Published in final edited form as:

Tob Control. 2013 January ; 22(1): 38–45. doi:10.1136/tobaccocontrol-2011-050208.

Effects of Tobacco-Related Media Campaigns on Young Adult Smoking: Longitudinal Data from the United States

Yvonne M. Terry-McElrath, MSA^{a,*}, Sherry Emery, PhD^b, Melanie A. Wakefield, PhD^c, Patrick M. O'Malley, PhD^a, Glen Szczypka, BS^b, and Lloyd D. Johnston, PhD^a

^aInstitute for Social Research, University of Michigan, Ann Arbor, MI, U.S.A

^bInstitute for Health Research and Policy, University of Illinois at Chicago, Chicago, IL, U.S.A

^cCenter for Behavioural Research in Cancer, Cancer Council Victoria, Carlton, Victoria, Australia

Abstract

Objective—Young adults in the U.S. have one of the highest smoking prevalence rates of any age group, and young adulthood is a critical time period of targeting by the tobacco industry. We examined relationships between potential exposure to tobacco-related media campaigns from a variety of sponsors and 2-year smoking change measures among a longitudinal sample of U.S. adults aged 20–30 from 2001–2008.

Methods—Self-report data were collected from a longitudinal sample of 13,076 U.S. young adults from age 20–30. These data were merged with tobacco-related advertising exposure data from Nielsen Media Research. Two-year measures of change in smoking were regressed on advertising exposures.

Results—Two-year smoking uptake was unrelated to advertising exposure. The odds of quitting among all smokers and reduction among daily smokers in the two years between the prior and current survey were positively related to anti-tobacco advertising, especially potential exposure levels of 104–155 ads over the past 24 months. Tobacco company advertising (including corporate image and anti-smoking) and pharmaceutical industry advertising were unrelated to quitting or reduction.

Conclusions—Continued support for sustained, public health-based, well-funded anti-tobacco media campaigns may help reduce tobacco use among young adults.

Keywords

health promotion; mass media; smoking cessation; tobacco; young adult

INTRODUCTION

Young adults have the highest rates of smoking among all adults in the U.S.[1] While the majority of smokers initiate use prior to age 18, studies have indicated that a growing number of young adult smokers have their first cigarette at age 18 or older.[2–3] Smoking patterns among young adults show that this group is more likely to smoke only occasionally and with lower daily consumption than older smokers, suggesting that this population is likely to be in transition to either nonsmoking or heavier smoking.[2] Interest in quitting

*Correspondence may be sent to Yvonne Terry-McElrath at Institute for Social Research, PO Box 1248, Ann Arbor MI 48106-1248. Telephone: 734-647-9142. Fax: 734-936-0043. yterry@umich.edu.

COMPETING INTERESTS The authors have no competing financial interests related to the findings of this paper.

smoking is high among young adults. Studies utilizing nationally representative U.S. data found that young adults were more likely than older adults to (a) have seriously tried to quit smoking, and (b) have succeeded in quitting for six months or longer.[4] Importantly, the tobacco industry strongly targets this price- and brand-sensitive population,[1, 5] and research indicates such targeting pays off, because younger adults are more receptive than older adults to cigarette marketing.[2]

Tobacco control recommendations commonly include sustained, high-intensity media campaigns, especially combined with other interventions.[6-9] Research supports the efficacy of such campaigns for youth,[10-13] while showing clear differences in outcomes by advertising sponsor.[14] Research also has established that anti-tobacco media campaigns have been effective for adults in general and older adults.[8-9, 15-17] However, research on media campaign effects among young adults is sparse. Evidence from Massachusetts showed that among recent adult quitters, TV advertisements were the most frequently mentioned source for cessation help, and young smokers were more likely than older smokers to report such perceived benefits from TV ads.[18] In California, younger adults were also more likely than older adults to report hearing about quitline services via media sources (television, radio, and print advertising).[19] To our knowledge, no large-scale studies that examine the effectiveness of anti-tobacco media campaigns specifically among young adults have been published.

In this paper, we contribute to the research on young adult smoking behaviors and policy intervention by examining relationships between potential exposure to tobacco-related advertising and smoking behavior change among a longitudinal U.S. sample. Specifically, we examine how anti-tobacco, tobacco industry, and pharmaceutical television advertising relate to past 2-year smoking uptake, reduction, and quitting (while controlling for a variety of factors such as race/ethnicity, gender, drug use at age 18, and state-level variables of cigarette price and smoke-free air policy).

METHODS

Sample

This analysis utilizes data from the Monitoring the Future (MTF) study, sponsored by the National Institute on Drug Abuse (detailed methodology can be found elsewhere).[20] Briefly, a nationally representative sample of 2,400 U.S. high school seniors from about 130 schools is chosen each year for longitudinal follow-up. Substance users are over-sampled (in analysis, weights are used to appropriately adjust for over-sampling). Respondents are randomly divided into two groups, with one half surveyed in even years and the other in odd years. Follow-up surveys are mailed in the spring with a modest monetary incentive. Response rates for Follow-up 1 (1-2 years past high school) average 56 percent; rates for Follow-ups 2-6 average 52 percent.[20] Study ethical approval was obtained from the University of Michigan Behavioral Sciences Institutional Review Board.

Given that the MTF longitudinal follow-up sample is chosen from high school seniors, individuals who drop out of high school before their senior year are necessarily excluded (estimated to be between 13%-20% of each age cohort nationally).[20] Research has shown that smoking rates among high school dropouts are significantly higher than among students who remain in school,[21] and thus the current study likely underestimates smoking rates in the entire population. However, as shown below, there is still a considerable amount of smoking behavior among respondents.

