

Smoking in Movies and Increased Smoking Among Young Adults

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Objective: This study assessed whether smoking in the movies was associated with smoking in young adults.

Methods: A national web-enabled cross-sectional survey of 1528 young adults, aged 18–25, was performed between September and November 2005. Logistic regression and path analysis using probit regression were used to assess relationships between exposure to smoking in the movies and smoking behavior. Analysis was completed in December 2006.

Results: Exposure to smoking in the movies predicted current smoking. The adjusted odds of current smoking increased by a factor of 1.21 for each quartile increase in exposure to smoking ($p < 0.01$) in the movies, reaching 1.77 for the top exposure quartile. The unadjusted odds of established smoking (100+ cigarettes with current smoking) increased by 1.23 per quartile ($p < 0.001$) of exposure, reaching 1.86 for the top quartile. This effect on established smoking was mediated by two factors related to smoking in the movies: positive expectations about smoking and exposure to friends and relatives who smoked, with positive expectations accounting for about two thirds of the effect.

Conclusions: The association between smoking in the movies and young adult smoking behavior exhibited a dose–response relationship; the more a young adult was exposed to smoking in the movies, the more likely he or she would have smoked in the past 30 days or have become an established smoker.

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Introduction

After falling for several decades, incidence of smoking in movies started increasing around 1990 and by 2000 was comparable to 1950 levels.^{1,2} Exposure to smoking in movies is an important environmental variable that stimulates adolescent smoking initiation.³ Experimental studies demonstrate that smoking in movies increases nonsmoking adolescents' positive emotions, excitement, and happiness and increases the likelihood that they will associate smoking with status and vitality.⁴ Epidemiologic studies detect a strong dose–response relationship between exposure to smoking in movies and adolescent smoking initiation, controlling for sociodemographic factors (gender and ethnicity); personality characteristics (sensation seeking); direct tobacco marketing (ad receptivity); peer influence (exposure to friends who smoke); and parenting.^{5–12} Adolescents in the top quartile of

exposure to smoking in movies are two to three times more likely to start smoking than those in the lowest exposure quartile.^{8,13} These findings are consistent with social learning theory, which predicts that behaviors are modeled by observing the behaviors and consequences of behaviors of others.¹⁴ In the case of smoking, adolescents are modeling the behaviors and attitudes of adults as seen in the movies.

While most first cigarette use occurs during adolescence, about one third of adult smokers begin smoking regularly as young adults (aged 18–25).^{15,16} Recent work identified young adults as a group at high risk for smoking¹⁷; smoking prevalence in young adults is the highest among all age groups at 25.3%.¹⁸ Young adulthood is also the time when most adolescent experimenters either transition to regular use or stop smoking.^{19–21} Young adults also compose the largest share of United States movie viewers, with 34% attending a film at least once a month.^{22,23} This study investigated the hypothesis that exposure to smoking in movies is related to smoking in young adults aged 18–25.

Methods

Panel Survey

A cross-sectional Internet survey of 1528 young adults (aged 18–25) was conducted using a web-enabled panel maintained

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by the commercial research company, Knowledge Networks, which collected the data for this study. Knowledge Network's panel members were recruited from the U.S. population using random-digit telephone dialing and were provided with free Internet access in exchange for completing surveys. Recruiting the panel using random-digit dialing avoided the limitation of spontaneous Internet surveys that rely on volunteers: demographic groups most likely to have Internet access would be overrepresented. Members of the panel included people who were not regular Internet users prior to their recruitment into the panel. Moreover, the Knowledge Networks panel was tested against a random-digit-dialing telephone survey and a large volunteer Internet panel.²⁴ The Knowledge Networks panel matched the demographics, attitudes, and behaviors of the telephone survey more closely than a volunteer Internet panel, with higher survey completion rates in the Knowledge Networks panel.

Panel members aged 18–25 were recruited for this study; of 1669 requests, 1325 completed surveys (79.3% response rate). In addition, 203 former panel members aged 18–25 were recruited to achieve the desired sample size of 1528. All surveys were completed via the Internet between September and November 2005, and analysis was completed in December 2006. The survey was conducted in accordance with a human subjects protocol approved by the University of California, San Francisco Committee on Human Research.

