wide household telephone surveys reported higher attrition rates (47-73%) than school-based surveys (64-97%). The state-wide surveys; however, also had the longest follow-up periods. In school-based studies, loss to follow up was due to absence, dropping out of school, or failure to track children through changes in school. Adequate follow-up rates (greater than 80%) were reported in eight of the included studies (Alexander 1983; Audrain-McGovern 2006; Diaz 1998; Gritz 2003; Henriksen 2010; Weiss 2006; While 1996; Hanewinkel 2011), while 10 studies did not achieve this level of follow up (Armstrong 1990; Biener 2000; Gilpin 2007; Lopez 2004; Pierce 1998; Pierce 2010; Pucci 1999; Sargent 2000; Sargent 2009a; Sargent 2009b). One study (Charlton 1989) did not report follow-up rates but only pupils who were absent at either test were excluded, so follow up is likely to have been fairly complete. Gilpin 2007 reported the lowest follow-up rates of 47% and 47.9% in two cohorts after six years (the longest follow-up time period of included studies).

Representativeness of Sample

Eleven of the studies were conducted in the United States. All of the states represented in these studies were part of the 1998 Master Settlement Agreement. This agreement was enacted in the United States in 1998 between states' attorneys general and the tobacco industry. Under this agreement major tobacco manufacturers agreed not to "take any action, directly or indirectly, to target Youth within any Settling State in the advertising, promotion or marketing of Tobacco Products, or take any action the primary purpose of which is to initiate, maintain or increase the incidence of Youth smoking within any Settling State." Further, five studies (Gilpin 2007; Henriksen 2010; Pierce 1998; Pierce 2010; Weiss 2006) were conducted in California which is widely recognized for its extensive public anti-tobacco campaigns and strict non-smoking

policies. These contextual factors and other unique regional characteristics may have affected participants' attitudes about smoking and their willingness to report their smoking behaviour. Thus, caution is required in generalizing the results of these studies to adolescents in other regions and countries.

The study by Weiss 2006 focused on schools with large Asian American and Latino populations (25% or higher), thus results may not be generalizable to adolescents representing other ethnic groups and in other areas of the United States. The settings for Sargent 2000 and Sargent 2009b study was three rural schools and represented a predominantly white population, limiting generalizability to rural communities with a similar ethnic composition.

The volunteer nature of samples in schools that used active parental suggests caution should be taken in generalizing results (Weiss 2006; Henriksen 2010; Sargent 2009a; Audrain-McGovern 2006; Gritz 2003; Hanewinkel 2011). In the Audrain-McGovern 2006 study, parent consent rate was 54%, thus caution is warranted in generalizing results of the study. In this study, white parents with greater than a high school education were significantly more likely to give consent, compared with parents with a high school education or less (89% versus 77%, respectively).

Effects of interventions

Receptivity to Tobacco Advertising

Ten of the 11 studies that measured tobacco advertising receptivity reported a significant positive association with smoking uptake. Two studies reported gender differences in smoking uptake.Six studies (Audrain-McGovern 2006; Biener 2000; Gilpin 2007; Pierce 1998; Pierce 2010; Sargent 2009a) reported that having a favourite advertisement predicted smoking uptake, while five studies (Audrain-McGovern 2006; Biener 2000; Gilpin 2007; Pierce 1998; Sargent 2000) reported that owning or being willing to own a tobacco promotional item predicted smoking uptake. Three studies (Charlton 1989; Lopez 2004; While 1996) found that naming a cigarette brand or a highly advertised cigarette brand predicted smoking uptake. Findings are summarized below.

One study (Sargent 2009b) did not find a significant association between tobacco marketing receptivity and future smoking. This study found that those with moderate receptivity (naming the brand of your favourite cigarette advertisement) were more likely to be experimental smokers (12.5%) than never smokers (1.6%) at baseline; however, no significant association between receptivity to tobacco marketing and onset of smoking after two years was found (moderate receptivity: OR 0.64, 95% CI 0.22 to 1.87; high receptivity: OR 1.12, 95% CI 0.86 to 1.48).

A detailed description of findings from studies assessing receptivity is provided below:

Pierce 1998 examined the influence of adolescents' receptivity to tobacco industry promotional activities on movement toward addiction to smoking. Survey participants who in 1993 had never smoked and who would not consider experimenting with smoking were followed up in 1996 to assess any progression in smoking uptake. Having a favourite advertisement (moderate receptivity) at baseline predicted which adolescents would progress in smoking acquisition at follow up compared to minimally receptive group (odds ratio [OR] 1.82, 95% confidence interval [CI] 1.04 to 3.20), possession or willingness to use a promotion item (high receptivity) predicted even higher likelihood of future progression (OR 2.89, 95% CI 1.47 to 5.68) controlling for school performance and demographic characteristics. Half of adolescents (51.7%, 95% CI 46.3 to 57.1) who had a favourite advertisement at baseline and 62.1% (95% CI 52.6 to 71.6) who possessed or were willing to use a promotion item progressed toward smoking at follow up. Lower levels of receptivity to promotions did not predict progression toward addiction to smoking. In a secondary report on participants who were experimenters at baseline, high receptivity was a significant predictor of progression to established smoking (OR 1.71, 95% CI 1.11 to 2.61, adjusted for age, gender, race/ethnicity), whilst moderate receptivity was not statistically significant (Choi 2002).

Biener 2000 found that 46% of nonsmoking adolescents (no more than one cigarette) who owned a tobacco promotion item and named a brand advertisement that attracted their attention (high receptivity) at baseline, progressed from not smoking or early experimenting to established smoking four years later. Further, 18% of adolescents who either owned an item or named a brand progressed toward established smoking (moderate receptivity), while only 14% who neither owned an item nor named a brand (low receptivity) progressed toward established smoking ($2 = 28.9$, $P < 0.001$). Controlling for family and peer smoking adolescents, baseline smoking status and rebelliousness, those who were highly receptive at baseline were more than twice as likely to become established smokers by follow up (OR 2.70, 95% CI 1.24 to 5.85). Among the subgroup of never-smoker (even a puff), 29% who were highly receptive at baseline had progressed to established smoking at follow up. The rates of uptake among moderate and low receptivity were 12% and 11% respectively ($2=8.38$, $P < 0.02$).

Audrain-McGovern 2006 reported that baseline tobacco advertising receptivity (naming your favourite brand or willing to own a promotional item) significantly increased the odds of progressing to a higher level of smoking between 9th and 12th grade (OR 1.11, 95% CI 1.02 to 1.19). This was a non-linear fixed relationship.

Gilpin 2007 found that the percentage of current established smokers increased with higher levels of receptivity in two separate cohorts with a six-year follow up. Naming the brand of favourite cigarette advertisement (moderate receptivity) at six-year follow up, versus minimal receptivity at baseline, increased the odds of becoming an established smoker for both a 1993-1999 cohort (OR 1.46, 95% CI 1.10 to 1.94), as well as a 1996-2002 cohort (OR 1.46, 95% CI 1.02 to 2.07). Adolescents who had or were willing to use tobacco promotional items (high receptivity) were also more likely to become an established smoker at follow up (1993-1999 cohort, OR 1.84, 95% CI 1.15 to 2.94; and 1996-2002 cohort, OR 1.84, 95% CI 1.28-2.63).

Sargent 2009a found that 34% of ever smokers named the brand of their favourite advertisement at baseline, while only 6% of never smokers were able to name a favourite advertisement. Identifying a favourite advertisement predicted smoking after 1 year in baseline never smokers (OR 1.53, 95% CI 1.07 to 2.20), and higher levels of smoking after one year in baseline ever-smokers (OR 2.17, 95% CI 1.78 to 2.63).

Pierce 2010 collected data on tobacco marketing receptivity at baseline and at four eight-month intervals. Results showed that adolescents having a favourite cigarette advertisement at baseline

increased the likelihood of smoking five years later (OR 1.5, 95% CI 1.0 to 2.3; P=0.39). It was also found that the proportion of girls who reported a favourite advertisement went up (increased of 10%) following a fashion-themed 'Camel No.9' advertising campaign (targeting younger women) which was launched between the 4th and 5th study follow up. Previous to the campaign, the number of girls reporting a favourite add had been stable across time. No increase was observed for boys during the same time period.

Sargent 2000 found that owning or being willing to use a personal item bearing a cigarette brand logo at baseline (receptive) was associated with higher smoking uptake at the 18-month follow up. Nearly half (48.7%) of adolescents who were not regular smokers at baseline moved up one or more categories on a smoking index. Controlling for other variables possibly related to smoking uptake, the odds of taking up smoking were higher for adolescents who were receptive compared to those not receptive (OR 1.9, 95% 1.3 to 2.9).

Charlton 1989 reported that naming a brand at baseline was related to trying smoking at four-month follow up, when data from boys and girls were analysed together using step-forward logistic regression (P < 0.025). Having a favourite cigarette advertisement was not predictive of smoking uptake. When boys and girls were analysed separately, neither factor was significant for boys. For girls, however, being able to name a brand was associated with trying smoking (P = 0.02, not controlled for other variables).

While 1996 reported that girls who named one of the two most advertised brands, Benson and Hedges, were at greater risk of taking up smoking one year later than those who named other less advertised brands (OR 2.50, 95% CI 1.18 to 5.30). Girls who named both Benson and Hedges and Silk Cut were also at greater risk of smoking than girls naming other brands (OR 2.15, 95% CI 1.04 to 4.42). Differences were larger and more significant when data were analysed using the group who named no brands as the control comparator. For girls who named Silk Cut alone the difference was not statistically significant against either no brand or less advertised brands groups. Both boys and girls who named brands other than Benson and Hedges and Silk Cut were not at greater risk of smoking at one-year follow up than those who named no brands, although for boys the difference almost reached statistical significance. Boys who named Benson and Hedges, Silk Cut or both were more likely to become smokers than boys who named no brand, but the differences were not statistically significant when compared to boys who named other brands. Results were not controlled for other factors that may influence smoking uptake.

Lopez 2004 found that the more cigarette advertisements adolescents correctly identified at baseline (slides of advertisements with brand names covered) the higher the percentage of smokers (p<0.0001). There was no significant difference in smoking between those who recognized none or one of the brands. Over time, the probability of being a smoker increased with the number of cigarette advertisements identified at baseline; at six-month follow up (OR 1.26, 95% CI 1.09 to 1.46), 12 months (OR 1.18, 95% CI 1.03 to 1.35) and 18 months (OR 1.15, 95% CI 1.03 to 1.35).