Nielsen advertising ratings data

Nielsen Media Research provided data on mean audience exposure to all tobacco-related advertising from 1998-2008 appearing on monitored national network and cable television and for local spot, clearance, and syndication television. The current study includes ratings from the U.S. top 75 media markets (encompassing 78% of American television-viewing households).[22] Ratings were aggregated by month, year and market (a detailed methodology is available elsewhere).[23] The current study uses gross ratings points (GRPs) that provide an estimate of the percentage of households watching a television ad per media market over a specified time period.[11] If an ad receives 50 GRPs per month, that ad is estimated to have been viewed an average of 1 time in the past month by 50 percent of all media market viewers. GRPs are averages; individuals may have higher or lower exposure based on personal television viewing behavior.

Merging MTF and Nielsen data

Individual respondents to the MTF surveys were assigned media-market-level measures of average potential exposure to anti-smoking ads based on their geographic location at the time of the survey and the date of survey return. A total of 39,307 individuals surveyed as high school seniors from 1991-2006 were randomly selected for follow-up. As part of the process of preparing the MTF data for merging and to establish consistent potential exposure to media market advertising, observations were retained if respondents reported living in the same state as identified in the mailing address, and if the current follow-up state was the same as reported for the previous survey (please see Appendix Figure 1 for a consort diagram of the sample selection process (available online only)). Further, to ensure that all observations had 24 months between surveys, Follow-up 1 data from respondents surveyed in the year immediately following the base-year survey were removed. The resulting sample included data from 23,294 respondents.

The sample selection process described above is biased towards young adults who are relatively stable geographically. Individuals who were included based on the requirement of residing in the same state as their mailing address were significantly *more likely* than excluded individuals to report lower parental education levels as a senior in high school and to be employed full-time when they responded to the survey. Included individuals were significantly *less likely* than excluded individuals to be white, to be attending college, and to have negative views of tobacco use (such as perceiving the harmful effects of cigarettes to have been exaggerated). Research has shown a significant and negative link between young adult cigarette smoking and non-White race/ethnicity,[20,24] but significant and positive relationships between young adult cigarette smoking and lower average parental education and non-college attendance.[20, 24-25] Thus, the retained sample has some characteristics that make them less likely to be smokers, while other characteristics are related to increased risk of smoking. Research among Massachusetts adults has shown that anti-tobacco advertising is more salient among smokers than non-smokers, but such advertising is perceived as more effective by those who are supportive of tobacco control goals.[26] Given that the retained sample for the current analysis exhibited more positive views of tobacco use than excluded individuals, it may be that anti-tobacco-related advertising would be perceived by this group as somewhat less effective.

MTF respondent data were merged with Nielsen advertising data using state and county Federal Information Processing Codes.[27] Research on the effects of tobacco-related media campaigns that involves the use of advertising ratings points has frequently utilized a 4-month depreciated sum of potential exposure as the main independent predictor.[11, 13, 28] However, other research has successfully used a straight 24-month sum.[29, 30] Given that our data were collected every other year, and given that the exact date when each respondent

filled out their questionnaire could not be specified with precision, we chose to follow the precedent of a straight 24-month sum. Given that we had access to Nielsen data starting in late 1998, the first MTF data collection year able to be merged with 24-month advertising sums was 2001. A total of 20,547 individuals had survey data from 2001-2008, 76% (15,527) of which resided in the top 75 media markets and were successfully merged with Nielsen data.

Measures

Smoking Behavior Change—Five types of transition in past 30-day smoking in the two years between the current and prior survey were examined: reporting no smoking at the prior survey and any smoking at the current survey (hereafter referred to as *2-year smoking uptake*); moving from no smoking to smoking one or more cigarettes per day (*2-year daily smoking uptake*); moving from any level of smoking to none (*2-year quitting among all smokers*); moving from smoking at least one cigarette per day to none (*2-year quitting among daily smokers*); and moving from smoking 1+ cigarettes/day to <1/day or none (*2-year reduction or quitting among daily smokers*).

Tobacco-Related Advertising—Based on the date each completed survey was returned, 24-month sums of advertising were created for each observation for the following three sponsor types: anti-tobacco (including state tobacco control programs and the American Legacy Foundation), pharmaceutical (including advertising for nicotine replacement therapy, bupropion, etc.), and tobacco industry (including corporate image advertising and youth smoking prevention targeting both parents and youth).¹ Each 24-month sum was then divided by 100 to estimate the number of ad exposures seen by 100% of the total television viewing audience over the preceding 24-month period.

Models also explored non-linear advertising specifications via (a) mean-centering the advertising measures and then creating accompanying quadratic terms, and (b) categorizing the advertising measures. The U.S. Centers for Disease Control and Prevention (CDC) recommends 400 target ratings points per four weeks during the introductory phase of anti-tobacco campaigns and 200 target rating points per four weeks following the introductory phase.[6,31] Extrapolating these numbers to 24-month time periods yielded 10,400 ratings points at campaign introductory levels (104 ad exposures for 100% of all viewers over 24 months), and 5,200 ratings points during non-introductory campaign phases (52 ad exposures for 100% of all viewers over 24 months). While current analysis utilized GRPs (as opposed to targeted ratings points as recommended by the CDC), we chose to categorize the advertising measures using 52 ad exposure increments based on available CDC recommendations.

