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Longitudinal effects of pro-tobacco and anti-tobacco messages on adolescent smoking susceptibility

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We examined the longitudinal impact of self-reported exposure to pro- and anti-tobacco media on adolescents' susceptibility to smoking, using in-school surveys from a culturally diverse sample. Ethnicity and acculturation also were examined as potential moderators. Middle-school students (N=2,292) completed self-report questionnaires during the 6th, 7th, and 8th grades. Chi-square analyses were conducted to determine whether reported exposure to pro- and anti-tobacco media varied according to ethnicity, acculturation, and immigration status. Logistic regression models were used to examine whether pro- and anti-tobacco media exposure in 6th grade was associated with susceptibility to smoking by later grades. Recall of people smoking in television programs and pro-tobacco advertisements in stores was associated with adolescent smoking susceptibility. Exposure to anti-tobacco advertisements on television protected against susceptibility. No significant interaction effects between pro- and anti-tobacco media exposure on smoking susceptibility were found. Ethnicity and acculturation did not moderate these associations. Our longitudinal study provides evidence that pro-tobacco media and advertising increases susceptibility to smoking over time. More important, anti-tobacco advertisements are not sufficient to reduce the harmful effects of adolescent exposure to pro-tobacco media. Policy-level interventions such as restrictions in tobacco advertising may be necessary to prevent adolescent smoking.

Introduction

Youth are exposed to many types of tobacco brand advertising, such as that found in retail outlets, and pro-smoking imagery, such as can be found on television and in movies (Lee, Taylor, & McGetrick, 2004). Because the pro-tobacco message cannot be completely suppressed, anti-tobacco media campaigns, usually sponsored by government agencies, try to counter their effects (Lee et al., 2004; Pechman & Reibling, 2000; Wakefield, Flay, Nichter, & Giovino, 2003). Ample evidence suggests that both pro-tobacco messages and anti-tobacco media campaigns are associated with smoking susceptibility among adolescents (Arnett & Terhanian, 1998; Feighery, Borzekowski, Schooler, & Flora, 1998; Straub, Hills, Thompson, & Moscicki, 2003). Less is known about the ways in which these forms of media interact, or their effects on susceptibility over time (Jackson, 1998; Siegel & Biener, 2000). Anti-tobacco and pro-tobacco media may dampen one another, or one type may raise the threshold required by the other to influence youth (Lee et al., 2004). These effects may be altered by the cultural experiences of the individuals exposed. We therefore undertook this study to answer three questions: First, to what extent does exposure to tobacco media affect susceptibility to smoking over time? Second, does anti-tobacco media exposure interact with pro-tobacco media exposure in relationship to smoking susceptibility in adolescents? Third, does ethnicity or acculturation affect the relationship between tobacco-related media exposure and intention to smoke?

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Exposure to pro-tobacco media

Evidence from previous studies suggests that exposure to tobacco-related marketing is one of the risk factors for smoking among adolescents (Botvin, Goldberg, Botvin, & Dusenbury, 1993; Pierce, Choi, Gilpin, Farkas, & Berry, 1998). Pro-smoking messages exist in nearly every form of media, including magazines, retail outlets, signs at sporting and cultural events (Feighery et al., 1998; Schooler, Feighery, & Flora, 1996), and most recently on the Internet (Hong & Cody, 2002). The past two decades have witnessed increased product placement in films and television programming (Shields, Carol, Ballbach, & McGee, 1999). As a result, exposure to tobacco advertising and promotions influences youth smoking susceptibility and smoking initiation (Altman, Levine, & Coeytaux, 1996; Sargent et al., 2001; Unger, Johnson, & Rohrbach, 1997). Smoking susceptibility (the lack of a firm commitment *not* to smoke and the likelihood of trying a cigarette in the near future) has been considered a crucial stage in the initiation process because it increases vulnerability to the many predisposing factors that stimulate smoking experimentation (Altman et al., 1996; Feighery et al., 1998; Jackson, 1998). Empirical studies indicate that recall of specific marketing promotions, receptivity toward tobacco advertising, and perceived pervasiveness of tobacco marketing have been associated with youth smoking susceptibility (Pierce et al., 1998; Sargent et al., 2002; Unger, Johnson, & Stoddard, 1997).

