Health Educ Behav OnlineFirst, published on June 29, 2007 as doi:10.1177/1090198106298421

Mass Media for Smoking Cessation in Adolescents

Laura J. Solomon, PhD
Janice Y. Bunn, PhD
Brian S. Flynn, ScD
Phyllis L. Pirie, PhD
John K. Worden, PhD
Takamaru Ashikaga, PhD

Theory-driven, mass media interventions prevent smoking among youth. This study examined effects of a media campaign on adolescent smoking cessation. Four matched pairs of media markets in four states were randomized to receive or not receive a 3-year television/radio campaign aimed at adolescent smoking cessation based on social cognitive theory. The authors enrolled 2,030 adolescent smokers into the cohort ($n = 987$ experimental; $n = 1{,}043$ comparison) and assessed them via annual telephone surveys for 3 years. Although the condition by time interaction was not significant, the proportion of adolescents smoking in the past month was significantly lower in the experimental than comparison condition at 3-year follow-up when adjusted for baseline smoking status. The media campaign did not impact targeted mediating variables. A media campaign based on social cognitive constructs produced a modest overall effect on smoking prevalence among adolescents, but the role of theory-based constructs is unclear.

Keywords: *smoking cessation; adolescents; mass media*

INTRODUCTION

Until the mid-1990s, most research testing ways to reduce the prevalence of cigarette smoking among adolescents focused on preventive interventions rather than cessation. However, as youth smoking prevalence rates climbed, peaking in 1997 (Johnston, O'Malley, Bachman, & Schulenberg, 2004), attention shifted to ways to help adolescent

---

Laura J. Solomon, Janice Y. Bunn, Brian S. Flynn, University of Vermont, Burlington. Phyllis L. Pirie, University of Minnesota, Minneapolis. John K. Worden and Takamaru Ashikaga, University of Vermont, Burlington.

Address correspondence to Laura J. Solomon, PhD, Department of Psychology, Dewey Hall, University of Vermont, 2 Colchester Avenue, Burlington, VT 05405-0134; phone: (802) 656-4059; e-mail: laura.solomon@uvm.edu.

This study was supported by Grant P01 CA82708 from the National Cancer Institute. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Cancer Institute. The authors are grateful to Kathleen Howe, Scott Connolly, and Anne Dorwaldt at the University of Vermont for their assistance with the development and placement of the media campaign and to the interview staff at the University of Minnesota Survey Center.

Health Education & Behavior, Vol. XX (X): xx-xx (Month XXXX)
DOI: 10.1177/1090198106298421
© by SOPHE

Copyright 2007 by Society for Public Health Education.

smokers stop smoking. A number of studies explored the impact of individual, small group, or classroom-based cessation interventions on adolescent smokers (see Garrison, Christakis, Ebel, Wiehe, & Rivara, 2003; McDonald, Colwell, Backinger, Husten, & Maule, 2003; Sussman, Lichtman, Ritt, & Pallonen, 1999, for reviews of the studies). These studies, including two testing nicotine replacement therapy (Hurt et al., 2000; Smith et al., 1996), generally yielded modest to poor short-term outcomes, and many were plagued by methodological problems including small sample sizes, participant selection biases, high attrition rates, lack of control conditions, short follow-up periods, and failure to follow intention-to-treat analyses. However, a consensus panel concluded after reviewing these studies that approaches based on cognitive-behavioral principles demonstrated the greatest promise of efficacy (McDonald et al., 2003).

The promise of efficacy is also predicated on the ability to enroll adolescent smokers in program offerings. Results from studies involving compulsory participation, sometimes as an alternative to disciplinary action, have not demonstrated strong cessation outcomes (Aveyard et al., 1999; Robinson, Vander Weg, Riedel, Klesges, & McLain-Allen, 2003). Yet, studies dependent on voluntary participation face the reality that although around 65% of adolescent smokers report wanting to quit smoking (Burt & Peterson, 1998; Stanton, Lowe, & Gillespie, 1996), nearly 80% prefer to quit on their own rather than through a formal cessation program (Stanton, McClelland, Elwood, Ferry, & Silva, 1996). This raises the possibility that for young smokers for whom public acknowledgment of smoking may result in parental disapproval and/or punitive sanctions, accessible cessation interventions may be ones that reach adolescents where they are rather than relying on these adolescents to seek out treatment.

Mass media, including television and radio, are channels through which carefully crafted messages can be delivered to a target audience. Media use tends to be high among adolescents (Rideout, Roberts, & Foehr, 2005) as the teenage years are a time when young people often look to the broader youth culture for their own sense of identity and belonging (B. B. Brown, Mory, & Kinney, 1994). Because mass media are a window for adolescents on that broader youth culture, they are ideal channels through which to try to influence youth health behaviors.

Numerous mass media campaigns have been launched over the past 10 years at the state and national levels to prevent smoking initiation; however, few of the campaigns have been tested within a rigorous experimental design, and few have been designed to address smoking cessation, as opposed to prevention, in adolescent smokers (see Farrelly, Niederdeppe, & Yarsevich, 2003, for a review). The one study to meet both criteria was a two-county, controlled media intervention trial by Hafstad and colleagues (Hafstad, Aaro, & Langmark, 1996; Hafstad et al., 1997) testing a dissonance-based broadcast and print media campaign targeting adolescents in Norway. These researchers observed a cessation effect in female but not male adolescent smokers and concluded that although the messages generated discussion as planned, the way in which the dissonance between smoking and other values is resolved is highly dependent on the cultural context and prevailing social norms about cigarette smoking.

Given that no other controlled mass media intervention study has demonstrated an effect on adolescent smoking cessation, we examined effective controlled trials of smoking prevention through mass media. The best results to date were observed by Flynn and colleagues (Flynn et al., 1992, 1994) in a study where media messages were developed to address constructs central to social cognitive theory (Bandura, 1986). Significant differences were observed in the prevalence of daily and weekly smoking among youth in media campaign compared to no media campaign communities at 5-year

follow-up. Importantly, mediating variables derived from social cognitive theory and measured annually revealed between-group differences in the expected direction prior to the findings of between-group differences in smoking prevalence. This suggested that a media intervention aimed at influencing intrapersonal factors (e.g., outcome expectations), social-environmental factors (e.g., perceived peer norms), and behavioral factors (e.g., self-efficacy) can prevent the onset of cigarette smoking in youth.