Control Variables—Clear differences have been found in young adult smoking and cessation activity by a variety of socio-demographic characteristics including gender, race/ethnicity, and education level.[1] Among young adults, males have consistently been shown to be more likely than females to be current smokers.[1] Among all adults, current smoking prevalence is highest for non-Hispanic Whites, followed by non-Hispanic Blacks, followed by Hispanics.[1] Reviews of the literature indicate that compared with individuals in college, both employed and unemployed young adults not in college are at particular risk for tobacco use,[32] and young adults who have obtained a college education have a significantly lower likelihood of smoking.[32-33] Differences in quit attempts based on

¹Tobacco industry documents have shown that corporations such as Philip Morris view both types of advertising (youth smoking prevention and corporate image) to be part of coordinated public relations efforts.[7] Thus, we include both in the current analyses.

education have been mixed, with some studies finding no differences,[33] while others have found quit rates to be lower among non-college educated young adults.[32]

Based on the above literature, gender, self-reported race/ethnicity (White, Black, Hispanic, or Other), and a dichotomous substance use indicator (all measured at modal age 18) were used as time-invariant controls. Time-varying controls included follow-up survey number (ranging from one to six, used as a proxy for age), a categorical measure of academic status, state cigarette price, an index of state smoke-free air policy, year (using individual year dummy variables), and state dummy variables to control for unmeasured state characteristics.² The measure of academic status was coded such that 1 = currently not in school and do not have a college degree; 2 = currently in school (either with or without a college degree); 3 = not currently in school and have a college degree.

Analysis

Analyses were run using SURVEY commands in SAS v.9.2 (SAS Institute Inc., Cary, NC). The SURVEY commands (FREQ, MEANS, LOGISTIC) were used to model the longitudinal repeated-measures data by using Taylor linearization-based variance estimation to account for clustering by respondent, computing robust standard errors. Further, all analyses were weighted to (a) account for over-sampling of high school substance users, and (b) address the impact of attrition by post-stratifying the data such that the reweighted cigarette use distribution reproduced the original (high school senior year) distribution of use.[20] Models were first run treating advertising variables as linear, followed by use of quadratic and categorical advertising measures. In quadratic models, the linear advertising terms were mean-centered, and quadratic terms were created from the mean-centered measures.

RESULTS

After restricting the data to observations with no missing data on control variables, 22,445 weighted observations from 12,931 individuals (unweighted) remained for analysis (including data from 74 media markets and 44 states). The range of observations per respondent was one to four; 37 percent of respondents had one observation, 33 percent had two observations, 18 percent had three observations and 11 percent four observations. Each observation measured smoking status change between the current survey (time t) and the previous survey ($t - 2$ years). Figure 1 shows trends in mean 24-month advertising measures across time. Table 1 summarizes the observed 2-year smoking behavior changes observed for this sample,³ and Table 2 provides descriptive statistics for all measures. Two-year smoking uptake was not common: eight percent of observations reported no smoking at the prior survey and any smoking at the current survey; only three percent of observations reported 2-year daily uptake (moving from no smoking at the prior survey to daily smoking at the current survey). In contrast, almost one quarter of all smokers reported moving from either daily or non-daily smoking at the prior survey to no smoking at the current survey. Among daily smokers, 15 percent reported quitting between the prior and current surveys, and 24 percent reported reduction or quitting (moving to smoking less than one cigarette per day or not smoking at all).

Multivariate models predicting 2-year smoking uptake, quitting, and reduction using linear advertising predictors showed no significant results for any of the three advertising predictors. Further, 2-year smoking uptake models shown no indication of significance in

²State fixed effects were considered to be more important to include than media-market fixed effects due to the specific focus on anti-tobacco advertising, consisting of advertising from both state tobacco control programs and the American Legacy Foundation.

³Detailed information on time trends for cigarette smoking among young adults can be found in Johnston et al.[20].

multivariate quadratic models (available online only; see Appendix Table 1). However, indications of significant quadratic relationships were observed between anti-tobacco advertising and 2-year quitting among all smokers and daily smokers, as well as 2-year reduction or quitting among daily smokers, but neither pharmaceutical nor tobacco industry advertising were associated with these outcomes (see online only Appendix Table 1). Multivariate models were then run using dummies created from the categorical advertising measures. Smoking uptake remained unrelated to any type of smoking-related advertising. Further, neither pharmaceutical nor tobacco industry advertising were associated with any quitting or reduction models. However, anti-tobacco advertising was positively and significantly associated with quitting and reduction outcomes.

Table 3 shows multivariate results from models predicting 2-year quitting and reduction using both the quadratic and categorical measures of anti-tobacco advertising (for full categorical model results showing estimates for all control measures, see Appendix Table 2 (online only)). Compared with potential exposure to fewer than 52 ads over the past 24 months, potential exposure to 104-155 anti-tobacco ads was associated with significantly increased odds of 2-year quitting among all smokers. Twenty-two percent of prior smokers reported no cigarette use when past 24-month anti-tobacco advertising levels were lower than 52 compared with 28 percent when advertising levels were 104-155. The overall distribution of both the percentages of smokers reporting quitting and obtained odds ratios showed the relationship between anti-tobacco advertising and quitting among all smokers to be curvilinear.

Among daily smokers, the odds of 2-year quitting were also significantly higher with anti-tobacco advertising levels of 104-155 compared with less than 52. Further, the odds of 2-year reduction or quitting among daily smokers significantly increased once anti-tobacco advertising reached 104-155 exposures or higher. Twenty-one percent of daily smokers reported 2-year reduction or quitting with ad exposure levels of less than 52 compared with 27 percent with advertising levels of 104-155, 24 percent when advertising levels were 156-207, and 25 percent when advertising levels were 208 or above.

DISCUSSION

Among this longitudinal sample of relatively geographically stable U.S. young adults, higher potential exposure to anti-tobacco advertising was associated with higher odds of quitting among all smokers and reduction or quitting among daily smokers. Specifically, potential exposure to 104-155 anti-tobacco ads over the past 24 months appeared to relate consistently to quitting and reduction when compared with potential exposure to less than 52 ads.