Exposure to Advertising

Findings from five studies found a significant positive association between exposure to cigarette advertising and adolescent smoking. One study found differences in smoking susceptibility and uptake by ethnicity (Gritz 2003) while Weiss 2006 found no ethnic differences. One study (Hanewinkel 2011) tested the specificity of advertising and reported that only advertisements for cigarettes, versus other consumer goods, predicted smoking initiation.

Pucci 1999 assessed baseline exposure of adolescents to brand-specific cigarette advertising in magazines. A follow-up survey of smoking behaviour was subsequently conducted in 1997/8. Adolescents' levels of brand-specific advertising exposure in magazines were highly correlated with brand of initiation among new smokers (r = 0.93, P = 0.0001). The top three brands of initiation (Marlboro, Newport, and Camel) were among the top four brands in terms of adolescents' exposure to magazine advertising. These brands accounted for 89.0% of initiation and 61.6% of the advertising exposure among the sample. The brands smoked by current smokers were highly correlated with the adolescents' exposure to brand specific advertising in magazines (r = 0.87, P = 0.0002).

Gritz 2003 investigated the impact of pro-tobacco media exposure on susceptibility to smoking by ethnicity. For all ethnicities, baseline never-smokers had increased odds of being susceptible to smoking (OR 1.31, 95% CI 1.14 to 1.51) and ever smoking (OR 1.15, 95% CI 1.03 to 1.28) after one year. When results were examined by ethnicity, exposure to tobacco marketing predicted susceptibility (OR 1.38, 95% CI 1.09-1.75) and ever-smoking (OR 1.35, 95% CI 1.09 to 1.33) in white students only. This association was not present for African American or Hispanic students.

Weiss 2006 examined the impact of participants' perceived exposure to pro-tobacco media and susceptibility to smoking after one or two years. Exposure to tobacco marketing on television or at a retail store was associated with being susceptible to smoking after one or two years' follow up (OR 1.89, 95% CI 1.23-2.91). These odds almost doubled with exposure to both television and retail store tobacco marketing (OR 3.33, 95% CI 2.16 to 5.16). Ethnicity status did not moderate the effects of pro-tobacco media exposure on susceptibility to smoking.

Henriksen 2010 examined exposure to cigarette retail advertising by measuring: shopping frequency, estimated cigarette brand impressions per week, and perceived exposure. After 12 months, initiation of smoking was highest for baseline never smokers who visited the most convenience stores at least twice per week as compared to those who visited these stores less than twice per month (29% versus 9%, respectively). Adolescents whose shopping frequency was moderate (0.5-1.9 visits per week) or high (>2 visits per week) had increased odds of smoking at 12 months (Moderate: OR 1.64, 95% CI 1.06 to 2.55, High: OR 2.58, 95% CI 1.68 to 3.97) and 30 months (Moderate: OR 1.19, 95% CI 1.00 to1.41, High: OR 1.42, 95% CI 1.19 to 1.69). High (>260 per week), but not moderate (60-259 per week) exposure to cigarette brand impressions predicted smoking initiation after 12 months (Moderate: OR 1.22, 95% CI 0.79 to 1.89, High: OR 2.36, 95% CI 1.55 to 3.61) and 30 months (Moderate: OR 1.20, 95% CI 0.81 to1.79, High: OR 1.58, 95% CI 1.05 to 2.37). Perceived exposure to advertising predicted a small increase in the odds of initiating smoking at the 30-month follow up (OR 1.11, 95% CI 1.02 to 1.22) but this relationship was no longer significant when adjusted for cigarette brand impressions per week.

Hanewinkel 2011 examined the specificity of the association between cigarette advertising and adolescent smoking initiation.

The incidence of trying smoking was associated with an increased exposure to cigarette advertisements (10% in the low exposure group, 12% in the medium exposure group, and 19% in the high exposure group). Exposure to advertisements for other consumer goods did not predict smoking initiation. The relative risk of smoking initiation was 1.46 (95% CI 1.08-1.97, P<0.05) times higher in those with high exposure to cigarette advertisements as compared to those with low exposure to cigarette advertisements. Exposure to advertisements for other consumer goods was not associated with an increased risk for smoking initiation.

Perceptions of Advertising

Results from three studies indicated a relationship between adoption of smoking and approval of advertising, as well as perceived influence of advertising.

Alexander 1983 found that approval of advertising was the fourth most important factor in predicting uptake after age, peer smoking, and sibling smoking. Students who approved of cigarette advertising were twice as likely to become smokers as those who disapproved (adoption rate of 27 per 100 versus 12.1 per 100 respectively). Further, the adoption rate of students who were ambivalent about advertising was 19.3 per 100 (Chi Square = 81.8 p<0.001, not controlled for other variables).

Diaz 1998 found that the relative risk of baseline nonsmokers becoming smokers was increased amongst those who accepted tobacco advertising (RR 2.1, 95% CI 1.5 to 3.0). The risk was not statistically significant for the subgroup who became weekly or daily smokers during the period (OR 1.3, 95% CI 0.5 to 3.0). Using logistic regression analysis the odds ratio for becoming smokers did not quite reach statistical significance (OR 1.6, 95% CI 0.9 to 2.7).

Armstrong 1990 examined perceived influence of advertising and found that among other significant variables, respondents' perceived response to cigarette advertising showed the strongest and most consistent evidence of an effect on the uptake of smoking. A higher influence of advertising was associated with a higher likelihood of becoming a smoker at both one and two-year follow up, adjusting for variables associated with uptake. The strongest effect occurred in the second year. In this study analyses were conducted separately for boys and girls. At the one-year follow up, among girls the adjusted difference in smoking prevalence rates was 8.4% (95% CI 1.2 to 18.1) between those who did and did not perceive advertisements as having some influence; among boys it was 5.3% (95% CI 5.2 to 15.8). At longest follow up (30 months) among girls the difference in prevalence rates was 15% (95% CI 2.1 to 27.9) and among boys it was 15.3% (95% CI 4.0 to 26.6).

DISCUSSION

The results from this review offer evidence that prior exposure to tobacco industry marketing, in the form of advertising and promotion, is associated with future smoking among adolescents. All but one of 19 included longitudinal studies concluded that tobacco industry marketing influences adolescents to start smoking. The caveats to this conclusion were two studies that reported an influence of advertising among girls, but not boys (Charlton 1989; While 1996). Both these studies were conducted in the United Kingdom and used the same measure of advertising awareness. Charlton and colleagues reported that, among girls, naming a brand of cigarette was significantly associated with trying smoking, but having a favourite advertisement was not. Neither factor was statistically significant for boys. In a later study, While 1996 and colleagues found that girls who named the most advertised brands were twice as likely to start smoking as girls who named other less advertised brands. Again, no such difference was found for boys. It might be argued that being able to name a cigarette brand need not be due to advertising alone. It is thus worth noting that in the study by While and colleagues girls who named one or both of the most heavily advertised brands were at greater risk of future smoking uptake, whereas girls who named other less advertised brands were not at greater risk.

The one study that found no effect of tobacco industry marketing on initiation of smoking (Sargent 2009b) examined receptivity to advertising. Having a favourite advertisement and owning or being willing to own a promotional item predicted higher levels of lifetime smoking; however, in a longitudinal analysis of baseline never smokers, no significant effect on smoking initiation was found. The researchers controlled for a large range of variables including exposure to smoking in movies, which was found to be predictive of smoking initiation.

In addition to demonstrating an association between measures of exposure to advertising and smoking uptake, seven studies reported a dose-response relationship (Audrain-McGovern 2006; Biener 2000; Gilpin 2007; Henriksen 2010; Lopez 2004; Pierce 1998; Weiss 2006. That is, an adolescent is more likely to initiate smoking as the dose, or amount of, tobacco advertising exposure or receptivity increases. For example, Gilpin 2007 found that the odds of initiating smoking increased by 46% for youth who were moderately receptive to advertising and by 84% in youth how were highly receptive to advertising. The presence of a dose-response relationship, in addition to the strength of the association, is needed in order to determine whether a relationship between two variables is causal. Hanewinkel 2011 was the first longitudinal study to demonstrate the specificity of tobacco advertising, versus receptivity to advertising in general, which provides a stronger case for the causal relationship between tobacco advertising and youth smoking.

Our decision to limit this review to longitudinal cohort studies requires justification. Other study designs have been used to evaluate the relationship between advertising and tobacco uptake, including cross-sectional studies, time-series and econometric studies. Cross-sectional studies can demonstrate an association between exposure to, awareness of, or attitudes towards advertising, and current smoking behaviour. But since they do not show whether exposure preceded smoking uptake they provide weaker evidence of a causal association. It is probable that adolescents who have begun to smoke will be more aware of advertising than those who have not (Moschis 1989). The association could also be due to residual confounding with other risk factors for uptake.

Cross-sectional studies do support the evidence from longitudinal studies in that they consistently report correlations between increased 'exposure' and greater likelihood of current smoking. For example, a study used the Robert Wood Johnson Foundation's Survey of tobacco price sensitivity, behaviour and attitudes among teenagers and young adults, with data from over 17,000 respondents aged 13 to19 (Kaufman 2002). This demonstrated a strong influence of receptivity to advertising on susceptibility to smoking, experimenting and regular smoking. The association was

independent of other risk factors, including exposure to smoking from friends and family. Other cross-sectional studies retrieved by our search strategy are listed in the table of excluded studies. All but one study (Zulu 2009) reported an association between smoking status and exposure to advertising, although the strength of the association and the extent to which confounding was corrected for varied. Zulu 2009 used cross-sectional survey data from 2378 youth who took part in the Lusaka (Zambia) Global Youth Tobacco Survey. The authors found a positive association between youth smoking and seeing actors smoking in media but found a negative association between youth smoking and possessing an item with a cigarette brand logo, seeing advertisements on billboards as well as ever being offered a free cigarette by a tobacco sales representative. Many cross-sectional studies also show that although smoking and exposure are correlated, many of the children who have not experimented with smoking recognize advertisements (e.g. Aitken 1985; DiFranza 1991; Emri 1998; Audrain McGovern 2003; Feighery 2006).