To test whether such a campaign might promote smoking cessation in adolescents, we developed messages tailored to adolescent smokers based on constructs from social cognitive theory and delivered them as paid advertisements on stations and around shows popular with that audience. We hypothesized that a 3-year mass media campaign would result in a lower prevalence of smoking among a cohort of baseline adolescent smokers living in media markets receiving the media campaign compared to a cohort of baseline adolescent smokers living in media markets where the campaign was never aired.

METHOD

Participants and Procedure

Four pairs of media markets known as designated market areas (DMAs), each consisting of one or more metropolitan statistical areas, were selected, with one matched pair of DMAs within each of four states (South Carolina, Florida, Texas, and Wisconsin). We selected states that had two or more DMAs, were geographically dispersed, collectively represented the racial/ethnic diversity of the United States (U.S. Census Bureau, 2000), and had no large-scale tobacco control media efforts underway other than national campaigns (Farrelly et al., 2002). We selected DMAs with adequate numbers of adolescent smokers, a range of economically feasible media outlets, and geographic separation and that matched each other demographically. In each DMA, the sample was defined to include adolescents in public middle and high schools having high concentrations of students from lower income households, where smoking is more prevalent (Lowry, Kann, Collins, & Kolbe, 1996). We selected schools in each DMA that best met these criteria.

Within each school, we sought active parental and student consent for participation in a confidential, self-administered, in-school survey on cigarette smoking perceptions, attitudes, and behaviors from students in randomly selected classrooms in Grades 7 through 10. A total of 16,934 adolescents completed the surveys in 2001, a participation rate of 65%. On the survey cover sheet, participants recorded their name, address, and phone number; detached that page; and turned it in before completing the questionnaire. A code number linked the survey to the cover sheet. Completed surveys were scanned into a database, and cover sheets from surveys of students who reported smoking at least once in the past 30 days were sent to the University of Minnesota Survey Center. From there, letters were mailed to parents asking permission to interview the youth annually by telephone to assess cigarette smoking beliefs, attitudes, and behaviors. Shortly after the letters were mailed, staff from the survey center called the parents to request active consent to contact the youth. If consent was provided, the survey staff called the adolescents to invite them to be part of the 3-year study involving annual telephone assessments. Of 2,828 youth who indicated smoking in the past 30 days on the school survey, 2,262 (80%) were reached, consented, and enrolled into this study. Of these, 14 moved out of the DMA before the start of the media campaign and were

considered ineligible. An additional 218 reported on the telephone baseline survey that they had never smoked; these were also removed. The final cohort contained 2,030 adolescents.

After the school survey, the two DMAs within each state were randomized into an experimental (media) or comparison (no media) condition such that four DMAs, one in each state, were designated to receive the 3-year television and radio campaign and the other four DMAs were not. A total of 987 adolescents constituted the cohort from the experimental DMAs; 1,043 adolescents made up the comparison cohort. Survey staff called participants annually for 3 years. The research team had no other contact with participants. The study was approved by the University of Vermont and the University of Minnesota Institutional Review Boards.

Media Intervention

The cessation media campaign had the following five educational objectives: to (a) increase confidence in ability to resist smoking in high-risk situations, (b) decrease expectations that bad things happen if youth stopped smoking completely, (c) increase expectations that good things happen if youth stopped smoking completely, (d) have more realistic perceptions of the prevalence of adolescent smoking and quitting, and (e) increase perceptions of peer approval for stopping smoking. These objectives were derived from social cognitive theory (Bandura, 1986) and were conceptually linked to mediator variables assessed in the annual telephone surveys. The media campaign did not link smokers to cessation services as the intent was to test the impact of the campaign on adolescent smokers unlikely to seek assistance with quitting.

Each year of the 3-year media campaign, which began in January 2002, at least five producers from different areas of the country submitted 30-second television and radio ad concepts aimed at adolescents and designed to communicate one or more of the aforementioned objectives. An expert panel of social scientists reviewed the ad concepts for adherence to educational objective content and for avoidance of unintended negative messages (e.g., glamorizing smoking). Selected ads were then rated by racially diverse adolescent smokers to determine their appeal and to provide feedback to producers. A subset of ads was selected for broadcast over paid media. Ads varied in format and included testimonials, dramas, music videos, and cartoons, usually with adolescent protagonists demonstrating or speaking about content related to one or more of our educational objectives. Typically, 10 television and 15 radio ads were aired each year. These numbers also reflect contributions from a simultaneous smoking prevention media campaign of approximately equal intensity serving the same age groups in these communities. (For a description of our message development process, see Worden et al., 1988.)

We scheduled a yearly average of 660 ad placements on broadcast and cable television outlets and 1,060 ad placements on radio stations in the DMAs receiving the combined media campaign. A heavy concentration of placements, about 30 each week on television and 26 on radio, were between January and April when youth were often home and media rates were low. A radio campaign with 26 placements per week ran from June through August, and the full television and radio campaign was resumed in August or September for 4 weeks coinciding with the beginning of the school year. This placement schedule was based on our prior study (Flynn et al., 1992), which yielded significant results for smoking prevention and is consistent with the campaign weight and design of the National Youth Anti-Drug Media Campaign of the Office of National Drug Control Policy (see Hornik et al., 2002). Placements were purchased in television

programs popular with high school–age youth in after-school, weekend, and prime-time periods; outlets included Fox, NBC, and WB television network affiliates and MTV and BET cable TV channels. Radio ads were purchased on two or three stations in each DMA that were preferred by high school–age youth. Public service matches amounted to about 10% overall. Placements were estimated to achieve an overall 380 GRP (Gross Rating Points), or an average of three to four exposures per week over 9 months each year. This level of exposure is somewhat higher than those reported in effective tobacco and marijuana prevention media campaigns (Flynn et al., 1994; Palmgreen, Donohew, Lorch, Hoyle, & Stephenson, 2001) but within a 300 to 400 GRP range suggested for commercial campaigns (Aaker & Brussone, 1981).

Measurement

Between 2 and 4 months after the in-school survey, participants completed a 25-minute telephone baseline survey and then completed three annual 20-minute telephone follow-up surveys administered by staff at the University of Minnesota Survey Center. Data were entered into a computer-assisted telephone interviewing system and transmitted electronically to the University of Vermont for analysis.