Our findings should be considered within the limitations of the current study. Due to funding restrictions, we were unable to work with advertising ratings data specifically targeting young adults, instead using gross ratings points. Analyses utilizing TRPs for young adults would help clarify results for all type of advertising: anti-tobacco, pharmaceutical, and industry. As noted in the Methods section, analyses have been adjusted for attrition using cigarette-specific post-stratification procedures; however, our results are subject to a clear selection bias given that we limited the sample for these analyses to young adults who reported residing in the same state for each 24-month time period, resulting in sample differences previously discussed. Included young adults also were limited to those residing in the top 75 media market areas; while the top 75 market areas do encompass more than 75% of American television-viewing households[22], young adults in more rural areas would be excluded. Such limitations notwithstanding, eight percent of the observations reported any late smoking uptake and 24 percent of smokers reported quitting. Thus, the

observations remaining for analysis appear to have meaningful levels of change in smoking behaviors over time.

U.S. young adults have one of the highest smoking prevalence rates of any age group,[1] and research indicates that young adulthood is a critical time period of advertising and promotion targeting by the tobacco industry.[2, 5, 36] Given the clear need for cessation and prevention services among this population, it is encouraging that the current study found anti-tobacco advertising significantly increased the odds of 2-year quitting among all young adult smokers, and 2-year reduction or quitting among young adult daily smokers. While this study did not investigate long-term quitting and relapse, quitting smoking by age 30 has been found to reduce significantly the excess health risks associated with tobacco use.[6] Continued funding of anti-tobacco media campaigns at the exposure levels found in this study would likely reduce long-term health costs. Smoking uptake is relatively uncommon after age 18; in our sample, only eight percent reported any late smoking uptake, and only three percent reported late smoking daily uptake within the 2-year intervals observed. Thus, it is perhaps not surprising that advertising was not associated with these behaviors, unlike the more usual pattern of smoking uptake in adolescence which is associated with exposure to anti-smoking advertising.[11, 13]

Potential exposure to 104-155 anti-tobacco ads over the past 24 months was consistently related to 2-year quitting and reduction. While potential advertising exposure seemed to have a curvilinear relationship with the odds of 2-year quitting among all smokers, no such point of diminishing returns was observed for the odds of 2-year reduction or 2-year quitting among daily smokers. Adequate funding of tobacco control media campaigns is becoming more and more difficult given current economic realities. Research has indicated that funding reductions to state tobacco control media campaigns can have immediate effects on cognitive precursors to smoking behaviors,[37] and published reviews of health campaign efforts repeatedly call for adequately funded, sustained, integrated health communication efforts.[6, 9] While our single study cannot assume to define adequate broadcast levels for anti-tobacco media campaigns, it does indicate an important possible range of advertising frequency relative to U.S. young adult smoking cessation efforts. Whether this range of advertising frequency might be consistently found to be effective with additional U.S. populations or with international populations is unknown. However, studies have indicated that there is considerable equity across socio-demographic groups and national borders in terms of response to anti-tobacco advertising.[13-14, 31, 38]

Tobacco industry advertising was not associated with the smoking uptake or cessation-related outcomes included in these analyses. Within the U.S., tobacco company corporate image and youth smoking prevention television advertising began in the late 1990s. However, tobacco industry youth smoking prevention programs have been promoted since the early 1980s not only in the U.S. but also throughout Canada, Latin America, Europe, Australia, and Asia.[39] Research has indicated that by providing media campaigns that ostensibly aim to reduce youth smoking or improve corporate image, tobacco industries often build important ties with governments and the public, thereby legitimizing their activities.[39] In the current study, 64 percent of mean tobacco industry advertising was related to corporate image, 22 percent to parent-targeted prevention, and 14 percent to youth-targeted prevention. Previous research found that tobacco industry advertising that targeted youth showed little in the way of relationships with youth smoking-related beliefs and behaviors. However, industry advertising targeting parents was associated with decreased perceived harm of smoking and increased approval of smoking and increased current smoking among youth.[28] Given that young adults were not the target of the majority of industry advertising in the current study, and their relative independence from parental influence, the lack of findings is perhaps not surprising.

Interestingly, levels of potential exposure to pharmaceutical advertising were not associated with late uptake, quitting or reduction among our sample. These findings are similar to evidence from studies of youth.[40] However, given that pharmaceutical advertising is not meant to target youth, but rather targets adult smokers, our lack of significant effects is of interest. Pharmaceutical advertising had the highest potential exposure levels in the current study and the least variance: only one percent of observations had potential exposure levels lower than 156 ads over the past 24 months. Given that significant results for anti-tobacco advertising were most often found when comparing advertising levels of 104-155 with less than 52, it may be that pharmaceutical advertising simply did not have adequate variance within this population to show significant effects. Other possible explanations for a lack of significant findings include: (a) our analyses utilized GRPs versus TRPs measuring exposure for young adults, and (b) the possibility that young adults are less likely than older adults to make use of pharmaceutical methods of quitting, and thus advertising levels are not as salient. Support for this hypothesis is suggested by some Canadian and U.S. studies.[41, 42] Prior research examining the comparative effects of tobacco control policies and televised antismoking advertising with a large Australian adult sample found that smoking prevalence was not related to pharmaceutical advertising levels or sales of nicotine replacement therapy or other pharmaceutical products.[8]

The results of the current paper demonstrate that among this longitudinal sample of relatively geographically stable U.S. young adults, anti-tobacco media campaigns appear to be an effective method of increasing smoking cessation and/or reduction. Further, they indicate that potential exposure levels of 140-155 ads over a 24-month period may be particularly effective. The findings highlight the need for continued support for adequately funded, sustained, integrated anti-tobacco media campaigns that can combat messages encouraging tobacco use among young adults.

Acknowledgments

FUNDING The authors would like to thank Young Ku Choi for statistical methods assistance. Monitoring the Future is supported by the National Institute on Drug Abuse (DA01411 and DA016575). Additional grant support was obtained from the National Cancer Institute (CA123444) and the Robert Wood Johnson Foundation (64703). The views expressed in this article are those of the authors and do not necessarily reflect the views of the funders.