Measures

Dependent Variables

Smoking behavior. Two measures of smoking were used: current smoking (those who had smoked at least one cigarette in the past 30 days) and established smoking (those who had smoked at least 100 cigarettes in their lifetime and now smoked cigarettes every day or some days). These measures were used in the California Tobacco Survey and the National Health Interview Survey (NHIS).^{25,26} Both behavioral measures were dichotomously coded 0 or 1 for absence or presence of smoking.

Independent Variables

Demographics. Respondents' gender was coded 0=Male and 1=Female. Highest level of education was coded 0 to 3, (0=less than high school; 3=Bachelors degree or higher). Income level was coded 0–18 (0=less than \$5000 per year; 18=more than \$175,000 per year). Ethnicity (Caucasian, African-American, other non-Hispanic, Hispanic American, biracial non-Hispanic) was entered as a categorical variable for all analyses.

Exposure to smoking in movies. Following the methods utilized by Sargent and colleagues^{5–7,13} that demonstrated a dose-response relationship between exposure to smoking in movies and adolescent smoking, each respondent was presented with a list of 60 motion pictures selected at random from the top-grossing 500 movies released between 2000 and 2004.²⁷ Respondents were asked to indicate which films he or she had seen. Since the survey was conducted over the Internet,

subjects also were prompted with a copy of the advertising poster for the film as well as the title to aid recall. As a test of recall or random responding, all subjects were asked if they had seen the non-existent film "Handsome Jack." Only 0.5% of the respondents reported having seen this "film," suggesting that false memory or random responding played little to no role in the study.

As in earlier studies of adolescents,^{5,6,8,13,28} exposure to smoking in the movies was estimated by adding up the total number of smoking occurrences in the 60 movies each respondent reported having seen. Responses were then divided into quartiles of exposure to facilitate comparison with research done on adolescents.^{5–7,13} The advantage of using Sargent's measure of exposure to smoking in the movies is that it is based on recognition skills, as opposed to measures that ask respondents to recall and list movies they have seen, which requires more-complex memory processes than recognition.^{29,30} This measure also reflects actual exposure to smoking in movies rather than respondents' attention, attitudes, or predispositions to smoking.⁸

Positive expectations associated with smoking. Respondents were asked to rate their level of agreement with three statements concerning their expectations associated with smoking (Smoking a cigarette can make you feel more comfortable around other people, Smoking a cigarette around others gives you something to do when others are talking, and Smoking helps to control your stress level). Their responses were combined to create a measure of "positive expectations" (similar to subjective expected utility⁵ and perception of benefits³¹ used by investigators of youth smoking) by averaging the 5-point Likert scale scores for these questions, with 0 representing the lowest response and 4 the highest. The questions demonstrated reliability with an internal consistency coefficient (Cronbach's alpha) of 0.83.

Sensation seeking. Six items from the Zukerman-Kuhlman Personality Questionnaire Sensation Seeking facet of the Impulsive Sensation Seeking Scale³² were used to measure impulsivity (I sometimes like to do things that are a little frightening, I enjoy getting into new situations where you can't predict how things will turn out, I sometimes do "crazy" things just for fun, I like doing things just for the thrill of it, I like to have new and exciting experiences and sensations even if they are a little frightening, and I'll try anything once). Responses were combined by averaging the 5-point Likert scale scores for these questions, with 0 representing the lowest response and 4 the highest. Cronbach's alpha for these questions was 0.85.

Exposure to smoking. Respondents were asked to report whether relatives, close friends, or coworkers around them smoked. Respondents reported how many people in each of the three exposure groups

smoked (none, some, most, or all). Exposure to relatives, exposure to friends, and exposure to coworkers were measured as separate variables since previous research on exposure to smoking in movies included similar exposure variables, such as exposure to friends, exposure to siblings, and exposure to parents.³³ Responses to each of the three questions were coded on a 4-point Likert scale score, with 0 representing the lowest exposure and 3 the highest. Since exposure to relatives and exposure to friends were correlated ($r=0.43$, $p<0.001$), the two questions were averaged to create a composite score called exposure to friends and relatives.