We excluded time-series studies. In this context, by time-series design we mean studies which relate trends in smoking initiation, or prevalence in the relevant age group, to a measure of advertising exposure, which might be the advertising spend, over an extended period. We excluded them because once again the design is not ideal for demonstrating a temporal relationship, and because there is a greater risk of confounding due to changes in other variables such as the price of cigarettes. The strength of the longitudinal cohort design, by contrast, is that the individuals followed are, to a large extent, exposed to the same external influences. A change in price or policy may change smoking initiation rates, without obscuring differences between the baseline characteristics of subgroups that do and do not change their behaviour. A variety of study designs come under the heading of time-series studies, but generally the advertising exposure variable is assessed at the population level, and smoking is measured as prevalence. But a few studies have addressed initiation; for example, Pierce and Gilpin (Pierce 1995) used data from a series of surveys to construct age-specific smoking initiation rates for males and females during a series of periods between 1910 and 1977. They used regression analyses to compare initiation rates in different periods and in males and females, and linked this to advertising and promotion of different brands. They concluded that initiation increased in the group targeted, so for example young female initiation increased during the 1930's when Lucky Strike was promoted to women. The same group showed that a decline in smoking initiation rates in 14- to 17-year olds between 1979 and 1984 reversed after this, at the time when tobacco marketing expenditures on coupons, value added items and promotions were increasing (Gilpin 1997). Another study used data from the Monitoring the Future project on rates of daily smoking initiation in different grades (Redmond 1999). Observed and expected rates of ninth-grade initiation were compared with advertising and sales promotion expenditures. This showed a significant correlation between year on year increases in sales promotion expenditures and greater than expected initiation rates. This association only became apparent from the early 1980s when promotional expenditures began to dominate tobacco marketing strategy. The association between initiation rates and advertising was not statistically significant, possibly because advertising is expected to have a long-term cumulative effect. Another study (Slater 2007) which used data from the Monitoring the Future project (waves from 1999 to 2003) assessed the impact of tobacco advertising on smoking uptake, an estimated measure based on current smoking and intentions for future smoking in cross-sectional samples. Regression models revealed that higher levels of point-of-sale advertising was associated with youth smoking initiation.

Econometric studies, which also use time-series data, typically bring together population level and macroeconomic data from multiple sources and use statistical modelling to detect associations. There are methodological problems with using these methods for assessing the effect of tobacco advertising (Chapman 1989; Smee 1992; Pollay 1996; Saffer 2000). Ideally there need to be valid measures of the amount of advertising, taking into account the possible different effects of advertising media, audience variations and advertising content. Values should also be assigned to other variables such as price, smoking restrictions and disposable income. The lagged and durable effects of advertising need to be taken into account. The sources of data are often aggregated national annual figures which have too little variability to detect associations. Wen 2005 used data on trends in cigarette sales, advertising expenditure, brand preference and cigarette consumption among youth following the 1987 opening of the cigarette market in Taiwan. Between 1995 and 2000, inflation adjusted advertising expenditures by foreign firms increased fourfold. By 2000, the market share of foreign cigarettes had exceeded domestic brands by three to one among young smokers. The leading domestic brand preferred by youth shifted from the most popular domestic brand to a foreign, widely advertised brand. Most econometric studies of tobacco and advertising were not relevant for this review because they only addressed tobacco consumption, generally from sales data, and did not provide data specifically on young people or smoking initiation. One study used data on self-reported television watching from US survey data between 1966 and 1970. This suggested that more exposure to television advertising increased the probability of being a smoker (Lewit 1981). However there could be confounding, if for example low socioeconomic status disposed teenagers both to smoke and to watch more television (Smee 1992). An unpublished study using Monitoring the Future data and a range of measures for advertising found generally positive effects, some of which were statistically significant for gender subgroups (Chaloupka 1999). One study used econometric modelling to investigate brand choice (Pollay 1996). This study found that brand choice among teenagers was correlated with past and present brand advertising. The relationship between brand choice and brand advertising was also stronger amongst teens than among adults.

This review found a consistent relationship between advertising and smoking uptake across 19 of the 19 longitudinal studies included. The exclusion of other, less robust study designs would threaten the validity of our conclusions only if a very strong effect were observed in the opposite direction. In fact other study designs support the conclusion that advertising influences adolescents to begin smoking.

There are several limitations that should be considered in interpreting the results of this review. First, it included 19 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. Seven of the studies measured and

controlled for other variables likely to be associated with smoking uptake. It is impossible to know if all relevant variables were measured and included in the analysis. Second, we focused on mass media advertising and promotion and did not consider other forms of marketing such as event sponsorship, placement in movies, television programs and popular music, thus no conclusions can be drawn regarding tobacco marketing in general. Third, the way in which exposure to advertising and promotion was operationalized varied across studies (e.g., receptivity, influence, awareness). One of the greatest methodological challenges in evaluating evidence on the effect of tobacco advertising on smoking behaviour of adolescents is the measure of exposure to tobacco advertising. We know of no validated instrument that measures tobacco industry marketing exposure reliably. As noted earlier the indirect approach used by Pucci 1999 had the advantage of avoiding recall bias by using an index of 'total gross impressions' based on self-reports of magazines read, but magazines are just one course of exposure to advertising. The consistency of the findings using different methods of measuring exposure and of analysis can be interpreted as a strength. Fourth, It has also been pointed out that longitudinal studies assessing advertising and youth smoking fail to address that baseline advertising receptivity or ownership of tobacco paraphernalia may be due to an endogenous, unmeasured characteristic of the individual that is related to smoking initiation (Nelson 2010). Elimination of this bias would require that advertising exposure be randomised to subjects using an experimental design which is impractical. The vast majority of studies included in this review, controlled for a variety of variables known to or hypothesized to be associated with tobacco use in order to reduce the potential for bias.

The problem of publication bias may also affect the studies identified for inclusion. It is possible that other cohort studies have measured variables related to advertising exposure. If they failed to detect an association with advertising they may not have been published, or were published but did not refer to advertising so failed to be retrieved by our search strategy.

Like public health interventions, industry tobacco marketing activities are very complex. The effects of tobacco industry marketing on adolescents exist in the context of broader society. Even with the application of statistical modelling procedures it is difficult to 'isolate' the effects of advertising and promotion because they are culturally embedded within the adolescent experience and are hard to quantify. Marketing includes many components in addition to conventional advertising, some of which are embedded in other contexts, for example product placement in films. There are many problems with trying to assess the impact of tobacco advertising even on overall consumption, as Saffer 2000 points out. For example, if there is a high level of aggregation of the data on advertising expenditure and consumption, as occurs if annual national figures are used, the loss of variance reduces the likelihood of detecting an effect (Saffer 2000). Studies of the impact of advertising bans can also be used as an indirect method of assessing the effect of advertising on consumption. The impact of bans can be assessed by comparing countries or geographic areas with and without advertising restrictions, or by comparing levels of consumption pre- and post-ban. A review of studies of the effect of advertising restrictions (World Bank 1999; Saffer 2000) concluded that comprehensive advertising bans can reduce tobacco consumption, but does not attempt to consider smoking prevalence. Detecting an effect of a ban on smoking uptake rates is difficult because analysis would need to take into account the gradual process of smoking initiation. Rimpela and colleagues have highlighted the problems of relating adolescent smoking prevalence to advertising bans in Norway and Finland. In Norway the introduction of a ban did appear to reduce the prevalence of young smokers, particularly females (Rimpela 1993). Gilpin 2004 examined receptivity to tobacco advertising among adolescents before and after California's 1998 Master Settlement Agreement, which placed strong restrictions on advertising. There was a 37% increase in the percentage of California young adolescents who did not name a brand of a favourite cigarette advertisement in 2002 compared to 1999. In 2000, cigarette advertising was banned from all Brazilian media. Galduroz 2007used cross-sectional survey data collected in 1997 and 2004 to assess adolescent tobacco use, in 10 Brazilian capitals, before and after the advertising ban. In 1997, 32.7% of adolescents had reported using tobacco, by 2004 it had decreased to 25.02%. A downward trend was observed in all but two capitals.

This review was guided by a logic model in which exposure to tobacco industry advertising and promotion increases awareness of cigarettes and engenders positive attitudes that lead to smoking. We hypothesized that exposure to tobacco advertising and promotion and other variables that may mediate between exposure and behaviour, such as brand awareness, receptivity, and positive attitudes towards advertising and promotion would predict future smoking behaviour. The evidence from our review of published longitudinal studies, as well as other reviews that have included cross-sectional studies (Biener 2001; Wakefield 2003), support the hypothesis that tobacco advertising and promotion influence adolescents to smoke cigarettes.

In summary, there is substantial evidence that exposure to tobacco advertising is associated with adolescent smoking:

(1) eighteen of the 19 longitudinal cohort studies showed a positive, consistent, and specific relationship;

(2) the association is considered strong and a temporally correct dose-gradient has been demonstrated between naming advertising brands and being willing to use a promotional item, and smoking uptake;

(3) it is theoretically plausible that exposure to advertising increases smoking uptake.

AUTHORS' CONCLUSIONS

Implications for practice

Longitudinal studies suggest that exposure to tobacco advertising and promotion is associated with the likelihood that adolescents will start to smoke. Based on the strength and specificity of this association, evidence of a dose-response relationship, the consistency of findings across numerous observational studies, temporality of exposure and smoking behaviours observed, as well as the theoretical plausibility regarding the impact of advertising, we conclude that tobacco advertising and promotion increases the likelihood that adolescents will start to smoke.

From a policy perspective, attempts to eliminate tobacco advertising and promotion should be supported.

Programmes to prevent uptake of tobacco use in young people should raise awareness of strategies that the tobacco industry uses to recruit teens into becoming smokers.

Implications for research

Evaluation of tobacco industry marketing is a methodologically challenging area, yet rigorous evaluation is still needed. More longitudinal research should be conducted that assesses the impact of a variety of marketing approaches in a wider range of cultural and geographic settings. Emphasis should be placed on developing measures of advertising exposure, as well as more in-depth exploration of gender differences. Effectiveness studies demonstrating the impact of advertising bans would contribute to what is known in this area. It is important that survey research in these areas account for variables known to predict smoking. More detailed descriptions of contextual factors should be incorporated into published studies.