Baseline Telephone Survey. The baseline survey was conducted between 1 and 6 months prior to the onset of the first media campaign and assessed key behavioral outcome variables (e.g., days smoked in the past 30 days, number of cigarettes smoked each of those days), demographic characteristics and smoking environment (e.g., age, gender, race, ethnicity, number of other smokers in the household), and mediator variables consistent with the educational objectives of the media campaign. These mediator variables, listed in the same order as the educational objectives reported earlier, included self-efficacy to resist smoking, outcome expectations for quitting, perceived prevalence of adolescent smoking and quitting, perceived peer approval for smoking and for quitting, and intention to smoke in the next 30 days.

The development and psychometric properties of the self-efficacy and outcome expectations measures are reported in another article (Solomon, Bunn, Pirie, Worden, & Flynn, 2006). The self-efficacy measure consisted of two factors: confidence to resist smoking in social situations (six items; $\alpha = .85$) and confidence to resist smoking when experiencing negative affect (four items; $\alpha = .85$). Items were scored on a 5-point scale with higher mean factor scores indicative of greater confidence to resist smoking.

The outcome expectations measure consisted of four factors: negative emotional consequences of quitting smoking (three items; $\alpha = .51$), negative social consequences of quitting (five items; $\alpha = .70$), positive self-evaluative consequences of quitting (five items; $\alpha = .71$), and positive physical consequences of quitting (two items; $\alpha = .59$). Items were scored on a 5-point scale with higher mean factor scores indicative of greater endorsement of that outcome for quitting smoking.

Perceived prevalence of smoking was determined by the mean of two items asking what percentage of guys your age smoke and what percentage of girls your age smoke. Perceived prevalence of quitting was determined by the mean of two items asking what percentage of guys who smoke have tried to quit and what percentage of girls who smoke have tried to quit.

Perception of peer approval for smoking was assessed by three items asking how much different friends approved of smoking ($\alpha = .49$). Responses were given on 4-point

scales; a higher mean score indicated greater approval of smoking. Perception of peer approval for quitting was assessed by three items asking how much different friends approved of quitting ($\alpha = .60$). Responses were reported on 3-point scales; a higher mean score indicated greater approval of quitting.

Intention to smoke in the next 30 days was assessed by one item. Responses were given on a 5-point scale, with a higher score indicative of greater intention to smoke in the next 30 days.

A skip pattern in the baseline survey resulted in participants who reported not smoking in the past 30 days not responding to the self-efficacy, outcome expectations, and intention items; therefore, for a segment of the sample we have no baseline data on those mediating variables.

Annual Follow-Up Surveys. Each annual follow-up survey measured smoking behavior in the past 30 days and all mediating variables described earlier. In addition, exposure to the media campaign was assessed by giving a brief verbal description of several of the television and radio ads aired that year and asking youth to indicate whether they recalled seeing (or hearing) the ad not at all, once or twice, or three or more times. Exposure to the ads was collapsed into a dichotomous measure indicating recall of exposure to at least one television or one radio ad.

Statistical Analyses

The study design is a group randomized trial in which DMAs were randomized to experimental or comparison conditions. Each experimental DMA was matched to a comparison DMA, with matching DMAs located in the same state. The analysis followed an intention-to-treat strategy, with values imputed for respondents not interviewed at a particular time point. For smoking status, those with missing data were considered to have smoked at least one cigarette in the past 30 days; imputation for all other variables was accomplished by using the last observation carried forward.

In general, the analytic approach was a repeated measures analysis of covariance, with the baseline dependent variable included as a covariate where possible (H. Brown & Prescott, 1999). Because longitudinal data were collected over a 3-year follow-up period, a random coefficients model was used (Murray, Hannan, Wolfinger, Baker, & Dwyer, 1998). Two models were employed. Model 1 included the fixed effects of time and condition as well as a condition by time interaction term to examine whether the follow-up slopes differed between the two conditions. Because the interaction term was not statistically significant in the majority of cases, the analyses were repeated, removing the interaction term from the models (Model 2). When controlling for baseline smoking status, a significant condition effect would indicate that similar condition differences were maintained throughout the follow-up years. In addition to inclusion of random variables to measure variance due to individual-specific intercepts and slopes, random variables were also included in the model to account for the correlation within the matched DMA pairs, correlation within the DMA by condition stratum cells, and the random variation among individuals (Murray, 1998). The length of time required for model convergence when employing a generalized mixed model approach in this situation was extreme; thus, analyses of both continuous and dichotomous outcome measures employed a general linear mixed model. This likely had very minor impact on the analysis (Hannan & Murray, 1996). In general, reported results are those from models in which the covariance parameters are not constrained to be positive (Murray, Hannan, &

Baker, 1996). In a few cases, however, results from these models were not interpretable; thus, reported analyses are based on models including the parameter constraint. Due to the absence of baseline data on the entire cohort, analyses for self-efficacy, outcome expectations, and intention to smoke did not include these baseline variables as the covariate when these mediators served as dependent variables. All analyses were performed using SAS, Version 8.01 (SAS Institute Inc., 2000).

RESULTS

Adolescents averaged slightly older than 15 years of age at the time of the baseline telephone interview and were in Grades 7 through 10 during the 2000-2001 academic year (Table 1). There were slightly more females than males (54.7% female), although the sex distribution was similar in the experimental and comparison conditions. More than 10% were African American, and almost 15% were Hispanic/Latino. There were slightly more Hispanic/Latino youth and slightly fewer youth who identified as non-Hispanic Caucasian in the experimental condition.

Although all youth in the cohort reported smoking at least one cigarette in the past 30 days on the self-administered school survey, only 55% reported smoking at least one cigarette in the past 30 days on the baseline telephone survey. The percentage of youth smoking in the past 30 days at baseline did not differ between the experimental and comparison conditions (54% and 58%, respectively). Youth who reported smoking a cigarette in the past 30 days smoked a mean of 25.3 ($SD = 37.2$) cigarettes per week in the experimental condition and 21.8 ($SD = 38.0$) cigarettes per week in the comparison condition. When including those who reported not smoking in the past 30 days, the mean number of cigarettes smoked per week at baseline decreased to 13.6 ($SD = 30.0$) and 12.5 ($SD = 30.8$) in the experimental and comparison conditions, respectively.