Receptivity to tobacco advertising. Advertising receptivity was measured on the index developed by Pierce and Gilpin^{34,35} to study advertising and teenage smoking. Respondents were asked questions regarding tobacco promotional items and advertisements they had encountered. Advertising receptivity was coded on a 4-point scale: 0=nonreceptive (answered no to all questions); 1=minimally receptive (could not name a favorite tobacco advertisement but could name a recently seen tobacco advertisement on billboards or magazines); 2=moderately receptive (respondents did not own or were not willing to use a promotional item, but could name a favorite tobacco advertisement); and 3=highly receptive (respondents either had a promotional item or who were willing to use an item). Advertising receptivity was entered as a continuous variable in the statistical analyses. Cronbach's alpha for these questions was 0.61.

Perceived prevalence of smoking. Respondents estimated how many people their age smoke based on their experience using a 10-point response scale with each point representing a 10% range (0=0%–10%; 9=91%–100%).

Statistical Analysis

Univariate and multivariate logistic regression quantified the relationship between current smoking and established smoking as dependent variables and exposure to smoking in the movies (coded as a continuous variable with 0 for the lowest quartile, 1 for the second quartile, 2 for the third quartile, and 3 for the top quartile), exposure to friends and relatives who smoke, exposure to coworkers who smoke, perceived prevalence of smoking, positive expectations of smoking, ad receptivity, sensation seeking, gender, education, income level, and ethnicity as independent variables. Logit plots were created for each variable to test for a linear relationship between these scores and the logit of current smoking. Where the relationship was linear, the variables were treated as continuous predictors. Exposure to smoking in the movies, exposure to friends and relatives who smoke, exposure to coworkers who

smoke, perceived prevalence of smoking, positive expectations of smoking, ad receptivity, sensation seeking, education, and income level were entered as continuous variables (Tables 2 and 3). Odds ratios indicated increases in odds of being a current smoker or established smoker for each incremental increase in coded category of the variable. Analysis treating number of incidents of smoking in the movies as a continuous variable yielded results consistent with the quartile approach. The quartile data were reported to facilitate comparisons with published results on adolescents.

Examination of logit plots revealed that quartile of exposure to smoking in movies treated as a continuous variable fit the data well, so this single variable was used in the regressions, rather than treating quartile as a categorical variable. This approach directly tested for a dose-response effect. Calculations were done with SPSS 14.0.

Path analysis using Mplus 4.20 tested mediated relationships among variables using weighted least square probit regression to estimate parameters within the model and chi-square goodness of fit, root mean square error of approximation (RMSEA), and weighted root mean square residual (WRMR) to assess how well the model fit the data.³⁶ Bootstrap estimation was used to determine 95% confidence intervals (CIs).

Results

Demographics

Table 1 shows that the demographic characteristics of the sample are comparable to the U.S. national average

Table 1. Comparison of demographic characteristics

	Study sample Aged 18–25 (n=1528)	2005 U.S. Census for young adults aged 18–24 ³⁸
Smoking prevalence (%)		
Current smoking (30-day prevalence)	31.0	—
Established smoking (100+ cigarettes)	24.7	25.3 ^a
Male–female ratio	50–50	48–52 ^b
Ethnicity (%)		
Caucasian American	61.0	66.9 ^b
African American	13.8	12.2 ^b
Other non-Hispanic	3.9	5.1
Hispanic American	18.3	14.5 ^b
Biracial non-Hispanic	3.0	1.3
Education (%)		
Less than high school	21.0	19.6
High school	30.5	34.0
Some college	36.0	37.1
Bachelors or higher	12.5	9.3
Economic		
Paid employee (%)	57.5	67.6
Median income (\$)	25,000–35,000	28,770

^aFrom the National Health Interview Survey.¹⁸

^bEntire national population (not just young adults).