Appendix

Appendix Table 1

Two-Year Smoking Behavior Change by Tobacco-Related Advertising: Linear and Quadratic Advertising Predictors, 2001-2008

	2-Year Smoking Uptake ^a			2-Year Daily Smoking Uptake ^b		
	OR	CI	p	OR	CI	p
Anti-tobacco ads						
Linear model	1.000	0.988-1.012	0.9610	0.988	0.968-1.008	0.2399
Quadratic model						
Linear term	1.000	0.986-1.014	0.9913	0.988	0.965-1.011	0.2983
Quadratic term	1.000	0.999-1.001	0.8397	1.000	0.998-1.002	.09353
Pharmaceutical ads						
Linear model	0.993	0.946-1.042	0.7710	0.975	0.904-1.051	0.5041
Quadratic model						

	2-Year Smoking Uptake ^a			2-Year Daily Smoking Uptake ^b						
	OR	CI	p	OR	CI	p				
Tobacco industry ads	Linear term	0.999	0.948-1.053	0.9692	0.982	0.904-1.066	0.6587			
	Quadratic term	1.000	0.995-1.005	0.9926	1.000	0.992-1.008	0.9693			
	Linear model	1.023	0.983-1.065	0.2581	1.033	0.969-1.102	0.3225			
	Quadratic model									
	Linear term	1.009	0.955-1.065	0.7562	1.017	0.932-1.109	0.7093			
	Quadratic term	1.001	0.999-1.003	0.4276	1.001	0.997-1.005	0.5919			
	2-Year Quitting Among All Smokers ^c			2-Year Quitting Among Daily Smokers ^d			2-Year Reduction or Quitting Among Daily Smokers ^e			
	OR	CI	p	OR	CI	p	OR	CI	p	
Anti-tobacco ads										
Linear model	0.995	0.984-1.007	0.4396	0.999	0.983-1.015	0.8959	1.012	0.998-1.026	0.0969	
Quadratic model										
Linear term	1.004	0.989-1.018	0.6185	1.009	0.988-1.030	0.4047	1.023	1.005-1.041	0.0131	
Quadratic term	0.999	0.998-1.000	0.0420	0.999	0.998-1.000	0.1009	0.999	0.998-1.000	0.0430	
Pharmaceutical ads										
Linear model	1.031	0.982-1.082	0.2201	1.028	0.961-1.100	0.4240	1.015	0.957-1.075	0.6241	
Quadratic model										
Linear term	1.029	0.977-1.084	0.2835	1.028	0.956-1.105	0.4539	1.013	0.951-1.078	0.6900	
Quadratic term	0.997	0.992-1.002	0.2882	0.998	0.991-1.006	0.6291	0.997	0.991-1.004	0.3820	
Tobacco industry ads										
Linear model	1.003	0.967-1.042	0.8604	1.005	0.953-1.059	0.8631	1.007	0.963-1.052	0.7724	
Quadratic model										
Linear term	0.996	0.948-1.045	0.8617	0.980	0.917-1.047	0.5438	0.992	0.936-1.051	0.7773	
Quadratic term	1.000	0.998-1.002	0.9885	1.001	0.998-1.004	0.4067	1.000	0.998-1.003	0.7591	

Notes: In these analyses, advertising measures are gross ratings points (GRPs) and have been re-scaled by units of 10. Thus, estimates should be understood as inferring the change in odds of the outcome for every 10-unit increase in advertising. Controlling for self-reported race/ethnicity, gender, base-year drug use, academic status, state-level policy variables of cigarette price and smoke-free air index, level of follow-up survey, year and state fixed effects.

^a Moving from no past-30-day smoking at the prior survey to any smoking in the past 30 days at the current survey.

^b Moving from no past-30-day smoking at the prior survey to smoking 1+ cigarettes/day in the past 30 days at the current survey.

^c Moving from any smoking in past 30 days at the prior survey to none at all at the current survey.

^d Moving from daily smoking in past 30 days at the prior survey to none at all at the current survey.

^e Moving from daily smoking in past 30 days at the prior survey to <1 cigarette/day or none at all at the current survey.

Appendix Table 2

Predicted Odds of 2-Year Quitting Smoking or Reduction by Tobacco-Related Advertising, 2001-2008