Outcome Evaluation

Annual follow-up assessment response rates were high in both conditions, ranging from more than 86% at the first follow-up to more than 75% at the third annual follow-up. Response rates did not differ between conditions.

As shown in Table 2, the 30-day smoking rates increased significantly ($p < .01$) in both conditions over the 3-year follow-up period. The lack of a significant interaction (Model 1) indicates that the smoking rates increased in a similar fashion in both the experimental and comparison conditions. However, when the interaction term was removed from the model (Model 2), the results indicate that the proportion of youth reporting smoking at least one cigarette in the past 30 days was significantly lower in the experimental condition than in the comparison condition when adjusted for baseline smoking status ($p = .04$). The lower prevalence of smoking in the experimental condition seems to have resulted from a combination of two processes (shown in the right-hand side of Table 2). First, the quit rate from baseline to the third annual follow-up assessment was 16% in the experimental condition compared to 12.8% in the comparison condition. In addition, fewer youth in the experimental condition who reported not having had a cigarette in the past 30 days on the telephone baseline survey resumed smoking during the follow-up period. From baseline to the third annual follow-up, 59.4% of youth in the experimental condition resumed smoking compared to 66.1% in

Table 1. Baseline Characteristics of Youth in the Experimental and Comparison Conditions

	Experimental Condition (n = 987)		Comparison Condition (n = 1,043)		
	%	n	%	n	p
Grade in school (2000-2001)					
7	13.7	135	13.3	139	.55
8	22.9	226	24.4	254	
9	30.2	298	30.4	317	
10	33.2	328	31.9	333	
Sex					
Male	46.4	458	44.1	460	.56
Female	53.6	529	55.9	583	
Race/ethnicity					
African American	10.7	104	10.9	113	.56[a]
Hispanic/Latino	17.5	170	12.6	130	
Non-Hispanic Caucasian	65.4	636	72.0	744	
Other/more than one race/ethnicity	6.4	66	4.4	46	
Academic achievement					
As/Bs	26.9	265	24.1	251	.47
Bs/Cs	51.4	507	49.7	518	
Cs/Ds	20.3	200	22.3	233	
Ds/Fs	1.1	11	3.2	33	
Fs	0.3	3	0.8	8	
Smoking status at baseline					
Did not smoke in past 30 days	46.2	456	42.4	442	.26
Smoked in past 30 days	53.8	531	57.6	601	
	M	SD	M	SD	
Age at interview	15.2	1.19	15.3	1.25	.42
Cigarettes smoked per week (restricted to those who reported smoking in the past 30 days)	25.32	37.17	21.76	38.02	.17
Cigarettes smoked per week (all youth in cohort)	13.57	29.99	12.45	30.71	.08
Number of smokers in the home	1.04	1.13	0.98	1.11	.33
Number of three closest friends who smoke	1.61	1.11	1.56	1.15	.31

a. p value for the State × Condition interaction is < .01, indicating differing racial profiles within some states but not others.

the comparison condition. It should be pointed out that the study was not designed to examine these subgroups, and thus, the power is insufficient to detect a statistically significant difference.

The results of both Model 1 and Model 2 indicate that there was no difference between conditions in the number of cigarettes smoked per week during the 3-year follow-up period (shown in the lower portion of Table 2). This is not surprising as those

Table 2. Smoking Status and Cigarettes Per Week in the Past 30 Days at Telephone Baseline and at Each Follow-Up by Condition and by Smoking Status at Telephone Baseline

	All Cohort Members				Smoked in the past 30 days at telephone baseline							
					Yes				No			
	Experimental Condition ($n = 987$)		Comparison Condition ($n = 1,043$)		Experimental Condition ($n = 531$)		Comparison Condition ($n = 601$)		Experimental Condition ($n = 456$)		Comparison Condition ($n = 442$)	
Time	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*
Smoked in the past 30 days												
Telephone baseline	53.8	531	57.6	601								
First annual follow-up	62.3	615	67.3	702	81.9	435	85.2	512	39.5	180	43.0	190
Second annual follow-up	71.0	701	74.2	774	85.5	454	87.4	525	54.2	247	56.3	249
Third annual follow-up	72.6	717	78.2	816	84.0	446	87.2	524	59.4	271	66.1	292
	Model 1[a]		Model 2[a]		Model 1		Model 2		Model 1		Model 2	
Model												
$p_{Condition}$	.32		.04		.57[b]		.24[b]		.94		.11	
p_{Time}	< .01		< .01		.20		.20		< .01		< .01	
$p_{Condition \times Time}$	.70				.98				.40			

(continued)

Table 2. (continued)

	All Cohort Members				Smoked in the past 30 days at telephone baseline							
					Yes				No			
	Experimental Condition (n = 987)		Comparison Condition (n = 1,043)		Experimental Condition (n = 531)		Comparison Condition (n = 601)		Experimental Condition (n = 456)		Comparison Condition (n = 442)	
Time	%	n	%	n	%	n	%	n	%	n	%	n
	M	SD^c	M	SD^c								
Cigarettes per week												
Telephone baseline	13.57	29.99	12.45	30.71								
First annual follow-up	16.70	32.58	17.99	33.68								
Second annual follow-up	23.42	41.02	24.14	37.95								
Third annual follow-up	27.01	42.31	29.85	43.08								
	Model 1		Model 2									
Model												
$p_{Condition}$	.65		.13									
p_{Time}	< .01		< .01									
$p_{Condition \times Time}$	.19											

a. Model 1 included fixed effects of condition, time, and the Time × Condition interaction; Model 2 included fixed effects of condition and time.
b. Based on analysis that placed a lower constraint of 0.0 on the covariance parameter.
c. Based on a logarithmic transformation.

youth who quit over time were more likely to have been lighter smokers. Indeed, youth in the experimental condition who reported smoking on the telephone baseline but not smoking in the past 30 days at the first follow-up smoked a mean of 7.4 (SD = 19.6) cigarettes per week at baseline compared to a baseline mean of 30.4 (SD = 40.8) cigarettes per week among youth who reported smoking at both baseline and at first follow-up. It should be noted also that given the trend toward an increasing number of cigarettes smoked per week over time, our imputation procedure likely resulted in an underestimate of the mean number of cigarettes smoked per week during the follow-up years.