Table 2. Predictors of current smoking (within the past 30 days)^a (*n*=1528)

	Unadjusted OR (95% CI)	Adjusted OR (95% CI) ^b
Movie exposure (per quartile)	1.30 (1.17–1.43)^c	1.21 (1.05–1.38)
Friends and relatives who smoke ^d	3.68 (3.03–4.45)	1.94 (1.49–2.52)
Coworkers who smoke ^d	1.17 (1.07–1.28)	1.07 (0.95–1.24)
Perceived prevalence of smoking ^e	1.23 (1.17–1.30)	1.12 (1.04–1.20)
Positive expectations ^f	4.94 (4.16–5.89)	3.85 (3.21–4.61)
Ad receptivity	2.53 (2.20–2.91)	1.61 (1.37–1.90)
Sensation seeking	1.23 (1.16–1.31)	1.09 (1.00–1.18)
Male gender	1.22 (0.98–1.51)	0.98 (0.73–1.32)
Education ^g	0.82 (0.73–0.92)	0.99 (0.83–1.18)
Income ^h	0.94 (0.85–1.04)	1.01 (0.98–1.05)
Ethnicity		
Caucasian	1.0	1.0
African American	0.57 (0.40–0.81)	0.54 (0.33–0.88)
Other non-Hispanic	0.72 (0.39–1.31)	1.49 (0.66–3.38)
Hispanic American	0.86 (0.64–1.15)	0.67 (0.44–1.01)
Biracial non-Hispanic	1.13 (0.61–2.12)	1.11 (0.47–2.64)

^aFor continuous variables, odds ratios indicate incremental increases in the odds of being a current smoker for each coded category of the variable.

^bAdjusted for all other listed variables.

^cSignificant (*p*<0.05) Odds ratios are bolded.

^dCoded categories are: 0=None smoke; 1=Some smoke; 2=Most smoke; 3=All smoke; entered as a continuous variable.

^eCoded categories range from 0=0–10% smoke to 9=91–100% smoke; entered as a continuous variable.

^fCoded categories range from 0=Low expectations to 4= High expectations; entered as a continuous variable.

^gCoded categories range from 0=Less than high school; 1= High school diploma; 2= Some college; 3=Bachelors or higher; entered as a continuous variable.

^hCoded categories range from 0=Less than \$5,000 per year to 18=More than \$175,000 per year; entered as a continuous variable.

for young adults in the same age group.³⁷ The smoking rate in the panel in 2002 was 24.7%, comparable to the 2002–2004 NHIS estimate for young adult smoking prevalence (25.3%).¹⁸

Exposure to Smoking in Movies

Figure 1 shows a histogram of the number of smoking occurrences in the 60 films seen by the people in the sample. The first quartile represents an exposure level of 0–48 occurrences; the second quartile, 49–90 occurrences; the third quartile, 91–143 occurrences; and the fourth quartile, 144–390 occurrences. These levels are approximately the same as the exposure patterns Dalton et al⁸ observed in adolescents aged 10–14; their quartiles corresponded to 59, 109, and 131 for a sample of 60 movies. (A sample of 50 movies was used in that study, their quartile points were multiplied by 60/50 to permit comparisons with the results from this survey.)

Movie Exposure and Current Smoking (30-day Prevalence)

Smoking in movies predicts whether a respondent smoked in the past 30 days (Table 2). The unadjusted odds of smoking significantly increased by a factor of 1.30 for each quartile of exposure to smoking in the movies. This increase in odds corresponds to unadjusted odds ratios (ORs) of 1.30, 1.69, and 2.20 for the second, third, and fourth quartiles of exposure. The adjusted odds increased by a factor of 1.21 per quartile of exposure. This increase in odds corresponds to adjusted ORs (AORs) of 1.21, 1.46, and 1.77 for the second, third, and fourth quartiles of exposure. (The corresponding adjusted estimates when treating quartile as a categorical variable are 1.1, 1.34, and 1.58 for the second, third, and fourth quartiles, respectively, indicating that the treatment of exposure quartile as a continuous variable is reasonable.) The fact that the AOR is similar to the unadjusted OR suggests that most of the effect of exposure to smoking in the movies on current smoking is a direct effect. The other variables