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CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Alexander 1983

Methods	Cohort study (reported as part of an RCT of a school-based prevention programme) Baseline survey: 1979 Follow-up: One year (1980) Site: Newcastle, Australia Research question: Primary question was to evaluate an educational programme, secondary aim was to relate changes in smoking behaviour to changes in attitudes, knowledge, and personal and social factors. Analysis: Chi Square, Logistic regression controlling for personal and social factors listed under interventions.
Participants	5616 children between 10 and 12 years of age who were in years 5 and 6 in 1979, and progressed to years 6 and 7 in 1980. (87% of original sample, excludes participants whose records could not be linked or whose smoking behaviour could not be classified) Survey method: Confidential self-administered questionnaires completed during school time under the supervision of a member of the study team
Interventions	Approval of cigarette advertising measured by semantic differential scales Personal and social factors associated with adoption and quitting smoking also measured: sibling and friend smoking, weekly spending money, number of smoking parents, teacher's sex, exposure to educational programme.
Outcomes	Smoking defined as puff in past 4 weeks.

Alexander 1983 *(Continued)*

	Four groups defined on basis of smoking behaviour at baseline and follow-up: never smoked/ became smokers by follow-up/ smoked only at baseline/ smoked at both points.
Notes	

Armstrong 1990

Methods	Cohort study (reported as part of an RCT of a school based prevention programme) Baseline survey: June 1981 Follow-up: 17 months (1982) and 30 months (1983) Site: Western Australia Research question: Primary question was to evaluate an educational programme, secondary aim to relate uptake of smoking to baseline factors including perceived influence of advertising Analysis: Logistic regression, separately for boys and girls. Prevention programme variable forced into model as first step. Additive risk model used to estimate parameters adjusted for other covariates measured at baseline
Participants	2366 children from 45 schools, 82% followed up at 17 months and 64% at 30 months Year 7 at baseline, between 11 and 14, modal age 12 Survey method: Questionnaire administered in classrooms. Students shown a film demonstrating how smoking could be detected from saliva analysis and samples collected but not all analysed. Smoking behaviour based on self-report.
Interventions	Influence of advertising measured by 1 question: How much do cigarette advertisements make you think you would like to smoke a cigarette? Responses dichotomised as none at all/ some influence. Baseline information on habits of parents, siblings and friends, knowledge of and attitudes to smoking also collected.
Outcomes	Smoking defined as even just a few puffs in past 12 months. Analysis uses only baseline nonsmokers
Notes	

Audrain-McGovern 2006

Methods	Cohort study Baseline survey: 2000 Follow-up: 1, 2 and 3 years (2001, 2002 and 2003) Site: northern Virginia, USA Research Question: Do novelty seeking and depressive symptoms have mediated or indirect effects on adolescent smoking progression through tobacco advertising receptivity? Analysis: Associative Latent Growth Curve Modelling, Indirect Effects Method
Participants	1053 of 2120 eligible grade 9 students from 5 schools included in final sample. Response rates for the 3 spring follow-ups in the 10th, 11th and 12th grades were 96% (1081), 93% (1043), and 89% (1005) respectively. Final sample based on participants with all available data for novelty seeking, depression, tobacco advertising receptivity, and smoking progression, using pair wise missing data strategy for random missing data. Survey Method: Confidential self-report survey administered by research member. Make-up sessions available for absent students.

Audrain-McGovern 2006 *(Continued)*

Interventions	Advertising receptivity was constructed as a dichotomous variable (high and low) from a five-item scale. Low receptivity was defined as being able to name no more than one frequently advertised brand and not having a favourite brand or never having received or used promotional items. High receptivity was defined as having a favourite brand or willing to use promotional items. Novelty seeding personality and depressive symptoms were measured using the Temperament and Character Inventory and Centre for Epidemiolgic Studies Depression Scale, respectively, at baseline. Control variables: gender and race assessed at baseline; peer or family smoking exposure; alcohol and marijuana use measured at each follow-up.
Outcomes	Smoking Behviour was summarised in four ordered categories representing increasing levels of smoking: Never Smoker; Puffer (never having smoked a whole cigarette); Experimenter (having smoked a whole cigarette but less than or equal to 100 cigarettes total in their lifetime OR smoked greater than 100 cigarettes in their lifetime but had not smoked in the past 30 days); Regular Smoker (smoked greater than 100 cigarettes in their lifetime and smoked in the past 30 days)
Notes	

Biener 2000

Methods	Cohort study Baseline survey: 1993 Follow-up: 48 months (1997-98) Site: Massachusetts, USA Research question: Does awareness of tobacco advertising/promotion predict smoking uptake Analysis: Logistic regression controlling for covariates significantly associated with both receptivity and progression (as listed in notes). Reported odds ratios are adjusted.
Participants	Baseline sample obtained by random digit dialling as part of the Massachusetts Tobacco Survey 1069 at baseline, 618 re-interviewed, response rate 57.8%. 529 had smoked no more than one cigarette at baseline and were included in the analysis. Age 12 to 15 Survey method: telephone interviewing
Interventions	Receptivity to marketing measured by 2 questions: 1 'Some tobacco companies make clothing, hats, bags or other thing with the brand on it. Do you have a piece of clothing or other thing that has a tobacco brand name or logo on it?' 2 'Of all the cigarette advertisements you have seen, which brand's ads do you think attract your attention the most?' High receptivity: owned an item AND named a brand Moderate receptivity: owned an item OR named a brand Low receptivity: neither owned an item nor named a brand. Also measured at baseline: age/ sex/ race/ SES/ smoking among family and friends, rebelliousness/ depression, current smoking status
Outcomes	At baseline, not smoking defined as no more than one cigarette in lifetime. Three categories: Nonsusceptible: Answered No to 'Do you think that you will try a cigarette soon?' and Definitely Not to 'If one of your best friends were to offer you a cigarette, would you smoke it?' and 'Do you think you will smoke a cigarette in the next year?' Moderate risk: Yes to trying a cigarette soon, or less definitively negative answers to other 2 questions Early experimenters - had had a puff or a whole cigarette At follow-up established smokers were those who had smoked 100 or more cigarettes.
Notes	

Charlton 1989

Methods	Cohort study Baseline survey: pre-1989 Follow-up: four months Site: Northern England Research question: Primary question to evaluate an education programme, secondary aim to relate uptake of smoking to baseline factors including awareness of advertising Analysis: Logistic regression using GLIM, separately for boys & girls.
Participants	1125 boys and 1213 girls from 29 schools. 65% of this sample were never-smokers at baseline. Main analysis on these 1390 never-smokers at baseline age 11 to13. Survey method: Self-administered questionnaires completed under examination conditions supervised by class teachers. Responses sealed in plain envelopes. Responses matched using birth date, sex and age.
Interventions	Awareness of advertising measured. Cigarette brand awareness ascertained by response to 'Can you name a brand of cigarette?' Up to 2 brands could be recorded. Favourite advertisements for cigarettes were ascertained using the question 'Do you have a favourite cigarette advertisement? If so which is it?'.Question also asked about watching sport on TV. Baseline information on parental and friends' smoking, positive and negative attitudes to smoking and knowledge of health effects. Exposure to 2-lesson prevention curriculum also recorded.
Outcomes	Smoking defined as ever trying a cigarette.
Notes	At baseline 80% of never-smokers could name at least one cigarette brand, and 15% had a favourite advertisement.

Diaz 1998

Methods	Cohort study Baseline survey: 1990 Follow-up: one year Site: Barcelona, Spain Research question: Identify factors that predict smoking. Analysis: Logistic regression, with all variables included in model. Variables covered attitudes and beliefs, family/ teacher smoking, demographic
Participants	Baseline sample were control group for another study. 1126 at baseline, 1003 at follow-up, response rate 89%. 906/1003 were nonsmokers.
Interventions	Single question about advertising: Accept tobacco advertising. Agree/disagree
Outcomes	Smoking categories: nonsmokers, experimental, daily, weekly smokers. Some analyses compared nonsmokers to others
Notes	

Gilpin 2007

Methods	Cohort study Baseline survey: cohort 1 - 1993; cohort 2 - 1996

Gilpin 2007 *(Continued)*

	Follow-up: 3 and 6 years (cohort 1 - 1996 and 1999; cohort 2 - 1999 and 2002) Site: California, USA Research Question: Does receptivity to tobacco advertising and promotions during adolescents predict smoking 6 years later? Analysis: Multivariate logistic regression used to predict what factors cause smoking initiation. Control variables: gender, age, race, school performance, family smoking, and peer smoking.
Participants	3687 and 4139 adolescents, aged 12-15 years, who were not established smokers at baseline in cohort 1 and 2 respectively. At follow-up 1,734 (47.0%) and 1,983 (47.9%) completed all interviews in cohort 1 and 2, respectively (aged 18-21 at 6-year follow-up). Survey method: telephone interviews
Interventions	High receptivity was defined as having or being prepared to use a tobacco promotional item. With the remaining respondents: Minimal receptivity was defined as adolescents who could not name a brand to the questions “think back to the cigarette advertisements you have recently seen on billboards or in magazines. What brand of cigarettes was advertised?” Low receptivity was defined as adolescents who named a brand of cigarettes they had recently seen advertised but could not name a favourite brand in response to the following question, “what is the name of the cigarette brand of your favourite cigarette advertisement” Moderate receptivity was defined as adolescents who could name a brand most advertising and could name their favourite cigarette brand
Outcomes	Adolescents categorized at each interview as committed never smokers, susceptible never smokers, experimenters, established smokers, or current established smokers. Main outcome variable of regression analysis was odds of being an established smoker at follow up. Established smoker was defined as someone who answered yes to having smoked at least 100 cigarettes in his/her lifetime.
Notes	Sample was weighted to account for household selection probabilities, differences in adolescent response levels, and loss to follow-up. Probability of response at follow up was adjusted for demographic characteristics of parent, gender and age of adolescent, number of biological parents in the household, the smoking status of the parent, and presence of home smoking ban.