Exposure to anti-tobacco media

In an effort to counter the deleterious effects of tobacco marketing on youth, various campaigns have been initiated by anti-tobacco coalitions. Although anti-smoking message themes vary widely, most advertisements emphasize short- and long-term health effects (including effects from second-hand smoke), resisting social pressures and influences, and most recently, illustrating tobacco industry manipulation (Farrelly, Niederdeppe, & Yarsevich, 2003; Goldman & Glantz, 1998; Pechman & Goldberg, 1998). A number of studies examining both community trials and government-funded anti-tobacco media campaigns report the reduction or prevention of tobacco use among youth (Flynn, Worden, & Secker-Walker, 1994; Flynn et al., 1992; Hafstad & Aarro, 1997; Sly, Heald, & Ray, 2001), whereas others find little association (Bauman, LaPrelle, Brown, Koch, & Padgett, 1991; Murray, Prokhorov, & Harty, 1994) or limited effects for certain youth populations (Siegel & Biener, 2000).

Some evaluations of anti-smoking media campaigns reveal that adolescents routinely receive substantial exposure to both pro- and anti-tobacco messages via many communication channels. Nevertheless, little is known about possible interaction between pro- and anti-tobacco media exposure (e.g., whether anti-tobacco media exposure can lessen the effects of pro-tobacco media exposure). To date, only one study has examined this relationship. Straub and colleagues (2003) found exposure to both anti- and pro-tobacco influences to be strong predictors of smoking intention among a high school cohort. Their analysis further indicated that although neither variable moderated the relationship between adolescent smoking intention and the other predictor, anti-tobacco advertising appeared to serve a protective function but failed to completely overcome the harmful impact of pro-tobacco advertising.

Acculturation and smoking

Some evidence suggests that pro-tobacco media influence does not affect all ethnic groups uniformly. Adolescents from certain ethnic populations may be more receptive to tobacco promotional messages. A cross-sectional survey of African American, Asian American, Hispanic, and non-Hispanic White adolescents in California found the last group to be more receptive to tobacco marketing practices than other ethnic groups (Chen, Cruz, Schuster, Unger, & Johnson, 2002). The authors suggest that variation in acculturation status and language proficiency may affect audience level of exposure to, comprehension of, and internalization of pro-tobacco messages. Although evidence exists regarding the tobacco industry's use of specific promotional strategies to target ethnic minorities (Luke, Esmundo, & Bloom, 2000; Muggli, Pollay, Lew, & Joseph, 2002; Pollay, Jung, & Carter-Whitney, 1992; Pucci, Joseph, & Siegel, 1998; Stoddard, Johnson, Sussman, Dent, & Cruz, 1998), the influence of acculturation on the effectiveness of those communications is less evident.

Evidence about the relationship between acculturation and smoking behavior among immigrant adolescents, including Asian Americans and Hispanics, is mixed. Previous studies identified acculturation as a risk factor for smoking among Hispanic adolescents (Epstein, Botvin, & Diaz, 1998; Marin, Perez-Stable, & Marin, 1989; Otero-Sabogal, Sabogal, & Perez-Stable, 1995; Unger et al., 2000), although there is controversy about this association for Asian Americans. Acculturation was a risk factor for smoking behavior among Asian Americans in some studies (Chen, Unger, Cruz, & Johnson, 1999a) but only a small or nonsignificant risk factor, or a risk factor for Asian American girls but not for boys, in other studies (Unger, Trinidad, Weiss, & Rohrbach, 2004; J. W. Weiss & J. A. Garbanati, manuscript submitted). Acculturation involves two dimensions: Maintenance of the traditional culture of one's own group, and

interaction with and adaptation to the host country culture (Berry, 1997; Kosic, 2002). The process incorporates the host culture into one's native culture and consolidates the two cultures into one's ethnic identity (Berry, 1980; Phinney, Horenczyk, Liebkind, & Vedder, 2001). Acculturation to the United States typically results in improved English proficiency, which may increase adolescents' receptivity and comprehension of pro- and anti-tobacco messages in the mass media (Keefe & Newcomb, 1996; Unger et al., 2000). The cultural practices and meanings of smoking in an individual's home country, as well as the youth's acculturation strategies in the host society, may affect the relationship between acculturation and smoking (Marin & Marin, 1991). Given the proportion of the U. S. population born outside the country, it is important to understand how the associations between exposure to pro- and anti-tobacco media and smoking susceptibility may vary across ethnic groups or levels of acculturation.