Table 3. Predictors of established smoking (100+ cigarettes)^a

	Unadjusted OR (95% CI) <i>n</i> =1528	Adjusted OR (95% CI) ^b <i>n</i> =1528
Movie exposure (per quartile)	1.23 (1.11–1.36)^c	1.08 (0.93–1.25)
Friends and relatives who smoke ^d	4.25 (3.48–5.20)	2.03 (1.54–2.68)
Coworkers who smoke ^d	1.21 (1.10–1.33)	1.16 (1.02–1.32)
Perceived prevalence of smoking ^e	1.30 (1.23–1.37)	1.20 (1.11–1.30)
Positive expectations ^f	5.76 (4.77–6.96)	4.63 (3.77–5.67)
Ad receptivity	2.83 (2.44–3.28)	1.75 (1.46–2.09)
Sensation seeking	1.22 (1.15–1.29)	1.07 (0.98–1.16)
Male gender	1.24 (0.99–1.55)	1.01 (0.73–1.38)
Education ^g	0.72 (0.64–0.81)	0.81 (0.68–0.97)
Income ^h	0.86 (0.78–0.96)	0.98 (0.95–1.02)
Ethnicity		
Caucasian	1.0	1.0
African American	0.67 (0.48–0.96)	0.54 (0.32–0.89)
Other non-Hispanic	0.47 (0.24–0.92)	0.67 (0.26–1.78)
Hispanic American	0.88 (0.66–1.18)	0.61 (0.39–0.94)
Biracial non-Hispanic	0.92 (0.48–1.77)	0.73 (0.28–1.88)

^aFor continuous variables, odds ratios indicate incremental increases in the odds of being an established smoker for each coded category of the variable.

^bAdjusted for all other listed variables.

^cSignificant (*p*<0.05) odds ratios are bolded.

^dCoded categories are: 0=None smoke; 1=Some smoke; 2=Most smoke; 3=All smoke; entered as a continuous variable.

^eCoded categories range from 0=0–10% smoke to 9=91–100% smoke; entered as a continuous variable.

^fCoded categories range from 0=Low expectations to 4=High expectations; entered as a continuous variable.

^gCoded categories range from 0=Less than high school; 1=High school diploma; 2=Some college; 3=Bachelors or higher; entered as a continuous variable.

^hCoded categories range from 0=Less than \$5,000 per year to 18=More than \$175,000 per year; entered as a continuous variable.

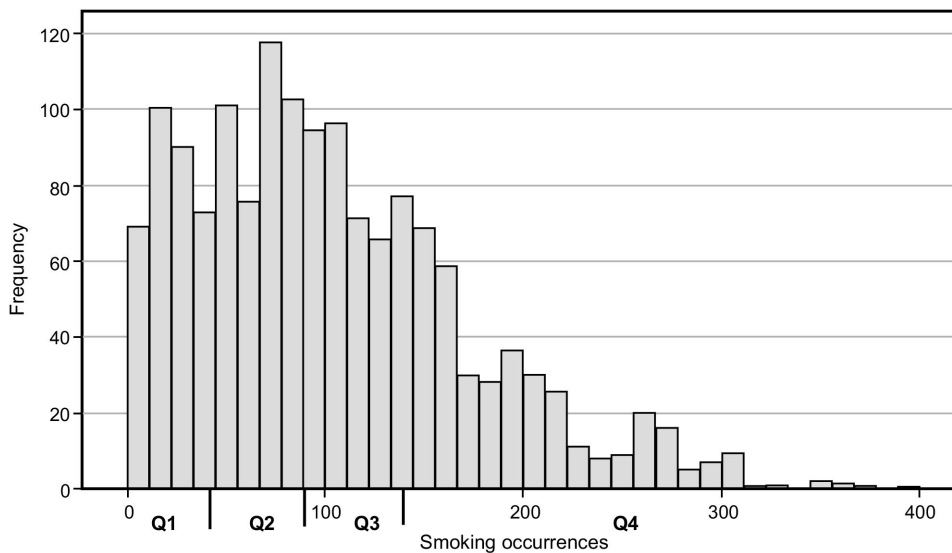


Figure 1. Number of smoking occurrences viewed by respondents. Most young adults in the sample saw around 100 smoking occurrences in the 60 of the top-grossing 600 films released between 2000 and 2004. The first quartile (reference condition) represents an exposure level of 0–48 smoking occurrences; the second quartile corresponds to 49–90 smoking occurrences; the third quartile corresponds to 91–143 smoking occurrences; and the fourth quartile corresponds to 144–390 smoking occurrences.