Gritz 2003

Methods	Cohort study Baseline Survey: Date unknown (prior to 1998) Follow-up: 12 months Site: Houston-Galveston, Texax, USA Research Question: Relationships of baseline predictor variables with two outcome variables, measured 1 year later: a) susceptibility to smoking, and b) onset of smoking. Focus was on ethnic specific predictors (White, African American, and Hispanic)

Gritz 2003 *(Continued)*

	Analysis: Logistic Regression. Stepwise regression was used to identify variables that predicted the outcome due to the large number of predictor variables.
Participants	659 students from 6 school districts in grades 5, 8 and 12 who were identified as never smokers at baseline and either were susceptible to smoking or had ever smoked at follow up. Of baseline sample (n=1,441), 82.1% were retained at follow-up (n=1,004). Survey method: self-report questionnaire (and saliva collection tube) distributed at school in a group setting.
Interventions	Exposure to pro-tobacco and anti-tobacco messages measured using one item, "Please mark all the following types of messages about smoking that you have seen or heard in the last month". Response categories included 5 major media sources: (1) television ads/show, (2) radio ads/programs, (3) billboards (road signs), (4) posters, and (5) newspaper/magazine ads. Students asked if they saw or heard messages "for smoking" or "against smoking" for each type. For each students, pro-tobacco and anti-tobacco scores were created by summing the number of sources marked.
Outcomes	At baseline, students categorized as Never Smokers if they had never tried a puff of a cigarette. At follow-up, students who smoked at least one or more puffs in their lifetime were categorized into: Experimenters (tried one or more puffs but not the whole cigarette, smoked 1-10 cigarettes in their lifetime, or smoked fewer than 12 times in the past 12 months); Current Smokers (smoked at least once a month); and Former Smokers (used to smoke but quit in the past 12 months or used to smoke but quit more than 12 months ago).
Notes	

Hanewinkel 2011

Methods	Cohort Study Baseline survey: 2008 Follow-up: 9 months after baseline Site: Brandenburg, Hamburg, and Schleswig-Holstein, Germany Research Question: Is there is a specific association between cigarette advertisements and adolescent smoking initiation? Analysis: Multilevel mixed-effects Poisson regression was used to determine the associations between the amount of advertising exposure and smoking initiation. Controlled for age, gender, socioeconomic status, parent smoking, peer smoking, rebelliousness, sensation-seeing, school performance, and average television screen time.
Participants	2346 students, aged 10-17 and who were not smokers at baseline completed the first survey (81.4% response rate). 2102 completed the follow-up survey (89.6% retention rate). Survey method: School-based survey
Interventions	At baseline, participants were provided with masked coloured images of different advertisements (6 cigarette advertisements and 8 'control' advertisements for other consumer brands). Other consumer brands included sweets, clothes, mobile telephones and cars. Images were mostly from billboard and television advertisements. All brand information was digitally removed. Two measures of exposure were combined into a single scale:

Hanewinkel 2011 *(Continued)*

	(1) Advertisement contact frequency was measured by asking students to rate, on a 4-point scale, how often they had seen the advertisement extract (0 = never; 1= 1-4 times; 2 = 5-10 times; 3 = >10 times). (2) Cued brand recall performance was measured by asking students to name the brand that was advertised (open format). Correct brand names were post coded as 1 and all other answers as 0 (misspellings of brand were counted as correct).
Outcomes	Lifetime smoking was assessed at baseline and 9-months follow-up by asking "How many cigarettes have you smoked in your life?" (never, smoked, just a few puffs, 1-19 cigarette, 20-100 cigarettes, or >100 cigarettes). The cohort consisted of participants who had never smoked at baseline. Any smoking at follow-up, even just a few puffs, was considered initiation of smoking.
Notes	

Henriksen 2010

Methods	Cohort Study Baseline survey: 2003 (February through April) Follow-up: 12 and 30 months after baseline Site: Tracy, California, USA Research Question: Is exposure to retail cigarette advertising a risk factor for smoking initiation? Which of 3 exposure measures is correlated with smoking initiation at follow up? Analysis: Multi level modelling was used to examine advertising exposure and smoking initiation. Controlled for gender, age, race, ethnicity, family and peer smoking, exposure to smoking in movies, self-reported grades in school and unsupervised time after school.
Participants	1681 adolescents, aged 11-14 years who had never smoked, completed the baseline survey (78% response rate). 1356 provided data about smoking behaviour at follow-up (81% retention rate). Survey method: school-based survey
Interventions	Used 3 measures of exposure: (1) 3-item measure of *shopping frequency*. Students were asked how often they visited any convenience stores, small markets, and liquor stores. *(2) Cigarette brand impressions per week* was calculated based on the frequency of visits to each store near the school, multiplied by the number of cigarette branded ads, functional items and product facings in each store, and summed scores for each student *(3) Perceived exposure* was a single item that asked students to estimate how often they see cigarette ads when they visit stores.
Outcomes	Ever smoking was assessed by 2 items, having ever smoked, even just a puff, and the number of days smoked in the past month Smoking initiation was defined as the transition from never smoking to ever smoking at either 12 or 30-month follow-up
Notes	

Lopez 2004

Methods	Cohort study Baseline: Date unknown (prior to July 2001) Follow-up: 6, 12 and 18 months later Site: Asturias, Spain Research Question: Investigate possible associations between billboard advertising from cigarettes and smoking behaviour Analysis: Logistic regression; Bivariate analysis to measure association between number of advertisements recognized and smoking status; Pearsons's Chi test of significance Controlled for age, gender, SES, attitude, social influence, and self-efficacy.
Participants	At baseline, 3,664 children aged 13-14; 3,089 at 6 months; 2,395 at 12 months; and 2,356 at 18 months. At 18 months, attrition was 35.7%. Participants were from 69 schools, located in municipalities of more than 50,000 in Asturias, Spain. Survey method: Self-report survey administered in groups and in class
Interventions	Advertisement awareness was measured at baseline only. Selection criteria for choosing cigarette advertisements were: (1) to have been on billboards within a radius of 500m of the schools at some time during the 3 months preceding the study, and (2) to be focused on young people (iconic and/or textual message). Experts selected, by consensus, the three advertisements with messages that were most focused on young people. Slides of these advertisements, with brand names covered, were shown to students. Students were asked to write the brand name, if recognized. An advertisement was assumed to be recognized when the brand was identified. Range of responses was 0, 1, 2, or 3 brand names identified and children were assigned to a group according to their reply, and remained in that group until the end of the study.
Outcomes	Regular smoking was measured at baseline, 6, 12 and 18 months. Two categories were used, Non-Smoker (defined as never smoked or smokes less than once per week, or ex-smoker) and Smoker (defined as having at least one cigarette per week on a regular basis).
Notes	

Pierce 1998

Methods	Cohort study Baseline survey: 1993 Follow-up: 3 years (1996) Site: California Research question: To assess the independent influence of receptivity to tobacco industry promotional activities on movement toward addiction to smoking. Analysis: logistic regression. Percentages were weighted to represent population of California according to age, sex, race/ethnicity and education. Jacknife procedure used to estimate variances. Odds ratios were adjusted for age, sex, race/ethnicity and school performance
Participants	Baseline sample obtained by random digit dialling as part of the California Tobacco Surveys 5531 at baseline, 3376 re-interviewed, response rate 61.5%. 1752 were non susceptible never-smokers at baseline. 965 were experimenters (Choi 2002) age 12 to17 Survey method: computer-assisted telephone interviewing
Interventions	Receptivity to advertising and promotion assessed as high/ moderate/ low/ minimal

Pierce 1998 *(Continued)*

	Yes to "Have you bought or received a promotional item?" or "Would you ever use a promotional item?" considered Highly Receptive. No to these Qs but naming a most advertised tobacco brand and having a favourite ad classified as Moderate. Naming a brand but not having a favourite ad classified as Minimal. Not naming a brand or a favourite classified as Low. Exposure to family/peer smoking also assessed
Outcomes	Smoking categories: Nonsusceptible never-smokers (responded negatively to trying a cigarette anytime soon, and "definitely not" to smoke if best friend offered, and smoking a cigarette during the next year) Susceptible never-smokers (answered affirmatively to trying a cigarette anytime soon, smoke if best friend offered, and smoking a cigarette during the next year) Experimenters (ever smoked a cigarette or tried or experimented with cigarette smoking, even a few puffs, but <100 in lifetime) Established smokers (at least 100 cigarettes in lifetime)
Notes	

Pierce 2010

Methods	Cohort study Baseline survey: September 2003- October 2004 Follow-up: 8-month intervals (April 2004-October 2005; May 2005-July 2006; April 2006-April 2007; July 2007-September 2008) Site: USA Research Question: Do cigarette advertising campaigns conducted after the MSA continue to influence smoking among adolescents? Analysis: Logistic Regression assessed which baseline variables predicted smoking initiation at final follow-up. Controlled for randomised group assignment as well as gender, age, race, geographic region, school performance, single-parent home, parental education, peer smoking, family smoking and susceptibility to smoking. Estimates were weighted to be representative of the US population and to minimize non-response bias.
Participants	National sample of 1036 adolescents, 10-13 years, were surveyed at baseline (71.8% were retained through survey 5). 937 were categorized as baseline never smokers (73% or 681 completed all 5 surveys). Average age was 15.7 years at final follow-up Survey method: 5 telephone surveys
Interventions	Receptivity to tobacco advertising was measured by naming the cigarette brand of your favourite cigarette advertisement. Respondents who said no were also asked: "Of all the cigarette advertisements you have seen, which do you think attracts your attention the most?" 5th interview took place 4-months after RJ Reynolds Camel No. 9 advertising campaign
Outcomes	Having smoked was a classified as a positive response to "have you ever smoked a cigarette?" or "have you ever tried or experimented with cigarette smoking, even a few puffs?"

Pierce 2010 *(Continued)*

	Never Smokers answered no to the above questions. Smoking initiation by baseline never smokers was assessed at survey 5
Notes	

Pucci 1999

Methods	Cohort study Baseline survey: 1993 Follow-up: 4 years (1997-98) Site: Massachusetts, USA Research question: Is there an association between brand-specific magazine advertising and subsequent brand of initiation or regular use? Analysis: Pearson correlation coefficients used to assess strength of relationship between brand advertising and brand-specific smoking behaviour. No correction for demographic or other variables
Participants	1069 youths from a community probability sample at baseline. 627 (response rate, 59%) re-interviewed at follow-up. Survey method: telephone interview
Interventions	Exposure to advertising measured by asking for names of up to 3 magazines or newspapers read in last 30 days. Data on pages of advertising by brand in each magazine obtained. Calculated individual exposure to brand-specific advertising and added exposures across all respondents to 'total gross impressions'. Share of gross impressions calculated for each brand. Also asked smokers: 'What brand did you smoke most often when you first started smoking regularly?' 'What brand do you usually smoke?' 'Which brand ads do you think attract your attention the most?'
Outcomes	Smokers at baseline defined as ever trying a cigarette, even a few puffs. At follow-up smokers defined as at least one cigarette in past 30 days
Notes	

Sargent 2000

Methods	Cohort study Baseline survey: Sept 1996 Follow-up: 12 and 18 months (1997 and 1998) Site: Vermont, USA Research question: Primary study evaluated a social influences tobacco prevention programme. This paper examines the association between receptivity to cigarette promotions and smoking uptake. Analysis: multivariate proportional odds, controlling for baseline smoking index, peer and family smoking, school grade, gender, intervention status, school performance and parental education
Participants	727 students (grade 4-11) from 3 schools 537 (74%) completed both follow-up surveys. 65.4% were never-smokers at baseline 480 never or experimental smokers at baseline used in analysis. Survey method: Survey read aloud to students in grades 4-5, self-administered for students in grades 6-11.
Interventions	Receptivity to cigarette promotions assessed as Yes/No Yes if they owned or would be willing to use a cigarette promotional item.