Evaluation of Mediators

In addition to overall level of smoking among these adolescents, we examined trends in mediating variables suggested by social cognitive theory (Table 3). Youth in both conditions rated their self-efficacy to resist smoking in both social and negative affect situations as fairly high, with means at each time point greater than 3 on a scale ranging from 1 to 5. The results of both models indicate that self-reported certainty that they could resist smoking in social and negative affect situations remained stable over the 3-year follow-up period, with no difference between conditions.

The adolescents generally endorsed positive outcome expectations for quitting (the positive self-evaluative and positive physical factors) and did not tend to endorse negative expectations for quitting (the negative emotional and negative social factors). Only negative social expectations for quitting declined significantly over time, although the lack of a significant interaction term indicates that the decrease over time did not differ between the two conditions. No differences were observed by condition for the negative outcome expectations factors; however, there were significant differences between conditions for the positive outcome expectations for quitting factors. Adolescents in the experimental condition endorsed higher positive physical outcome expectations across all follow-up assessments (p = .05 and .02 for Models 1 and 2, respectively). For positive self-evaluative expectations, when the interaction term was included in the analysis, the results indicate that there was no difference in the slope of these expectations during the follow-up period; however, when this term was deleted, the results of Model 2 suggest that adolescents in the experimental condition endorsed higher positive self-evaluative outcome expectations than those in the comparison condition. Unfortunately, the lack of complete baseline data, due to the baseline skip pattern among respondents who reported not smoking in the past 30 days, hinders interpretation of these results.

Perceived prevalence of smoking did not differ between conditions in either model. Respondents estimated that about half of the youth their age smoke cigarettes, a perception that did not change over the 3 years of the study. The perceived prevalence of youth who made a quit attempt increased from slightly greater than 27% to more than 31% by the third annual follow-up. The results of Model 1 indicate that the rise in perceptions of the prevalence of quitting increased at a greater rate in the experimental than in the comparison condition. We ran an analysis for mediation with perceived prevalence of quitting, but the test did not support a mediation effect. There were no differences between conditions in either peer approval for smoking or peer approval for quitting. However, there were significant increases in perceived peer approval for quitting in both conditions over time ($p < .01$).

Starting with the first annual follow-up, participants were asked about their intention to smoke a cigarette in the next 30 days. This intention increased over the three follow-up years, paralleling the increases over time in percentage of smokers and in the number

Table 3. Mediators of Youth Smoking at Baseline and at Each Annual Follow-Up in the Experimental and Comparison Conditions

Variable	Experimental Condition (n = 531)		Comparison Condition (n = 601)		Model 1[a]			Model 2[a]	
	M	*SD*	*M*	*SD*	$p_{Condition}$	p_{Time}	$p_{Condition \times Time}$	$p_{Condition}$	p_{Time}
Self-efficacy[b]									
Social					.58[c]	.15	.34	.11[c]	.15
Baseline	—		—						
First annual follow-up	3.60	1.17	3.48	1.16					
Second annual follow-up	3.61	1.15	3.44	1.19					
Third annual follow-up	3.58	1.16	3.41	1.19					
Negative affect					.27[c]	.07	.92	.15[c]	.07
Baseline	—		—						
First annual follow-up	3.53	1.30	3.40	1.26					
Second annual follow-up	3.47	1.30	3.34	1.25					
Third annual follow-up	3.41	1.31	3.28	1.28					
Outcome expectations[b]									
Negative emotional					.08	.74	.09	.27	.75
Baseline	—		—						
First annual follow-up	2.36	0.98	2.27	0.94					
Second annual follow-up	2.33	0.97	2.36	0.97					
Third annual follow-up	2.32	1.01	2.33	0.99					
Negative social					.08[c]	.02	.29	.07[c]	.02
Baseline	—		—						
First annual follow-up	1.65	0.73	1.57	0.68					
Second annual follow-up	1.54	0.67	1.50	0.65					
Third annual follow-up	1.50	0.65	1.46	0.63					
Positive self-evaluative					.56[c]	.60	.16	.04[c]	.56
Baseline	—		—						
First annual follow-up	3.48	0.85	3.37	0.91					
Second annual follow-up	3.49	0.88	3.35	0.89					
Third annual follow-up	3.50	0.89	3.32	0.92					
Positive physical					.05	.08	.15	.02	.07
Baseline	—		—						
First annual follow-up	4.54	0.74	4.43	0.84					
Second annual follow-up	4.53	0.74	4.50	0.71					
Third annual follow-up	4.55	0.73	4.52	0.72					
Perceived prevalence of:									
Smoking					.73	.82	.50	.93	.82
Baseline	50.37	20.08	49.98	19.28					
First annual follow-up	52.84	19.01	52.55	17.65					
Second annual follow-up	53.02	18.58	52.82	17.37					
Third annual follow-up	52.81	18.58	53.07	17.20					
Quitting					.07	.04	.05	.97	.05
Baseline	27.18	21.37	27.74	21.74					
First annual follow-up	29.02	21.00	29.85	21.13					
Second annual follow-up	31.93	22.42	30.77	22.93					
Third annual follow-up	33.22	22.64	31.07	22.69					
Peer approval for:									
Smoking					.80	.92	.59	.74	.90
Baseline	2.25	0.65	2.27	0.65					
First annual follow-up	2.30	0.66	2.31	0.69					
Second annual follow-up	2.30	0.67	2.31	0.66					
Third annual follow-up	2.32	0.70	2.30	0.67					

(continued)

Table 3. (continued)

Variable	Experimental Condition (n = 531)		Comparison Condition (n = 601)		Model 1[a]			Model 2[a]	
	M	*SD*	*M*	*SD*	$p_{Condition}$	p_{Time}	$p_{Condition \times Time}$	$p_{Condition}$	p_{Time}
Quitting					.68	.01	.75	.74	.01
Baseline	2.41	0.39	2.41	0.38					
First annual follow-up	2.39	0.40	2.40	0.39					
Second annual follow-up	2.44	0.40	2.41	0.38					
Third annual follow-up	2.43	0.41	2.44	0.40					
Intention to smoke[b]					.44	.01	.83	.12c	.01
Baseline	-		-						
First annual follow-up	2.4	1.5	2.5	1.5					
Second annual follow-up	2.5	1.6	2.7	1.6					
Third annual follow-up	2.7	1.6	2.9	1.6					

a. Model 1 included fixed effects of condition, time, and the Time × Condition interaction; Model 2 included fixed effects of condition and time.

b. Restricted to those responding to the first annual follow-up; baseline value not used as a covariate.

c. Based on analysis that placed a lower constraint of 0.0 on the covariance parameter.

of cigarettes smoked per week (p = .01). This occurred in a similar fashion for youth in both conditions.