associated with significant odds of current smoking were exposure to friends and relatives who smoke, perceived prevalence of smoking, positive expectations, ad receptivity, sensation seeking, and ethnicity. Young adults with friends and relatives who smoked were more likely to have smoked. Perceived prevalence of smoking, positive expectations for smoking, ad receptivity, and sensation seeking were also positively associated with recent smoking. African Americans were less likely to smoke compared to Caucasians, AOR=0.54 (95% CI=0.33–0.88). The overall logistic regression model was statistically significant, $\chi^2_{14}=702.28$, $p<0.001$; Nagelkerke $R^2=0.53$.

Movie Exposure and Established Smoking

The unadjusted odds of having smoked at least 100 cigarettes and smoking every day or on some days significantly increased by a factor of 1.23 for each quartile of movie exposure ($p<0.001$), corresponding to an OR of 1.86 for the highest quartile of movie exposure (Table 3). This effect became nonsignificant in the multivariate analysis, with an AOR of 1.08 ($p=0.32$). The variables that did significantly predict smoking in the multivariate analysis were exposure to friends and relatives who smoke, coworkers who smoke, perceived prevalence of smoking, positive expectations, ad receptivity, education, and ethnicity. Young adults with friends, relatives, and coworkers who smoked were more likely to be established smokers. Perceived prevalence, positive expectations, and ad receptivity were also positively linked with established smoking. Education was negatively related to established smoking;

young adults with higher levels of education were less likely to be established smokers. Compared to Caucasian Americans, African Americans and Hispanic Americans were less likely to be established smokers, AOR=0.54 (95% CI=0.32–0.89) and AOR=0.61 (95% CI=0.39–0.94), respectively. The overall logistic regression model was statistically significant, $\chi^2_{14}=797.22$, $p<0.001$; Nagelkerke $R^2=0.59$.

Test of Mediation Between Movie Exposure and Established Smoking

The fact that the direct effect of movies dropped below statistical significance for established smokers once exposure to smokers, attitudes, and personality variables were included in the model suggested that some of these variables mediate the relationship between movie exposure and established smoking. The method of Baron and Kenny³⁸ was used to identify the variables that mediate this relationship by identifying variables that (1) were related to both movie exposure and established smoking, and (2) when included in the logistic regression, decreased the relationship between movie exposure and established smoking. For each independent variable entered into the logistic regression equation, two-step logistic regressions were computed with movie exposure entered on the first step and one other independent variable on the second step to test whether including that independent variable decreased the estimated relationship between movie exposure and established smoking. Independent variables that caused a significant decrease in movie expo-