	2-Year Quitting Among All Smokers ^a			2-Year Quitting Among Daily Smokers ^b			Reduction or Quitting Among Daily Smokers ^c		
	OR	CI	p	OR	CI	p	OR	CI	p
Anti-tobacco ads									
Less than 52	(ref)			(ref)			(ref)		
52 to 103	1.151	0.912-1.452	0.2361	1.177	0.840-1.648	0.3431	1.178	0.887-1.565	0.258
104 to 155	1.401	1.072-1.830	0.0134	1.545	1.041-2.293	0.0309	1.59	1.147-2.204	0.0054
156 to 207	1.207	0.896-1.626	0.2152	1.349	0.873-2.084	0.1779	1.432	0.991-2.068	0.0556
208 or greater	1.222	0.898-1.662	0.2013	1.409	0.902-2.202	0.1317	1.659	1.143-2.408	0.0077
Pharmaceutical ads									
Less than 208	(ref)			(ref)			(ref)		
208 to 259	1.012	0.834-1.229	0.9015	0.905	0.679-1.207	0.4984	0.958	0.753-1.220	0.7305
260 or greater	0.947	0.679-1.319	0.7463	0.944	0.586-1.522	0.8142	1.026	0.689-1.527	0.8999
Tobacco industry ads									
Less than 104	(ref)			(ref)			(ref)		
104 to 155	1.056	0.811-1.374	0.6864	0.794	0.558-1.130	0.2006	0.872	0.638-1.190	0.3871
156 to 207	1.092	0.762-1.564	0.6315	0.67	0.407-1.102	0.1144	0.719	0.467-1.105	0.1326
208 or greater	1.444	0.843-2.474	0.181	0.766	0.364-1.612	0.4829	0.8	0.422-1.518	0.4944
Survey ^d	0.988	0.946-1.032	0.5974	1.019	0.959-1.084	0.5393	0.974	0.925-1.027	0.3281
Race/ethnicity									
White	(ref)			(ref)			(ref)		
African American	1.223	0.867-1.724	0.2512	1.093	0.686-1.741	0.7096	0.791	0.497-1.259	0.3228
Hispanic	1.564	1.216-2.012	0.0005	1.296	0.862-1.949	0.2119	1.54	1.084-2.188	0.016
Other or missing data	1.008	0.785-1.295	0.9496	0.827	0.574-1.193	0.3099	0.938	0.695-1.265	0.6745
Male	0.859	0.757-0.974	0.018	0.816	0.683-0.975	0.0254	0.838	0.719-0.977	0.0239
Academic status									
Not in school, no degree	(ref)			(ref)			(ref)		
In school	1.644	1.425-1.896	<.0001	1.318	1.076-1.614	0.0075	1.697	1.431-2.012	<.0001
Not in school, with degree	2.008	1.705-2.364	<.0001	1.396	1.097-1.776	0.0067	2.054	1.669-2.529	<.0001
Cigarette price ^e	0.999	0.995-1.004	0.796	1.002	0.995-1.008	0.5664	1.005	1.000-1.011	0.0649
Smoke-free air index ^f	1.005	0.999-1.011	0.1226	0.997	0.988-1.007	0.582	0.996	0.988-1.004	0.3415
Survey calendar year									
2001	(ref)			(ref)			(ref)		
2002	1.01	0.736-1.389	0.9453	0.84	0.532-1.328	0.4558	0.81	0.550-1.188	0.2785
2003	1.54	0.884-2.675	0.1276	0.90	0.410-1.969	0.7894	0.81	0.417-1.579	0.5385
2004	1.38	0.775-2.446	0.2756	0.70	0.313-1.569	0.3874	0.58	0.290-1.150	0.1183
2005	1.20	0.699-2.061	0.5073	0.73	0.341-1.575	0.4264	0.68	0.357-1.300	0.2440
2006	1.31	0.781-2.180	0.3090	0.96	0.462-1.977	0.9023	0.97	0.528-1.792	0.9299

	2-Year Quitting Among All Smokers ^a			2-Year Quitting Among Daily Smokers ^b			Reduction or Quitting Among Daily Smokers ^c		
	OR	CI	p	OR	CI	p	OR	CI	p
2007	1.57	0.929-2.653	0.0918	1.09	0.522-2.286	0.8137	0.93	0.497-1.734	0.8148
2008	1.51	0.800-2.841	0.2042	0.89	0.364-2.188	0.8025	0.87	0.405-1.867	0.7194
State									
AL	0.17	0.029-0.951	0.0438	0.04	0.003-0.391	0.0064	0.05	0.006-0.456	0.0074
AZ	0.18	0.035-0.888	0.0354	0.05	0.006-0.336	0.0025	0.09	0.013-0.581	0.0117
AR	0.13	0.023-0.795	0.0270	<0.001	<0.001-<0.001	<.0001	0.03	0.003-0.375	0.0059
CA	0.25	0.055-1.140	0.0734	0.08	0.013-0.446	0.0043	0.11	0.019-0.624	0.0128
CO	0.22	0.046-1.038	0.0558	0.06	0.009-0.360	0.0022	0.11	0.019-0.668	0.0161
CT	0.18	0.033-0.979	0.0472	0.06	0.008-0.470	0.0072	0.06	0.008-0.431	0.0053
DE	0.29	0.019-4.543	0.3798	0.13	0.005-3.058	0.2027	0.09	0.003-2.079	0.1308
DC	0.22	0.030-1.516	0.1228	0.09	0.006-1.449	0.0898	0.15	0.013-1.690	0.1246
FL	0.25	0.054-1.143	0.0736	0.09	0.014-0.508	0.0069	0.15	0.025-0.843	0.0315
GA	0.25	0.049-1.268	0.0940	0.11	0.015-0.719	0.0216	0.12	0.017-0.760	0.0248
ID	0.23	0.044-1.205	0.0820	0.06	0.008-0.436	0.0058	0.06	0.008-0.437	0.0056
IL	0.20	0.043-0.898	0.0358	0.08	0.013-0.450	0.0045	0.09	0.016-0.536	0.0078
IN	0.23	0.048-1.051	0.0579	0.07	0.011-0.386	0.0027	0.07	0.012-0.402	0.0029
IA	0.42	0.086-2.061	0.2861	0.22	0.036-1.362	0.1036	0.28	0.045-1.767	0.1767
KS	0.29	0.060-1.367	0.1167	0.12	0.019-0.736	0.0220	0.16	0.027-0.997	0.0496
KY	0.30	0.061-1.465	0.1365	0.13	0.021-0.783	0.0261	0.15	0.024-0.914	0.0396
LA	0.12	0.015-0.878	0.0369	<0.001	<0.001-<0.001	<.0001	0.03	0.004-0.301	0.0024
MD	0.18	0.039-0.879	0.0339	0.07	0.011-0.445	0.0049	0.10	0.016-0.578	0.0105
MA	0.22	0.046-1.080	0.0622	0.08	0.012-0.510	0.0079	0.08	0.013-0.504	0.0072
MI	0.19	0.042-0.907	0.0371	0.08	0.014-0.499	0.0065	0.11	0.018-0.623	0.0130
MN	0.24	0.052-1.101	0.0662	0.09	0.014-0.505	0.0067	0.12	0.020-0.673	0.0164
MS	0.20	0.016-2.485	0.2117	<0.001	<0.001-<0.001	<.0001	<0.001	<0.001-<0.001	<.0001
MO	0.09	0.019-0.455	0.0034	0.06	0.009-0.364	0.0024	0.12	0.020-0.710	0.0196
NE	0.27	0.051-1.366	0.1124	0.08	0.012-0.599	0.0135	0.09	0.013-0.585	0.0121
NV	0.32	0.043-2.440	0.2740	0.08	0.005-1.315	0.0767	0.05	0.003-0.865	0.0392
NJ	0.25	0.051-1.183	0.0800	0.08	0.012-0.514	0.0080	0.06	0.009-0.365	0.0024
NM	0.22	0.045-1.075	0.0614	0.05	0.007-0.346	0.0026	0.10	0.015-0.636	0.0149
NY	0.14	0.030-0.693	0.0156	0.05	0.008-0.326	0.0017	0.05	0.009-0.328	0.0015
NC	0.17	0.036-0.850	0.0307	0.06	0.009-0.416	0.0042	0.10	0.016-0.599	0.0120
OH	0.19	0.042-0.844	0.0292	0.08	0.014-0.438	0.0037	0.09	0.016-0.509	0.0063
OK	0.32	0.068-1.510	0.1499	0.18	0.030-1.116	0.0656	0.25	0.042-1.467	0.1244
OR	0.76	0.142-4.017	0.7431	0.40	0.050-3.174	0.3839	0.36	0.046-2.902	0.3399
PA	0.17	0.036-0.758	0.0204	0.07	0.011-0.378	0.0024	0.08	0.014-0.461	0.0046
RI	0.15	0.028-0.792	0.0254	0.06	0.008-0.421	0.0047	0.07	0.010-0.440	0.0050
SC	0.26	0.053-1.270	0.0960	0.10	0.015-0.608	0.0129	0.13	0.022-0.809	0.0286
TN	0.25	0.054-1.157	0.0762	0.09	0.016-0.563	0.0096	0.12	0.020-0.683	0.0171
TX	0.23	0.051-1.038	0.0559	0.09	0.015-0.488	0.0057	0.13	0.023-0.725	0.0201