Reported Exposure to Campaign Ads

At each follow-up, participants were asked whether they had seen or heard a sample of the messages that had been broadcast during the year. During the 3-year campaign, 68%, 62%, and 58% of the adolescents assessed in the experimental condition reported seeing or hearing at least one sample ad broadcast during the first, second, and third campaign years, respectively. For youth in the experimental condition, we examined their smoking status in relation to their reported ad exposure (Table 4). At the first annual follow-up, youth who reported having seen at least one television message were significantly less likely to have smoked a cigarette in the past 30 days compared to youth who reported not having seen any of the messages (54.0% vs. 62.6%, p = .01). Similar trends were observed in subsequent years, although the differences were not statistically significant. No differences were found between experimental participants who reported having heard at least one radio message and those who had heard none.

DISCUSSION

The overall findings provide mixed support for the impact of the mass media campaign on smoking prevalence in our cohort of baseline smokers. Although we did not observe a significant condition by time interaction, we did find a significant effect for condition when we adjusted for baseline smoking status. This small effect appears to be due to the combined influence of slightly greater cessation among adolescents who reported smoking in the past 30 days on both the school and telephone baseline assessments (conducted at least 1 month apart) and slightly less progression to regular smoking among adolescents who reported smoking in the past 30 days on the school survey but

Table 4. Relationship Between Youth Smoking Status and Exposure to TV or Radio Ads in the Experimental Condition Only

	Percentage of Youth Smoking in the Past 30 Days			
Variable	Time	Saw ≥1 Ad	Saw No Ads	*p*
TV ads	First annual follow-up	54.0 (*n* = 517)	62.6 (*n* = 313)	.01
	Second annual follow-up	60.1 (*n*= 429)	66.5 (*n* = 343)	.07
	Third annual follow-up	60.9 (*n* = 443)	67.7 (*n* = 297)	.06
Radio ads	First annual follow-up	58.1 (*n* = 427)	56.3 (*n* = 403)	.61
	Second annual follow-up	62.9 (*n* = 426)	63.0 (*n* = 346)	.98
	Third annual follow-up	61.8 (*n* = 380)	65.6 (*n* = 360)	.29

not on the telephone baseline assessment. At the very least, the latter youth can be considered experimental smokers who by virtue of their experimentation are at risk for subsequent smoking. These findings combined with data indicating that the youth in the experimental condition who quit smoking tended to be lighter smokers suggest that the mass media campaign was most effective in assisting adolescents who were light and occasional smokers to stop. We found little evidence from our cigarettes-per-day data to indicate that heavier smokers were influenced by the media campaign. This is not surprising as our 30-second ads did not address issues of dependence and addiction but instead focused on cessation outcome expectations, peer norms and approval for not smoking, and ways to manage various social and emotional aspects of quitting.

The modest cessation effect for the media campaign seemed to occur following the first campaign year, with an 18.1% 30-day point-prevalent quit rate among baseline smokers in the experimental condition compared to a 14.8% quit rate among baseline smokers in the comparison condition. Subsequent follow-up assessments revealed no further gains in abstinence among baseline smokers. Our quit rates are similar to those obtained in the only other mass media intervention trial with adolescent smokers (Hafstad et al., 1996, 1997), where 12.7% of male and 25.6% of female baseline weekly smokers were abstinent following a 3-year media campaign compared to 19.1% of males and 17.6% of females in the control condition. The fact that our results appeared greatest in the first year of the campaign suggests that interventions that target recent onset adolescent smokers may have greater promise than those that reach adolescents after smoking has become more established.

In contrast, smoking rates in both conditions increased over time among adolescents who were experimental smokers at baseline (i.e., reported smoking on the school baseline survey but reported no smoking in the past 30 days on the telephone baseline assessment). Among these youth, 40% and 43% in the experimental and comparison condition, respectively, smoked at the first follow-up; 54% and 56% smoked at the second follow-up; and 59% and 66% smoked at the third follow-up. The greatest difference between conditions seemed to occur following the final media campaign year, suggesting that the cumulative effect of the media campaign appeared most effective in deterring smoking onset. This finding is consistent with that observed in a prior mass media prevention trial with adolescents (Flynn et al., 1992) where smoking prevention effects increased over the 5-year campaign period. Thus, prevention campaigns may require ongoing exposure throughout adolescence to have an impact, whereas adolescent cessation interventions may exert their influence by targeting recent onset smokers.

Mediating Variables

Curiously, we did not observe effects of the media campaign on mediator variables the ads were designed to influence. We found no differences between conditions on self-efficacy to resist smoking in social or negative affect situations, negative outcome expectations for quitting, perceived prevalence of smoking, peer approval for smoking or quitting, or intentions to smoke in the next 30 days. We did find higher positive outcome expectations for quitting among adolescents in the experimental condition relative to the controls across the three follow-up assessments; however, the absence of baseline data prior to the airing of the media campaign makes it difficult to attribute these differences to the campaign itself. We observed a significant condition by time interaction for perceived prevalence of quitting that was in the expected direction.

The fact that we observed a modest behavioral effect for the media campaign but little evidence of impact on the mediator variables is an interesting dilemma. How did the campaign exert its modest effect? One possibility is that the campaign ads worked through other mediating mechanisms that were not measured by our surveys. For example, we did not assess negative physical outcomes for smoking despite the fact that a number of ads implied a negative health consequence. Possibly, the emotionally charged nature of these ads, which tended to be some of the best liked by participants, may have contributed to smoking deterrence. Biener and colleagues (Biener, 2002; Biener, Ji, Gilpin, & Albers, 2004) found that youth judged ads that evoked strong negative emotions (e.g., fear, sadness, or anger) and that often included illness-related content to be most effective in deterring smoking. Because we did not explicitly measure the emotional content of the ads or the adolescents' negative physical outcome expectations for smoking, we cannot determine whether these may have played a role in influencing our behavioral outcomes.