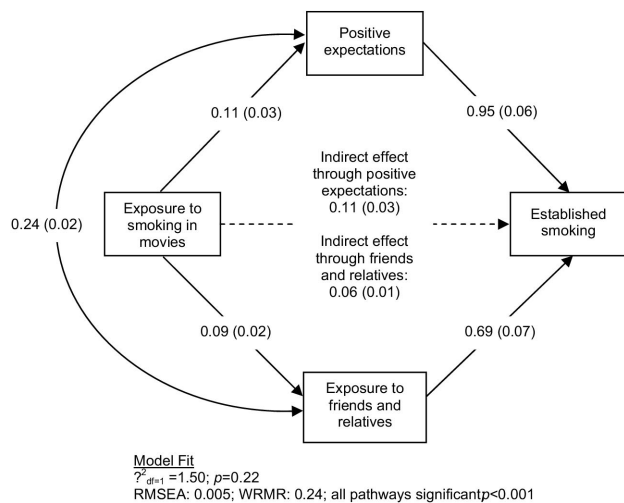


Figure 2. Path analysis. The results of a probit path analysis indicated that the effects of smoking in the movies established smoking via two pathways: through exposure to friends who smoke and positive expectations for smoking. The pathways were also correlated to each other. As shown in the top half of the diagram, exposure to smoking in the movies increased positive expectations for smoking, which in turn, increased the probability of established smoking. The second pathway shown in the bottom half of the diagram indicated that exposure to smoking in the movies increased the probability that a respondent would have friends who smoked which, in turn, increased the probability of smoking. The effect of smoking in the movies on established smoking was about twice as great through positive expectations than exposure to friends and relatives who smoke. (All path coefficients are unstandardized probit coefficients with the standard errors in parenthesis.)

sure's estimated association with established smoking were identified as potential mediators. A decrease in association was judged worth considering for mediation analysis if the p -value for movie exposure increased from its unadjusted level ($p < 0.001$) to $p > 0.01$. Variables that did not decrease the relationship between movie exposure and established smoking were eliminated from further consideration. This process identified two potential mediating variables: exposure to friends and relatives who smoke and positive expectations.

Including exposure to friends and relatives who smoke in a logistic regression after movie exposure decreased the odds of smoking from 1.23 ($p < 0.001$) to 1.15 ($p = 0.013$) per quartile of movie exposure to smoking. Including positive expectations after movie exposure decreased the odds ratio for movie exposure from 1.23 ($p < 0.001$) to 1.18 ($p = 0.013$) per quartile of exposure to movie smoking. Including both variables reduced the OR for movie exposure to a nonsignificant, 1.11 ($p = 0.13$). These logistic regressions suggest that both exposure to friends and relatives who smoke and positive expectations may mediate the relationship between exposure to smoking in movies and established smoking (Figure 2).

Probit regression was used to conduct a formal path analysis to compare the relative importance of these two paths. (Probit regression was used because no software existed that would allow a mixture of continuous mediators [exposure to friends' and relatives' smoking and positive expectations] and a dichotomous dependent variable [smoking behavior] and provide a global fit statistic.) A model was hypothesized that showed a causal direction from movie exposure to established smoking because longitudinal studies on adolescents suggest that smoking in the movies causes an increase in smoking.^{8,39,40} This model allowed exposure to smoking in movies to increase exposure to smoking friends and relatives and positive expectations associated with smoking, with exposure to friends and relatives who smoke and positive expectations increasing the probability of established smoking. The model also allowed a correlation between the two potential mediating variables (without hypothesizing the direction of that relationship). There was no hypothesized direct association between movies and established smoking because the multivariate logistic regression showed that a direct association was not significant.

This model adequately fit the data ($\chi^2_1 = 1.50$, $p = 0.22$; RMSEA < 0.005 ; WRMR = 0.24; a good fit is indicated by a nonsignificant χ^2 , an RMSEA < 0.05 , or a WRMR < 0.90 ^{36,37}). Figure 2 shows that both increased exposure to friends and relatives who smoke and increased positive expectations associated with smoking are pathways through which increased exposure to smoking in movies increased established smoking, with the positive expectations pathway accounting for about two thirds of the effect.

Discussion

This study is the first to demonstrate that smoking in movies is associated with smoking in young adults in a dose-dependent manner; the more a young adult is exposed to smoking in the movies, the more likely he/she will have smoked in the past 30 days or have become an established smoker. These results are similar to prior studies demonstrating the effect smoking in the movies has on smoking initiation in adolescents.^{3,5-8,13,41-43}

Exposure to smoking at the highest quartile corresponded to an AOR of 1.77 (1.21³) for 30-day young adult smoking. Previous studies on adolescents reported a strong effect of exposure on smoking initiation, 2.50¹³ (95% CI = 1.7-3.5) to 2.71⁸ (95% CI = 1.7-3.50) for the highest quartile of movie exposure. The effect in young adults is probably smaller than in adolescents for two reasons. First, about two thirds of ever smokers are current smokers by the time they reach their 18th birthday, so many of the young people who are affected by smoking in the movies will have started smoking by the time they reach age 18, leaving

fewer people susceptible to starting smoking because of exposure to smoking in movies. Second, studies on adolescents focused on smoking initiation (Have you ever tried smoking a cigarette, even just a puff?), not current or established smoking, because smoking is infrequent among adolescents⁷ and not all initiators go on to become current or established smokers. Since most young adults will have smoked a few puffs of a cigarette during adolescence, ever smoking a single puff (initiation) is not an appropriate behavior to study smoking behavior in young adults. The current study on young adults used the most analogous behavior for adolescent initiation: current and established smoking.