Sargent 2000 *(Continued)*

	Test-retest reliability of questions tested in separate sample. K was > = 0.70 for all questions, for smoking index it was 0.96
Outcomes	Smoking index with 6 categories: Never-smoker/ non-susceptible (Never puffed on a cigarette and 'Definitely not' response to 'Do you think you will smoke a cigarette in next 6 months?' and 'Would you smoke a cigarette if best friend offered you one?' Never-smoker/ susceptible (Never puffed on a cigarette and answered affirmatively to smoke if best friend offered, and smoking a cigarette during the next t6 months) Puffer (not more than 1 cigarette) Experimenter/Not current (2-100 in lifetime but none in past 30 days) Experimenter/Current (2-100 in lifetime and smoked in past 30 days) Regular (> 100 in lifetime) ('bogus pipeline' used to increase self-report validity)
Notes	

Sargent 2009a

Methods	Cohort study Baseline survey: 2005 Follow-up: 1 year later (2006) Site: Schleswig-Holstein, Germany Research Questions: To determine differential effects of smoking in films and tobacco advertising on adolescent never and ever smoking Analysis: Multivariate odds model was used to examine the association of predictor variables with higher levels of life time smoking. Regression analysis was used to examine interaction effects between marketing and media influences on ever or never smokers at baseline and smoking at follow up. Controlled for school, age, gender, family smoking, peer smoking, school performance, sensation seeking and parenting style.
Participants	5626 adolescents, aged 11-15 years, were surveyed at baseline 4384 (78%) adolescents had complete data at 1 year follow-up: 1668 were ever smokers and 2716 were never smokers at baseline. Survey Method: in school, classroom-based, self-completed survey at baseline and follow-up
Interventions	Receptivity to tobacco advertising index, 0-1, was measured as being able to name the brand for your favourite tobacco advertisement.
Outcomes	Baseline smoking was assessed as life-time smoking How many cigarettes have you smoked in your life? Follow-up smoking was a combined variable of life-time and current smoking (0-4) How many cigarettes have you smoked in your life? How often do you smoke at present? 0 represents a never smoker
Notes	

Sargent 2009b

Methods	Cohort Study Baseline survey: 1999 Follow-up: 1-2 years later Site: New Hampshire and Vermont, USA Research Question: To examine the concurrent effects of movie smoking and tobacco marketing receptivity on adolescent smoking onset and progression. Analysis: Generalised linear models (link log) to assess smoking onset as a function of receptivity to tobacco marketing, movie exposure and baseline covariates. Covariates included school, age, sex, parents education, family smoking, peer smoking, school performance, sensation seeking, rebelliousness, self-esteem, maternal demandingness, maternal responsiveness and parental disapproval of smoking.
Participants	3547 adolescents, aged 10-14 years at baseline, completed the baseline survey, were never smokers and provided their phone number for follow-up. Of this, 2603 completed the follow-up survey. Survey method: school-based survey at baseline, telephone survey at follow-up
Interventions	Tobacco marketing receptivity was measured by an index, 0-2. High receptivity was a positive response to either do you own something that has the name of a cigarette brand on it, like a t-shirt, a backpack or a hat? or would you use or wear something that has the name of a cigarette brand on it, like a t-shirt, a backpack or a hat? Intermediate receptivity was naming a brand of your favourite cigarette advertisement.
Outcomes	Smoking status was assessed at baseline and follow up using the following question: How many cigarettes have you smoked in your life? Smoking onset was a response other than none.
Notes	

Weiss 2006

Methods	Cohort Study Baseline: Unknown (prior to 2005) Follow-up: 12 and 24 months Site: Los Angeles metropolitan area, USA Research Question: (1) to what extent does exposure to tobacco media affect susceptibility to smoking over time? (2) Does anti-tobacco media exposure interact with pro-tobacco media exposure in relationship to smoking susceptibility in adolescents? (3) Does ethnicity or acculturation affect the relationship between tobacco-related media exposure and intention to smoke? Analysis: Logistic regression models using hierarchical generalized linear models (to cluster students within classrooms, within schools) with gender, ethnicity, acculturation status, pro-tobacco and anti-tobacco media exposure, and experimental conditions as covariates to predict smoking susceptibility by later grades. Interaction and moderation effects of pro- and anti-tobacco media exposure on ethnicity, acculturation and immigration status were tested using Chi-square analysis.

Weiss 2006 *(Continued)*

Participants	3,190 6th grade students at baseline; 2,822 7th grade students at year 1; and 2,561 8th grade students at year 3. Total of 2,046 student with complete data at each follow-up and were non-susceptible non-smokers at baseline. Participants were from 24 schools with grades 6-8, located in Southern California with student population comprised of at least 25% Hispanic or at least 25% Asian American. Survey Method: self-reported, pencil-and-paper surveys administered in classrooms.
Interventions	Pro-tobacco media exposure was measured at baseline with two items: " when you watch TV, how often do you see people smoking" and "When you go to a small market, convenience store (like 7/11) or gas station mini-mart (like AM/PM), how often do you see advertisements for cigarettes?" Response options were rated on a 6-point scale (1= Alot to 4= Never, plus 5= I never watch TV/go to a small market, store or mini-mart, and 6= I don't know) Pro-tobacco media exposure was then re-coded into four categories: 0 = non-exposure to both TV smoking and market advertising; 1= exposure to either TV smoking or market advertising; 2= exposure to both TV smoking and market advertising; and 3= other (for those who answered options 5, 6 or missing). Anti-tobacco media exposure was assessed at baseline with the question: In the last month, how many TV commercials have you seen about NOT smoking? Responses were rated on a 4-point scale (1=none to 4= a lot). The scores for anti-tobacco exposures were then re-coded into exposure versus non-exposure to TV commercials. Acculturation was measured using the eight-item Acculturation, Habits, and Interests Multicultural Scale for Adolescents (AHIMSA) to assess one of four acculturation statuses. The questions such as "I am most comfortable being with people from..." and "The holidays I celebrate are from..." had four response options: a) The United States (assimilation orientations); b) The country my family is from (separation orientations); c) both (integration orientation); and d) Neither (marginalization orientation). Each student was assigned to one of the four orientation categories based on his/her most commonly selected response.
Outcomes	Baseline smoking status was classified by two categories, Non-susceptible non-smokers and all others (including susceptible non-smokers and smokers). Smoking susceptibility was captured using the question "At any time in the next year (12months), do you think you will smoke a cigarette?" Students responding "No, definitely not" out of a four-point scale were coded as non-susceptible non-smokers, all other responses (Maybe no, Maybe yes, and Yes definitely) were coded as susceptible non-smokers)
Notes	

While 1996

Methods	Cohort study Baseline survey: June 1993 (phase 3 of ongoing cohort study) Follow-up: One year (1994, phase IV) Site: England Research question: Is there a relationship between uptake of smoking and awareness of most and least advertised brands? Analysis: Odds ratios and CIs for likelihood of uptake using least advertised brands as the base, no adjustment was made for any potential confounders
Participants	814 boys & 676 girls (age 11-12) from 31 schools present at baseline and follow-up. 40 questionnaires (2.7%) omitted as incomplete. Main analysis on 136 boys and 134 girls who became smokers during period Survey method: Self-administered in the classroom, returned in sealed envelopes.
Interventions	Awareness of advertising measured. Cigarette brand awareness measured using same questions as Charlton 1989 Smokers were asked which brand they smoked and why.

While 1996 *(Continued)*

Outcomes	Smoking defined as ever trying a cigarette
Notes	Benson & Hedges and Silk Cut were most advertised brands during the period. Embassy heavily advertised in period before first survey.

Interventions column gives details of the measurement of exposure/ attitudes to advertising

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Aitken 1985	Not a longitudinal study. Qualitative study of children's perceptions of advertisements.
Aitken 1987	Not a longitudinal study. Focuses on recognition of advertisements and brand preferences.
Aitken 1991	Future intention to smoke measured at follow-up. Data not given separately for current and non-smokers.
Aloise-Young 2006	Not a longitudinal study. No primary outcome data on youth smoking behaviour.
Altman 1996	Not a longitudinal study.
Arnett 1998	Not a longitudinal study. Investigated correlation between preferred and most advertised brands.
Arora 2008	Not a longitudinal study.
Audrain McGovern 2003	Not a longitudinal study. Corss-sectional design aimed to identify adolescents' most receptive to tobacco advertising based on differences in novelty-seeking personality and other variables.
Audrain-McGovern 2004	Longitudinal study using same data source as Audrain-McGovern 2006. Focus was on characterizing adolescent smoking trajectories based on a variety of covariates including tobacco advertising receptivity.
Barbeau 1998	Not a longitudinal study. Assessed the appeal of advertisement for adolescents.
Beguinot 2010	Not a longitudinal study. Examined the relationship between exposure to sports sponsorship of tobacco products and recall of cigarette brands. Sample was aged 12 to 24.
Beltramini 2001	Longitudinal study. Measures changes in students' understanding of the role of advertising when exposed to an educational curriculum.
Borzekowski 1999	Not a longitudinal study. Correlates perceived influence of advertisements and smoking susceptibility.
Botvin 1991	Not a longitudinal study.
Botvin 1993	Not a longitudinal study.
Braverman 2004	Not a prospective cohort study. Used two sperate samples from two different years, but from the same city.
Brown 2009	Time series study, before, during, and after the UK's ban on tobacco advertising and promotion.
Burton 2010	Not a longitudinal study. Outcome was intention to smoke. No measure of smoking behaviour.