Another possible influence on the smoking behavior of the adolescents in our experimental condition may have come from our simultaneously aired mass media smoking prevention campaign that targeted youth of the same age in the same experimental communities. Although the focus of the prevention campaign was on deterring smoking in nonsmokers, some of the messages may have resonated with the light and occasional smokers in our cohort. However, the fact that the educational objectives for the prevention campaign were similarly drawn from social cognitive theory suggests that its impact should have strengthened the effect of the mediators in the experimental communities, but this effect was not observed.

A third possibility concerns the measurement of our mediating variables. In a prior article (Solomon et al., 2006), we described the development of the self-efficacy and outcome expectations measures. The two-factor self-efficacy scale performed well and showed good internal consistency (from .83 to .88). This was not the case for some of the factors of the outcome expectations measure, where internal consistency ranged from .51 to .71. However, our questions assessing smoking prevalence, approval, and intentions were used before and were responsive to media influences in a prior study of youth smoking (Flynn et al., 1992), suggesting that measurement per se is not a likely explanation for the lack of mediator effects.

A fourth possible reason the media campaign failed to impact our mediating variables may have been message diffusion. Different campaign ads addressed our five educational objectives, although many ads covered more than one objective. Each year, we intentionally created a campaign of numerous ads with their message content balanced across our educational objectives. Thus, no one objective received placement prominence.

Instead, we expected that the media campaign gestalt each year would be the active intervention. This strategy may have inadvertently diffused the impact of the ads on any one mediator variable and could explain how we found a modest experimental effect on smoking prevalence but not on individual mediators. This possibility is supported by the observation that specific television ads in our first campaign year were recalled by 22% to 54% of our experimental respondents and specific radio ads were recalled by 17% to 32%. Thus, exposure to any one educational objective might have been limited despite a frequent and strategic ad placement schedule. The growing presence of satellite dishes, cable TV, and alternative ways to access music may have curtailed exposure of our ads to our target audience, limiting mediator effects and possibly dampening smoking outcomes.

Study Limitations

Some study limitations were alluded to in the discussion of mediating variables. Although the campaign development process we followed was thorough (Worden et al., 1988) and the ad placement frequency was consistent with that recommended for commercial (Aaker & Brussone, 1981) and tobacco prevention campaigns (Pechmann & Reibling, 2000), our exposure data revealed less than optimal recall of ads by our experimental cohort. This could be a reflection of the broad range of media outlets to which adolescents can choose to attend, or it could reflect less memorable ads among the mix that barrage viewers daily. It could also reveal a diffusion of the impact of any single message amid the array of campaign ads we produced and aired. Perhaps campaigns that focus on a smaller number of well-crafted ads that drive home just one or two educational objectives would have a better chance of retention.

The study was designed as a cessation campaign; however, nearly half of the participants were not regular smokers at telephone baseline. Although this decline in reported smoking from the school, self-administered, baseline survey to the home, telephone, baseline survey may be in part an artifact of the change in survey modality, it weakened the test of the media campaign on cessation per se and instead produced a test of a social cognitive theory–based campaign on light and occasional adolescent smokers. In addition, the presence of skip patterns for certain mediator variables in the baseline telephone survey made conclusions about the impact of the campaign on these variables difficult. This leaves unresolved the role of constructs from social cognitive theory on the design of media messages to help adolescent smokers stop smoking. Finally, the presence of a simultaneous smoking prevention campaign in these communities limits our ability to attribute the behavioral effects observed to the impact of the cessation campaign alone.

Implications for Practice

This randomized, controlled trial testing a theory-based media intervention on smoking in adolescents produced a modest overall effect on prevalence despite the fact that theory-based mediators measured in the study did not change in a way that could be attributed to the media intervention. The practical implications suggest that a media-based smoking cessation intervention for adolescent smokers that focuses solely on the mediators addressed in this study may be insufficient to produce large cessation outcomes. Instead, media efforts might combine messages designed to stimulate cessation attempts in youth with an array of self-help and facilitated assistance options.

References

Aaker, D., & Brussone, D. (1981). Viewer perceptions of prime time television advertising. *Journal of Advertising Research*, *21*, 15-23.

Aveyard, P., Cheng, K. K., Almond, J., Sherratt, E., Lancashire, R., Lawrence, T., et al. (1999). A cluster-randomized controlled trial of an expert system based on the transtheoretical ("stages of change") model for smoking prevention and cessation in schools. *British Medical Journal*, *319*, 948-953.

Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice Hall.

Biener, L. (2002). Anti-tobacco advertisements by Massachusetts and Philip Morris: What teenagers think. *Tobacco Control*, *11*(Suppl. II), ii43-ii46.

Biener, L., Ji, M., Gilpin, E. A., & Albers, A. B. (2004). The impact of emotional tone, message, and broadcast parameters in youth anti-smoking advertisements. *Journal of Health Communication*, *9*, 259-274.

Brown, B. B., Mory, M. S., & Kinney, D. (1994). Casting adolescent crowds in a relational perspective: Caricature, channel, and context. In R. Montemayor, G. R. Adams, & T. P. Gullota (Eds.), *Personal relationships during adolescence* (pp. 123-167). Thousand Oaks, CA: Sage.

Brown, H., & Prescott, R. (1999). *Applied mixed models in medicine*. New York: John Wiley.

Burt, R., & Peterson, A. (1998). Smoking cessation among high school seniors. *Preventive Medicine*, *27*, 319-327.

Farrelly, M. C., Healton, C. G., Davis, K. C., Messeri, P., Hersey, J. C., & Haviland, L. (2002). Getting to the truth: Evaluating national tobacco countermarketing campaigns. *American Journal of Public Health*, *92*, 901-907.

Farrelly, M. C., Niederdeppe, J., & Yarsevich, J. (2003). Youth tobacco prevention mass media campaigns: Past, present and future directions. *Tobacco Control*, *12*(Suppl. 1), i35-i47.