Even though the effect demonstrated in young adults is smaller than effects shown in adolescents, the magnitude of the effect of smoking in the movies is comparable to other environmental risk factors for smoking initiation in young adults. For example, tobacco company advertising in bars, clubs, or college campus social events increases the odds of 30-day young adult smoking by a factor of 1.75 (95% CI=1.47–2.08),⁴⁴ similar to the effect of exposure to smoking in the movies at the highest quartile (odds ratio=1.77).

The effect of smoking in the movies on smoking behavior is direct with 30-day smoking and indirect with established smoking. The finding that smoking in the movies is related to recent 30-day smoking suggests that movies may primarily influence young adult smoking by recruiting new smokers. Rather than directly encouraging young adults to smoke frequently, smoking in the movies may instead encourage young adults to experiment with smoking. Once experimentation occurs, other factors become influential in encouraging smoking. As Figure 2 indicates, exposure to friends and relatives who smoke and having positive expectations for smoking—both of which increase with increased exposure to smoking in movies—increase the probability of established smoking. These effects persist even after controlling for a wide variety of other variables, including the effects of cigarette advertising. This model is supported by psychological literature on social learning, modeling, and imitation that suggest that much of behavior is learned by observing others, including those shown on screen.^{14,45,46}

Limitations

As in any cross-sectional study, the research can demonstrate only an association between exposure to movie smoking and smoking behavior. Although the model and previous longitudinal studies of adolescents suggest that the direction of the association goes from smoking in the movies to established smoking, the absence of longitudinal data precludes conclusively establishing causality. Future research in the area should consider cohort data, not only to establish causality, but also to provide insight on whether smok-

ing in the movies also causes transitions to elevated levels of smoking (e.g., initiation to established smoking) by including initial questions addressing if and when young adults began smoking and following them across time to see if exposure to smoking in the movies predicts an increase in smoking behavior at later time points.

The use of a pre-recruited panel is also a potential limitation, although the panel was recruited through random-digit dialing rather than simply recruiting volunteers via the Internet. This panel methodology also provides a young adult sample more diverse than in traditional study samples of college students. In addition, the measure of exposure to smoking in movies does not account for the possibility that respondents might watch a particular movie multiple times, so the measure probably underestimates actual exposure. Finally, the fact that the reference category for the logistic regressions was the first quartile of exposure to smoking in movies—as opposed to a truly unexposed group—underestimates the actual effect of exposure to smoking in the movies on young adult smoking behavior.

Conclusion

This study demonstrates that smoking in the movies is both directly and indirectly related to smoking behavior among young adults. Smoking in the movies has a direct association with 30-day smoking in young adults—which probably reflects experimentation and initiation in this group—as well as an indirect effect on established smoking (100+ cigarettes). The finding that smoking in the movies is associated with positive expectations for smoking and exposure to friends and relatives who smoke, which in turn is related to established smoking is supported by research done on adolescents. This result is consistent with experimental and epidemiologic evidence in adolescents and young adults that movies directly influence attitudes about smoking.^{3,47} In particular, studies have shown that adolescent smokers hold higher positive expectations for smoking than adolescent nonsmokers.^{31,48,49} The current study provides insight as to where adolescents and young adults may get these expectations: the movies.

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Drs. Glantz and Ling designed the study and supervised the data collection. Dr. Neilands provided methodologic and statistical support during the data collection and analyses stages of the study. Dr. Song prepared the first draft of the manuscript. All authors participated in conducting the statistical analysis and revised the drafts of the manuscript. Dr. Glantz serves as guarantor.

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