	2-Year Quitting Among All Smokers ^a			2-Year Quitting Among Daily Smokers ^b			Reduction or Quitting Among Daily Smokers ^c		
	OR	CI	p	OR	CI	p	OR	CI	p
UT	0.21	0.039-1.150	0.0721	0.07	0.009-0.491	0.0077	0.07	0.010-0.457	0.0058
VT	0.42	0.053-3.276	0.4063	0.21	0.020-2.132	0.1859	0.15	0.016-1.494	0.1064
VA	0.24	0.052-1.099	0.0659	0.09	0.016-0.536	0.0079	0.13	0.022-0.732	0.0210
WA	0.21	0.042-0.988	0.0483	0.06	0.010-0.389	0.0031	0.08	0.013-0.485	0.0060
WV	0.15	0.021-1.006	0.0507	0.06	0.006-0.566	0.0141	0.18	0.020-1.588	0.1218
WI	0.25	0.054-1.165	0.0775	0.10	0.017-0.596	0.0114	0.10	0.017-0.592	0.0110
WY	(ref)			(ref)			(ref)		

Notes: In these analyses, advertising measures are gross ratings points (GRPs) and have been re-scaled by units of 10. Thus, estimates should be understood as inferring the change in odds of the outcome for every 10-unit increase in advertising.

^aMoving from any smoking in past 30 days at the prior survey to none at all at the current survey; N (wtd) = 6,365.

^bMoving from daily smoking in past 30 days at the prior survey to none at all at the current survey; N (wtd) = 4,476.

^cMoving from daily smoking in past 30 days at the prior survey to <1 cigarette/day or none at all at the current survey; N (wtd) = 4,476.

^d1=First follow-up...6=sixth follow-up; used as a proxy for age.

^eState-level price in cents per pack of cigarettes obtained using data from first 6 months of the year, generics excluded, and adjusted for the CPI82-84.

^fState-level scale measuring the strictness of state smoke-free air laws.

Appendix Figure 1. Sample Flow Diagram

Notes: *n* indicates unweighted unique respondents.

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Figure 1. Mean 24-Month Sums of Tobacco-Related Advertising, 2001-2008

Notes: All advertising measures are gross ratings points (GRPs) and should be interpreted such that each 1-unit increase represents 1 additional potential exposure for 100% of the viewing audience over the preceding 24-month period. Anti-tobacco advertising includes both state tobacco control advertising and American Legacy Advertising. Pharmaceutical advertising includes advertising for nicotine replacement therapy, bupropion, etc. Tobacco industry advertising includes corporate image and youth prevention (targeting either parents or youth).

Table 1**Two-Year Change in Past 30-Day Smoking Behavior**

Past 30-day smoking, <i>prior</i> survey	Past 30-day smoking, <i>current</i> survey			
	None	Less than daily	Daily	Total N
None	14,896	729	456	16,080
	93%	5%	3%	
	90%	42%	11%	
Less than daily	890	635	364	1,889
	47%	34%	19%	
	5%	36%	9%	
Daily	678	384	3,414	4,476
	15%	9%	76%	
	4%	22%	81%	
Total N	16,464	1,748	4,233	22,445

Notes: N denotes weighted observations. “Prior” survey refers to the survey taken 24 months prior to the survey at which the outcome was measured (ranging from age base year (age 18) to Follow-up 5). “Current” survey refers to the survey at which the outcome was measured (ranging from Follow-up 1 to 6). The first line in each prior survey smoking level row denotes the weighted frequency of observations. The second line denotes row percentage (e.g., the 93% in the second line of the “none” row indicates that 93 percent of observations that reported no smoking at the past survey also reported no smoking at the current survey). The third line denotes column percentage (e.g., the 42% in the third line of the “less than daily” column indicates that 42 percent of observations that reported less than daily smoking at the current survey reported no smoking at the past survey).