Flynn, B. S., Worden, J. K., Secker-Walker, R. H., Badger, G. J., Geller, B. M., & Costanza, M. C. (1992). Prevention of cigarette smoking through mass media intervention and school programs. *American Journal of Public Health*, *82*, 827-834.

Flynn, B. S., Worden, J. K., Secker-Walker, R. H., Pirie, P. L., Badger, G. J., Carpenter, J. H., et al. (1994). Mass media and school interventions for cigarette smoking prevention: Effects 2 years after completion. *American Journal of Public Health*, *84*, 1148-1150.

Garrison, M. M., Christakis, D. A., Ebel, B. E., Wiehe, S. E., & Rivara, F. P. (2003). Smoking cessation interventions for adolescents: A systematic review. *American Journal of Preventive Medicine*, *25*, 363-367.

Hafstad, A., Aaro, L. E., Engeland, A., Anderson, A., Langmark, F., & Stray-Pedersen, B. (1997). Provocative appeals in anti-smoking mass media campaigns targeting adolescents: The accumulated effect of multiple exposures. *Health Education Research*, *12*, 227-236.

Hafstad, A., Aaro, L. E., & Langmark, F. (1996). Evaluation of an anti-smoking mass media campaign targeting adolescents: The role of affective responses and interpersonal communication. *Health Education Research*, *11*, 29-38.

Hannan, P. J., & Murray, D. M. (1996). Gauss or Bernoulli? A Monte Carlo comparison of the performance of the linear mixed-model analyses in simulated community trials with a dichotomous outcome variable at the individual level. *Evaluation Review*, *20*, 338-352.

Hornik, R., Maklan, D., Cadell, D., Prado, A., Barmada, C., Jacobsohn, L., et al. (2002). *Evaluation of the National Youth Anti-Drug Media Campaign: Fourth semi-annual report of findings. Report prepared for the National Institute on Drug Abuse* (Contract No. N01DA-8-5063). Washington, DC: Westat.

Hurt, R. D., Croghan, G. A., Beede, S. D., Wolter, T. D., Croghan, I. T., & Patten, C. A. (2000). Nicotine patch therapy in 101 adolescent smokers: Efficacy, withdrawal symptom relief, and carbon monoxide and plasma cotinine levels. *Archives of Pediatrics and Adolescent Medicine*, *154*, 31-37.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2004). *Monitoring the future national results on adolescent drug use: Overview of key findings, 2003*. Bethesda, MD: National Institute on Drug Abuse.

Lowry, R., Kann, L., Collins, J. L., & Kolbe, L. J. (1996). The effect of socioeconomic status on chronic disease risk behaviors among US adolescents. *Journal of the American Medical Association*, *276*, 792-797.

McDonald, P., Colwell, B., Backinger, C. L., Husten, C., & Maule, C. O. (2003). Better practice for youth tobacco cessation: Evidence of review panel. *American Journal of Health Behavior*, *27*(Suppl. 2), S144-S158.

Murray, D. M. (1998). *Design and analysis of group-randomized trials*. New York: Oxford University Press.

Murray, D. M., Hannan, P. J., & Baker, W. L. (1996). A Monte Carlo study of alternative responses to intraclass correlation in community trials. Is it ever possible to avoid Cornfield's penalties? *Evaluation Review*, *20*, 313-337.

Murray, D. M., Hannan, P. J., Wolfinger, R. D., Baker, W. L., & Dwyer, J. H. (1998). Analysis of data from group-randomized trials with repeat observations on the same groups. *Statistics in Medicine*, *17*, 1581-1600.

Palmgreen, P., Donohew, L., Lorch, E. P., Hoyle, R. H., & Stephenson, M. T. (2001). Television campaigns and adolescent marijuana use: Tests of sensation seeking targeting. *American Journal of Public Health*, *91*, 292-296.

Pechmann, C., & Reibling, E. T. (2000). Anti-smoking advertising campaigns targeting youth: Case studies from USA and Canada. *Tobacco Control*, *9*(Suppl. II), ii18-ii31.

Rideout, V., Roberts, D. R., & Foehr, U. G. (2005). *Generation M: Media in the lives of 8-18 year-olds* (Publication No. 7250). Menlo Park, CA: Henry J. Kaiser Family Foundation.

Robinson, L. A., Vander Weg, M. W., Riedel, B. W., Klesges, R. C., & McLain-Allen, B. (2003). "Start to stop": Results of a randomised controlled trial of a smoking cessation programme for teens. *Tobacco Control*, *12*(Suppl. 4), IV26-IV33.

SAS Institute Inc. (2000). SAS system for Windows (Version 8.1) [Computer software]. Cary, NC: Author.

Smith, T. A., House, R. F., Croghan, I. T., Gauvin, T. R., Colligan, R. C., Offord, K. P., et al. (1996). Nicotine patch therapy in adolescent smokers. *Pediatrics*, *98*, 659-667.

Solomon, L. J., Bunn, J. Y., Pirie, P. L., Worden, J. K., & Flynn, B. S. (2006). Self-efficacy and outcome expectations for quitting among adolescent smokers. *Addictive Behaviors*, *31*, 1122-1132.

Stanton, W. R., Lowe, J. B., & Gillespie, A. M. (1996). Adolescents' experiences of smoking cessation. *Drug and Alcohol Dependence*, *43*, 63-70.

Stanton, W. R., McClelland, M., Elwood, C., Ferry, D., & Silva, P. A. (1996). Prevalence, reliability and bias of adolescents' reports of smoking and quitting. *Addiction*, *91*, 1705-1714.

Sussman, S., Lichtman, K., Ritt, A., & Pallonen, U. E. (1999). Effects of thirty-four adolescent tobacco use cessation and prevention trials on regular users of tobacco products. *Substance Use and Misuse*, *34*, 1469-1503.

U.S. Census Bureau. (2000). *General characteristics: Race and Hispanic or Latino: 2000 data set census (SF1) (SF3)*. Retrieved October 5, 2005, from http://www.census.gov

Worden, J. K., Flynn, B. S., Geller, B. M., Chen, M., Shelton, L. G., Secker-Walker, R. H., et al. (1988). Development of a smoking prevention mass media program using diagnostic and formative research. *Preventive Medicine*, *17*, 531-558.