To our knowledge, the present study is the first to examine longitudinal effects of exposure to both pro- and anti-smoking media on smoking susceptibility. In addition, the study features an ethnically diverse cohort and explores the interaction between ethnicity and media exposure. To assess the effects of pro- and anti-tobacco media exposure on adolescents' smoking susceptibility, we determined the odds ratios of smoking susceptibility in 8th grade according to pro- and anti-tobacco advertising exposure in 6th grade. We expected higher exposure to pro-tobacco media to be associated with higher smoking susceptibility, higher exposure to anti-tobacco media to be associated with lower smoking susceptibility, and pro- and anti-tobacco media exposure to have an interactive effect on susceptibility. We also anticipated that smoking susceptibility would vary according to ethnicity and acculturation status, and that ethnicity and acculturation would moderate the associations between pro- and anti-tobacco media exposure and smoking susceptibility.

Method

Sample

The data described here are from a 2-year follow-up survey of a longitudinal school-based experimental trial of smoking prevention strategies in a multicultural, urban population of adolescents in Southern California (Unger, Chou et al., 2004). Students were surveyed annually while in the 6th, 7th, and 8th grades.

School selection

Because the larger study focused on schools with large proportions of Hispanic or Asian American students, schools were eligible to participate in the study if their student population was at least 25% Hispanic or at least 25% Asian American. A total of 36 public and private school districts in and near the Los Angeles metropolitan area were invited to participate. Of those, 26 districts agreed to participate. The 26 districts contained 150 middle schools, of which 68 agreed to participate. Of those schools, 33 met the criteria for ethnic distribution, geographic distance from the research center, inclusion of grades 6, 7, and 8, and ability to obtain sufficient parental consent. Nine of those schools participated in qualitative and quantitative pilot research for questionnaire development, and the remaining schools participated in this longitudinal study. The catchment areas of the participating schools had a median income of US$44,590, compared with the statewide median of $47,493 in 2000 (U.S. Census Bureau, 2001).

All 6th-grade students in the 24 schools in the longitudinal study were invited to participate. Of the 4,427 students invited to participate, 3,358 (75.9%) provided active parental consent. Of the students who provided consent, 3,190 completed the 6th-grade survey, 2,822 completed the 7th-grade survey, and 2,561 completed the 8th-grade survey. A total of 2,292 students completed surveys in all three waves, and these students constitute the sample for the present study. Attrition rates were lower among Asian Americans than among other ethnic groups ($p<.001$) and were higher for those who reported ever smoking relative to those who reported never smoking while in 6th grade ($p<.001$).

Procedure

Each year, students completed a 160-item paper-and-pencil survey in their classrooms during a single class period (45–50 min). Trained data collectors, who were not previously acquainted with the students, distributed the surveys. The surveys were identified only by a code number, not with the students' names or any other identifying information. Because all students were attending English-language schools in which classes were conducted only in English, a basic level of English-language proficiency was assumed and the surveys were provided only in English. However, students were encouraged to ask the data collectors to clarify the meanings of any unfamiliar words.

Measures

Smoking susceptibility. Baseline smoking status was classified into two categories: Nonsusceptible nonsmokers, and all others, including susceptible nonsmokers and smokers (both experimenters and

past-30-day smokers). Students were defined as nonsusceptible to smoking if they answered "definitely not" to the question "At any time in the next year (12 months), do you think you will smoke a cigarette?" Responses for this question were rated on a four-point scale (1="No, definitely not" to 4="Yes, definitely"). Responses with "No, definitely not" were coded as nonsusceptible nonsmokers. All other responses ("Yes, definitely," "Maybe yes," and "Maybe no") were coded as susceptible nonsmokers. According to previous research (Pierce et al., 1998; Unger, Cruz, Schuster, Flora, & Johnson, 2001), individuals with these responses are not committed to never smoking a cigarette. Although this does not mean these individuals intend to smoke, they do not absolutely rule out the possibility of smoking in the short term (in 6 or 12 months) and do not rule out accepting a cigarette offered by a friend. For the present study, only those students who were nonsusceptible nonsmokers at baseline were included in the analyses. The outcome variable was smoking susceptibility in year 2 and year 3. If students reported lifetime smoking or susceptibility to smoking at either year 2 or year 3, they were coded as susceptible to smoking. This measure of susceptibility to smoking has been shown to reliably predict progression to smoking (Pierce et al., 1998; Pierce, Farkas, Evans, & Gilpin, 1995) and is a more sensitive measure than actual smoking among children and young adolescents because of the low rates of smoking in these groups (Sargent et al., 2002).