Table 2**Descriptives**

	Proportion/Mean	Std Er	Range
<u>2-Year Smoking Behavior Change Outcomes</u>			
2-year smoking uptake ^a (N=16,080)	0.07	0.002	0,1
2-year daily smoking uptake ^b (N=16,080)	0.03	0.001	0,1
2-year quitting among all smokers ^c (N=6,365)	0.25	0.006	0,1
2-year quitting among daily smokers ^d (N=4,476)	0.15	0.006	0,1
2-year reduction or quitting, daily smokers ^e (N=4,476)	0.24	0.007	0,1
<u>Potential advertising exposure^f (N=22,445)</u>			
Advertising measures – continuous			
Anti-tobacco advertising	138.78	0.746	28.68 – 566.80
Pharmaceutical advertising	220.66	0.227	119.71 – 335.55
Tobacco industry advertising	155.02	0.363	19.69 – 370.88
Advertising measures - categorical			
Anti-tobacco advertising			
Less than 52	0.11	0.002	0,1
52 to 103	0.32	0.003	0,1
104 to 155	0.21	0.003	0,1
156 to 207	0.15	0.003	0,1
208 or greater	0.21	0.003	0,1
Pharmaceutical advertising			
Less than 208 ^g	0.35	0.003	0,1
208 to 259	0.54	0.004	0,1
260 or greater	0.11	0.002	0,1
Tobacco industry advertising			
Less than 104 ^h	0.22	0.003	0,1
104 to 155	0.41	0.003	0,1
156 to 207	0.15	0.002	0,1
208 or greater	0.21	0.002	0,1
<u>Control measures (N=22,445)</u>			
Academic status			
Not in school, no college degree	0.36	0.005	0,1
In school, with or without college degree	0.36	0.004	0,1
Not in school, college degree	0.28	0.004	0,1
Male	0.38	0.005	0,1
Race/ethnicity			
African American	0.06	0.002	0,1
Hispanic	0.09	0.003	0,1
White	0.77	0.004	0,1

	Proportion/Mean	Std Er	Range
Other or missing data	0.08	0.003	0,1
Survey (1=first follow-up...6=sixth follow-up)	3.72	0.013	1-6
State-level policy measures (continuous)			
Average real price per pack of cigarettes ⁱ	220.89	0.349	164.81 - 319.78
Smoke-free Air Index ^j	20.94	0.163	-13.50 - 61.00

Notes: N denotes weighted observations.

^a Moving from no past-30-day smoking at the prior survey to any smoking in the past 30 days at the current survey.

^b Moving from no past-30-day smoking at the prior survey to smoking 1+ cigarettes/day in the past 30 days at the current survey.

^c Moving from any smoking in past 30 days at the prior survey to none at all at the current survey.

^d Moving from daily smoking in past 30 days at the prior survey to none at all at the current survey.

^e Moving from daily smoking in past 30 days at the prior survey to <1 cigarette/day or none at all at the current survey.

^f All linear advertising measures are in gross ratings points (GRPs) and should be interpreted such that each 1-unit increase represents 1 additional potential exposure for 100% of the viewing audience over the preceding 24-month period. "Anti-tobacco" includes both state tobacco control advertising and American Legacy Advertising. "Tobacco industry" includes corporate image and youth smoking prevention advertising.

^g Only 1.18% of observations had pharmaceutical advertising values below 156; thus, all values below 208 were collapsed.

^h Only 0.72% of observations had tobacco industry advertising values below 52; thus, all values below 104 were collapsed.

ⁱ State-level price in cents per pack of cigarettes obtained using data from first 6 months of the year, generics excluded, and adjusted for the CPI82-84.[34]

^j State-level scale measuring the strictness of state smoke-free air laws.[35]

Table 3

Predicted Odds of 2-Year Quitting Smoking or Reduction by Anti-Tobacco Advertising, 2001-2008

2-Year Quitting Among All Smokers (wtd N=6,365 observations)				
	%	OR	CI	p
Quadratic model				
Linear term		1.004	0.989-1.018	0.6185
Quadratic term		0.999	0.998-1.000	0.0420
Categorical model				
Less than 52	22.2	(ref)		
52 to 103	23.2	1.151	0.912-1.452	0.2361
104 to 155	28.1	1.401	1.072-1.830	0.0134
156 to 207	24.5	1.207	0.896-1.626	0.2152
208 or greater	24.9	1.222	0.898-1.662	0.2013
2-Year Quitting Among Daily Smokers (wtd N=4,476 observations)				
	%	OR	CI	p
Quadratic model				
Linear term		1.009	0.988-1.030	0.4047
Quadratic term		0.999	0.998-1.000	0.1009
Categorical model				
Less than 52	13.6	(ref)		
52 to 103	14.6	1.177	0.840-1.648	0.3431
104 to 155	17.3	1.545	1.041-2.293	0.0309
156 to 207	14.9	1.349	0.873-2.084	0.1779
208 or greater	15.0	1.409	0.902-2.202	0.1317
2-Year Reduction or Quitting Among Daily Smokers (wtd N=4,476 observations)				
	%	OR	CI	p
Quadratic model				
Linear term		1.023	1.005-1.041	0.0131
Quadratic term		0.999	0.998-1.000	0.0430
Categorical model				
Less than 52	21.1	(ref)		
52 to 103	22.4	1.178	0.887-1.565	0.2580
104 to 155	26.5	1.590	1.147-2.204	0.0054
156 to 207	23.6	1.432	0.991-2.068	0.0556
208 or greater	25.0	1.659	1.143-2.408	0.0077

Notes: Advertising measured using gross ratings points (GRPs). Models controlled for categorical measures of pharmaceutical and tobacco industry advertising, self-reported race/ethnicity, gender, base-year drug use, academic status, state-level policy variables of cigarette price and smoke-free air index, level of follow-up survey, year and state fixed effects. See Appendix Table 2 for full results (available online only).