Study	Reason for exclusion
Butt 2009	Not a longitudinal study.
Carson 2005	Not a longitudinal study.
Carter 2007	Experimental study on the influence of smoking imagery in magazines. Outcome was smoking intention.
Chapman 1982	Not a longitudinal study.
Charlton 1986	Not a longitudinal study.
Chen 2002	Not a longitudinal study.
Chetwynd 1988	Effect of advertising cannot be separated for young people.
Choi 2002	Longitudinal study using same data sources as Pierce 1998, analyses progress of smoking uptake by subset who were already experimenting at baseline. Results given briefly with Pierce 1998.
Delener 1995	Review
DiFranza 1991	Not a longitudinal study.
DiFranza 1994	Not a longitudinal study.
Dirocco 2007	Not a longitudinal study. No measure of smoking behaviour. Outcome was intention to smoke after viewing cigarette advertisements.
Emri 1998	Not a longitudinal study.
Evans 1995	Not a longitudinal study. Assessed susceptibility to smoking and receptivity to advertising.
Feighery 1998	Not a longitudinal study.
Feighery 2006	Not a longitudinal study.
Freeman 2009	Not a longitudinal study. Examined relationship between understanding of cigarette advertisements and susceptibility to smoking. No measure of smoking behaviour.
Galduroz 2007	Time series study, before and after a ban on cigarette advertising in Brazil.
Gilpin 1997	Not a longitudinal cohort study. Correlated cross-sectional data in initiation rates with cigarette prices and marketing activity 1979-89.
Gilpin 2004	Time series study, before and after the master settlement agreement in the USA.
Gittelsohn 1999	Not a longitudinal study.
Goldberg 2003	Not a longitudinal study.
Goldstein 1987	Not a longitudinal study.
Grandpre 2003	Not a longitudinal study. Primary outcome was smoking intention.
Green 2002	Opinion piece, not an original research study.

Study	Reason for exclusion
Hanewinkel 2010	Not a longitudinal study.
Hastings 1994	Not a longitudinal study.
Hawkins 2000	Not a longitudinal study.
Henk 1995	Not a longitudinal study.
Henriksen 2008	Not a longitudinal study.
Ho 1994	Not a longitudinal study.
Jason 2004	No primary outcome data on youth smoking behaviour.
Kaufman 2002	Not a longitudinal study.
Kaufman 2004	Not a longitudinal study. Used 3 national cross-sectional surveys to understand changes in adolescent cigarette brand choices.
Kelly 2002	Not a longitudinal study. No primary outcome data on youth smoking behaviour.
Klitzner 1991	Not a longitudinal study.
Krugman 2005	Not a longitudinal study. No primary outcome data on youth smoking behaviour.
Lam 1998	Not a longitudinal study.
Lancaster 2003	No primary outcome data on youth smoking behaviour.
Lewit 1981	Not a longitudinal study. Used survey data to correlate teenage smoking status and hours of television watched.
Lewit 1997	Not a longitudinal cohort study. Cross-sectional surveys correlating smoking status with tobacco-related variables.
Lovato 2007	Not a longitudinal study.
Manfredi 2002	Descriptive article.
Mashita 2011	Not a longitudinal study.
Maziak 2003	Not a prospective cohort study. Used two separate samples from two different years, but from the same city.
Meier 1991	Not a longitudinal study.
Minh 2010	Not a longitudinal study.
Moodie 2008	Time series study, before and after the UK's ban on tobacco advertising and promotion.
Peters 2006	Not a longitudinal study.
Pierce 1991	Not a longitudinal cohort study. Correlates advertising of brands to smoking behaviour from two cross-sectional surveys.

Study	Reason for exclusion
Pierce 1994	Not a longitudinal cohort study. Correlated trends in initiation rates and targeted advertising, based on cross-sectional surveys.
Pierce 1995	Not a longitudinal cohort study. Correlated trends in initiation rates and targeted advertising, based on cross-sectional surveys.
Pierce 1996	Longitudinal study (Teenage Attitudes and Practices Survey). No assessment of tobacco advertising exposure or attitudes.
Pierce 1999	Estimates the number of experimenters attributable to promotion of specific brands and the consequent future mortality.
Pierce 2002	Associations between tobacco advertising and youth smoking initiation is reported by parenting style only. Data used in this analysis is also used in Gilpin 2007, included in this review.
Pierce 2005	Main outcome measure was curiosity about smoking, not smoking status.
Pollay 1996	Econometric model using survey data correlating brand share for adults and youth with marketing spend.
Redmond 1999	Not a longitudinal cohort study. Cigarette marketing expenditure correlated to smoking rates from national survey 1978-1995
Rimpela 1993	Not a longitudinal study. Review.
Ritchie 1988	Not a longitudinal study.
Santana 2003	Not a longitudinal study.
Shadel 2004	Not a longitudinal study. Investigated the role of self-conflict on response to cigarette advertising. Did not measure smoking behavior.
Shadel 2008	Not a longitudinal study. Examined intention to smoke after exposure to cigarette advertisements. No measure of smoking behaviour.
Shadel 2009	Examined level of self-conflict and intention to smoke after exposure to cigarette advertisements. No measure of smoking behaviour.
Slater 2007	Not a longitudinal study. Time series study using multiple, nationally representative, cross-sectional studies that were part of the Monitoring the Future (MTF) Survey. Smoking uptake was estimated from measures of current smoking status and future smoking intentions.
Smith 1999	Not a longitudinal study.
Straub 2003	Not a longitudinal study.
Tercyak 2002	Does not report longitudinal data yet.
Turco 1997	Not a longitudinal study.
Unger 1995	Not a longitudinal study.
Unger 1999	Not a longitudinal study.
Villanti 2011	Not a longitudinal study.

Study	Reason for exclusion
Voorhees 2011	Not a longitudinal study.
Wakefield 2002	Not a longitudinal study. Outcome measure was usual brand choices.
Wen 2005	Econometric study.
Wills 2010	Not a longitudinal study. Examined the effect of self-control as a moderator for adolescent alcohol and tobacco use.
Zulu 2009	Not a longitudinal study.

DATA AND ANALYSES

Comparison 1. Results

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Association between exposure and smoking onset			Other data	No numeric data

Analysis 1.1. Comparison 1 Results, Outcome 1 Association between exposure and smoking onset.

	Association between exposure and smoking onset	
Study	Onset rates	Association with exposure
Alexander 1983	735 (14.5%) of baseline non-smokers reported smoking at 1 year follow-up.	Approving of cigarette advertising was related to adoption of smoking. Children who approved of advertising were twice as likely to become smokers as those who disapproved (adoption rate of 27.0 per 100 versus 12.1 per 100 respectively). The adoption rate of children who were ambivalent about advertising was 19.3 per 100 (X2 = 81.8 P<0.001). Using logistic regression to control for other factors of importance, approval of advertising was the 4th most important factor after controlling for age and having friends and siblings who smoked.
Armstrong 1990	1028 (499 boys, 529 girls) initiated smoking by 17 months and 752 (366 boys, 386 girls) between 17- and 30-month follow-up.	A perceived influence of advertising was associated with a higher likelihood of becoming a smoker at both follow-ups with a significant effect in the 2nd year for both girls and boys. At the 17-month follow-up, among girls the adjusted difference in smoking prevalence was 8.4% (CI 95% -1.2, 18.1) between those who did and did not perceive advertisements as having some influence; among boys it was 5.3% (CI 95% -5.2, 15.8). At 30-month follow up, among girls the difference in prevalence rates was 15% (CI 95% 2.1, 27.9%) and among boys it was 15.3% (CI 95% 4.0, 26.6).
Audrain-McGovern 2006	316 (30%) of students became smokers (126 puffers, 137 experimenters, 53 regular) at 3 years follow-up.	Baseline tobacco advertising receptivity had a significant positive effect on smoking trend after 3 years (OR 1.11, 95% CI 1.02-1.19). Therefore, each increase in the level of tobacco advertising receptivity at baseline, the odds of progressing to a higher level of smoking increased by 11%. The Authors note that this was a non-linear fixed relationship (log odds would need to be multiplied by factor loadings of 0, 1, 1.86 and 2.46). Only the change from year 1 to 2 was linear.
Biener 2000	110 (21%) became established smokers during 4-year follow-up.	Among respondents with baseline high receptivity 46% progressed from never smoking or early experi-

Association between exposure and smoking onset		
Study	**Onset rates**	**Association with exposure**
		mentation to established smoking. Progression rates for moderate receptivity were 18% and low receptivity 14% (X2 = 28.9, P < 0.001). Adolescents highly receptive to marketing were more than twice as likely to become established smoker as those with low receptivity (OR 2.70, 95% CI 1.24 to 5.85).The same trend held for the subgroup of never-smokers; 29% of those who were highly receptive at baseline had progressed to established smoking at follow-up. The rates of uptake among moderate and low receptivity were 12% and 11% respectively (X2=8.38, P < 0.02).
Charlton 1989	220 (15.8%) never smokers had tried smoking by 4 month follow-up.	When the variables for both sexes were analysed together by step forward logistic modelling, having a favourite cigarette advertisement was not predictive of smoking uptake, but naming a brand of cigarettes was (P < 0.025). When analysing boys and girls separately and treating variables singly neither factor was significant for boys. For girls naming a brand was associated with trying smoking (P = 0.02).
Diaz 1998	132 (14.6%) never smokers had experimented, or become weekly or daily smokers after 1 year follow-up.	For baseline nonsmokers, relative risk of becoming smoker if agreed with advertising at baseline: 2.1 (95% CI 1.5 to 3.0) becoming regular smoker 1.3 (95% CI 0.5 to 3.0). Odds ratio (from logistic regression) of becoming a smoker 1.6 (95% CI 0.9 to 2.7).
Gilpin 2007	In the 1993-1999 cohort: 366 (21.1%) of adolescent never smokers or experimenters were established smokers at 6 years follow-up (young adulthood). In the 1999-2002 cohort: 309 (15.6%) of adolescent never smokers or experimenters were established smokers at 6 years follow-up (young adulthood).	The percentage of current established smokers increased with higher levels of receptivity in two separate cohorts with a 6-year follow up. Naming the brand of favourite cigarette advertisement (moderate receptivity) at 6-year follow up, versus minimal receptivity at baseline, increased the odds of becoming an established smoker for both a 1993-1999 cohort (OR 1.46, 95% CI 1.10 to 1.94), as well as a 1996-2002 cohort (OR 1.46, 95% CI 1.02 to 2.07). Adolescents who had or were willing to use tobacco promotional items (high receptivity) were also more likely to become an established smoker at follow up (1993-1999 cohort, OR 1.84, 95% CI 1.15 to 2.94; and 1996-2002 cohort, OR 1.84, 95% CI 1.28-2.63).
Gritz 2003	140 (21.2%) students, of which 20% were boys and 22% were girls, who were never smokers at baseline became ever smokers at one year follow-up.	For all ethnicities, baseline never smokers had increased odds of being susceptible to smoking (OR 1.31, 95% CI 1.14 to 1.51) and ever smoking (OR 1.15, 95% CI 1.03 to 1.28) after 1 year. When results were examined by ethnicity, exposure to tobacco marketing predicted susceptibility (OR 1.38, 95% CI 1.09-1.75) and ever smoking (OR 1.35, 95% CI 1.09 to 1.33) in white students only. This association was not present for African American or Hispanic students.
Hanewinkel 2011	277 (13%) baseline never smokers initiated smoking after nine months (137 smoked just a few puffs, 112 smoked between 1-19 cigarettes, 12 students smoked between 20-100 cigarettes, and 16 smoked >100 cigarettes).	The incidence of trying smoking was associated with an increased exposure to cigarette advertisements (10% in the low exposure group, 12% in the medium exposure group, and 19% in the high exposure group). Exposure to advertisements for other consumer goods did not predict smoking initiation. The relative risk of smoking initiation was 1.46 (95% CI 1.08-1.97, P<0.05) times higher in those with high exposure to cigarette advertisements as compared to those with low exposure to cigarette advertisements. Exposure to advertisements for other consumer goods was not associated with an increased risk of smoking initiation.
Henriksen 2010	213 (18%) of baseline never smokers, had initiated smoking after 12 months, and 242 (27%) had initiated smoking after 30 months.	After 12 months, initiation of smoking was highest for baseline never smokers who visited the most convenience stores at least twice per week as compared to those who visited these stores less than twice per month (29% versus 9%, respectively). Adolescents whose shopping frequency was moderate (0.5-1.9 visits per week) or high (>2 visits per week) had increased odds of smoking at 12 months (Moderate: OR 1.64, 95% CI 1.06 to 2.55, High: OR 2.58, 95% CI 1.68 to 3.97) and 30 months (Moderate: OR 1.19, 95% CI 1.00 to1.41, High: OR 1.42, 95% CI 1.19 to 1.69). High (>260 per week), but not moderate (60-259 per week) exposure to cigarette brand impressions predicted smoking initiation after 12 months (Moderate: OR 1.22, 95% CI 0.79 to 1.89, High: OR 2.36, 95% CI 1.55 to 3.61) and 30

Association between exposure and smoking onset		
Study	**Onset rates**	**Association with exposure**
		months (Moderate: OR 1.20, 95% CI 0.81 to1.79, High: OR 1.58, 95% CI 1.05 to 2.37). Perceived exposure to advertising predicted a small increase in the odds of initiating smoking at the 30 month follow up (OR 1.11, 95% CI 1.02 to 1.22) but this relationship was no longer significant when adjusted for cigarette brand impressions per week.
Lopez 2004	556 (17.6%) of baseline non-smokers were regular smokers at 6 months, 569 (18.9%) at 12 months and 575 (23.8%) at 18 months follow-up.	The greater the number of cigarette advertisements adolescents correctly identified at baseline (slides of advertisements with brand names covered) the higher the percentage of smokers (X^2 not reported; P<0.0001). There was no significant difference in smoking between those who recognized none or one of the brands. Over time, the probability of being a smoker increased with the number of cigarette advertisements identified at baseline; at 6 month follow-up (OR 1.26, 95% CI 1.09 to 1.46), 12 months (OR 1.18, 95% CI 1.03 to 1.35) and 18 months (OR 1.15, 95% CI 1.03 to 1.35).
Pierce 1998	49.7% of non susceptible non-smokers progressed toward smoking; 16.6% by becoming susceptible, 29.6% by experimenting and 3.6% by reaching >100 cigarettes.	Having a favourite advertisement (moderate receptivity) at baseline predicted which adolescents would progress in smoking acquisition at follow-up compared to minimally receptive group (odds ratio [OR] 1.82, 95% confidence interval [CI] 1.04 to 3.20), possession or willingness to use a promotion item (high receptivity) predicted even higher likelihood of future progression (OR 2.89, 95% CI 1.47 to 5.68) controlling for school performance and demographic characteristics. Half of adolescents (51.7%, 95% CI 46.3 to 57.1) who had a favourite advertisement at baseline and 62.1% (95% CI 52.6 to 71.6) who possessed or were willing to use a promotion item progressed toward smoking at follow-up. Lower levels of receptivity to promotions did not predict progression toward addiction to smoking. In a secondary report on participants who were experimenters at baseline, high receptivity was a significant predictor of progression to established smoking (OR 1.71, 95% CI 1.11 to 2.61, adjusted for age, gender, race/ethnicity), whilst moderate receptivity was not statistically significant (Choi 2002).
Pierce 2010	27% of baseline never smokers had smoked at 32 month follow-up.	Having a favourite advertisement at baseline increased the likelihood of smoking five years later (OR 1.5, 95% CI 1.0 to 2.3; P=0.39). It was also found that the proportion of girls who reported a favourite advertisement went up (increased of 10%) following a fashion-themed Camel No.9 advertising campaign (targeting younger women) which was launched between the 4th and 5th study follow-up, Previous to the campaign, the number of girls reporting a favourite add had been stable across time. No increase was observed for boys during the same time period.
Pucci 1999	109 non-smokers at baseline initiated smoking at follow-up.	Brand of initiated smoking between baseline and follow-up highly correlated with exposure to brand-specific advertising in magazines (r = 0.93, P = 0.0001). Top 3 brands of initiation (Marlboro, Newport, and Camel) among top 4 brands in terms of exposure to magazine advertising. These brands accounted for 89% of the brands of initiation and 61.6% of the advertising exposure among the sample. Brands smoked by current smokers correlated with the adolescents' exposure to brand-specific advertising in magazines (r = 0.86, P = 0.0004). Correlation between the brand whose advertisements were reported to attract the most attention among adolescents in follow-up sample and exposure to brand-specific advertising in magazines at baseline (r = 0.87, P = 0.0002).
Sargent 2000	30% categorized as receptive to promotions at baseline. 185 (38.5%) had moved to a higher category on smoking index by third survey.	Receptivity predicted future progression in smoking. Adjusted proportional odds ratio for the odds of progression on smoking index if receptive to promotions at baseline 1.9, 95% CI 1.3 to 2.9, P = 0.002. Acquisition of receptivity to promotions associated with smoking uptake with those becoming receptive in surveys 2 and 3 (OR = 3.6, 95% CI 1.8 to 7.0, P < 0.0001 and OR = 2.9, 95% CI 1.5 to 5.5, P < 0.001 respectively). Sen-

Association between exposure and smoking onset		
Study	**Onset rates**	**Association with exposure**
		sitivity analysis for effect of loss to follow-up did not change results.
Sargent 2009a	At follow-up 46.7% of students reported some level of smoking. Outcome rate not reported.	Identifying a favourite advertisement predicted smoking after 1 year in baseline never smokers (OR 1.53, 95% CI 1.07 to 2.20), and higher levels of smoking after 1 year in baseline ever smokers (OR 2.17, 95% CI 1.78 to 2.63).
Sargent 2009b	255 (9.8%) of baseline never smokers had tried smoking at 1 to 2 years follow-up.	Adolescents with moderate receptivity (naming the brand of your favourite cigarette advertisement) were more likely to be experimental smokers (12.5%) than never smokers (1.6%) at baseline; however, no significant association between receptivity to tobacco marketing and onset of smoking after 2 years was found (moderate receptivity: OR 0.64, 95% CI 0.22 to 1.87; high receptivity: OR 1.12, 95% CI 0.86 to 1.48).
Weiss 2006	418 (47.9%) and 468 (41.5%) girls who were baseline non-susceptible non-smokers were susceptible to smoking at three years follow-up.	Exposure to tobacco marketing on television or at a retail store was associated with being susceptible to smoking after 1 or 2 years follow-up (OR 1.89, 95% CI 1.23-2.91). These odds almost doubled with exposure to both television and retail store tobacco marketing (OR 3.33, 95% CI 2.16 to 5.16). Ethnicity status did not moderate the effects of pro-tobacco media exposure on susceptibility to smoking.
While 1996	136 (23%) boys and 134 (26%) girls became smokers during study period.	Boys and girls who named brands other than Benson and Hedges and Silk Cut in 1993 were at no greater risk for taking up smoking at follow-up than those who named no brands. Girls who named Benson and Hedges were at greater risk for taking up smoking than those who named other brands (OR=2.50, 95% CI 1.18 to 5.3) as were those who named both Benson and Hedges and Silk Cut (OR=2.15, 95% CI, 1.04 to 4.42). No such significant difference was found for boys.

WHAT'S NEW

Date	Event	Description
23 August 2011	New citation required but conclusions have not changed	One new author (AW) and two authors of first version removed (see Acknowledgements).
23 August 2011	New search has been performed	Review updated with addition of 10 new studies. Conclusions remain the same

HISTORY

Protocol first published: Issue 1, 2002
Review first published: Issue 4, 2003

Date	Event	Description
19 June 2008	Amended	Converted to new review format.

CONTRIBUTIONS OF AUTHORS

The guarantor of the review is Chris Lovato. Chris Lovato and Allison Watts jointly shared data extraction and drafting of the review. Chris Lovato and Allison Watts coordinated and revised the review. Lindsay Stead contributed to the conceptualizing and coordinating of the review as well as making substantive revisions.

DECLARATIONS OF INTEREST

None known

SOURCES OF SUPPORT

Internal sources

- Canadian Cancer Society-University of British Columbia Centre for Cancer Prevention, Canada.
- School of Population & Public Health, University of British Columbia, Canada.

External sources

- Canadian Cancer Society Research Institute (formerly, National Cancer Institute of Canada), Canada.
- Canadian Cancer Society, Canada.
- PROPEL Centre for Population Health Impact (formerly, Centre for Behavioural Research and Program Evaluation), Canada.

NOTES

The protocol for this review was published under the title: 'Impact of advertising on adolescent smoking behaviours'.

INDEX TERMS

Medical Subject Headings (MeSH)

*Advertising; Adolescent Behavior [*psychology]; Longitudinal Studies; Smoking [*psychology]; Tobacco Use Disorder [psychology]

MeSH check words

Adolescent; Humans