Pro-tobacco media exposure. We assessed baseline exposure to pro-tobacco media with two items: "When you watch TV, how often do you see people smoking" and "When you go to a small market, convenience store (like 7-11), or gas station mini-mart (like AM/PM), how often do you see advertisements for cigarettes?" Response options were rated on a four-point scale (1="A lot" to 4="Never"). We also included two additional options for these questions: 5="I never watch TV/go to a small market, store, or mini-mart" and 6="I don't know." Then, pro-tobacco media exposure was recoded into four categories: 0=nonexposure to both TV smoking and market advertising; 1=exposure to either TV smoking or market advertising; 2=exposure to both TV smoking and market advertising; 3="other" for those who answered "5" or "6" to either TV smoking or market advertising, or who had missing data. We did not directly observe exposure but instead used the two items that capture the perceived pervasiveness of pro-tobacco marketing. These measures have been shown to reliably indicate exposure to pro-tobacco media, and they have correlated highly with some of the other similar measures that researchers are using (Schooler et al., 1996; Unger et al., 2001). An advantage of this method is that these measures are not dependent on the content of specific ads and responses can be compared over time regardless of changes in advertising campaigns.

Anti-tobacco media exposure. One question was asked to assess baseline exposure to anti-tobacco media advertising: "In the last month, how many TV commercials have you seen about NOT smoking?" Responses were rated on a four-point scale (1="None" to 4="A lot"). To keep consistency in the data analysis between effects of pro-tobacco and anti-tobacco exposure and to avoid too many combinations in these measures, the scores for anti-tobacco exposure were coded into exposure versus nonexposure to TV commercials. This approach was justified by our finding of no statistically significant linear relationship between anti-tobacco exposure and smoking susceptibility (p=.51). In addition, one of our main objectives was to test the interaction between anti- and pro-tobacco exposure. We may lose power if we test the interaction using the two categorical variables that have multiple small cells. As mentioned earlier, our measure has been shown to reliably indicate exposure to anti-tobacco media (Schooler et al., 1996; Unger et al., 2001).

Acculturation. The eight-item Acculturation, Habits, and Interests Multicultural Scale for Adolescents (AHIMSA; Unger et al., 2002) was used to assess acculturation. The questions, such as "I am most comfortable being with people from…" and "The holidays I celebrate are from …," all offered the same four response options, which are labeled as four orientation categories: a="The United States" (assimilation orientation), b="The country my family is from" (separation orientation), c="Both" (integration orientation), and d="Neither" (marginalization orientation). Each student was assigned to one of four orientation categories based on his or her most commonly selected response. Students who had a plurality of "The United States" responses were assigned to the assimilation category. Those whose most common response was "The country my family is from" were assigned to the separation category. Those who responded "Both" most often were assigned to the integration category, and those who responded "Neither" most often were assigned to the marginalization category. Three kinds of ties arose within the data, and in these cases we adopted the following tie-breaking rules. Ties between "The United States" and "Both" led to a classification of "assimilation," and ties between "The country my family is from" and "Both" led to a classification of "separation." The rationale for this strategy is that a

response of "Both" includes the country that generates the assigned label. Finally, ties between "The United States" and "The country my family is from" were resolved by assigning the student to the integration category, because that classification implies a foot in both cultures.

Covariates. To control for confounding, we treated as covariates the demographic variables measuring ethnicity, gender, immigration status, acculturation status, and effects of our prevention programs.

As part of this longitudinal study, the schools were randomly assigned to participate in a program evaluation of two newly developed smoking prevention curricula. Schools received either their school's standard smoking prevention curriculum or one of the two new curricula. The exposure to smoking prevention programs might have confounded the results of this study. To address this issue, we performed an analysis that examined the prevention program group × media exposure interaction. We found no significant interaction between experimental condition and media exposure in the prediction of smoking susceptibility, which suggested that program effects did not bias our findings. The effects of our prevention programs are reported elsewhere (Unger, Chou, et al., 2004).

Data analyses

To better examine the temporal link between exposure to tobacco media and smoking susceptibility, we excluded from the data analyses those students who were already susceptible nonsmokers, experimenters, and current smokers at baseline. Hence, the analytic sample consisted of 2,046 students (89% of those with complete data for all three years), all of whom had never tried smoking, and who reported no susceptibility toward smoking at baseline. At year 3 follow-up, students were classified as being either nonsusceptible (those students who remained nonsusceptible toward smoking), or susceptible (those students who reported susceptibility during year 2 or 3, or both).

Chi-square analyses were conducted to determine whether nonsusceptible and susceptible students by year 3 varied in their exposure to pro- and anti-tobacco media. Chi-square analyses also were conducted to determine whether exposure to pro- and anti-tobacco media varied by demographic characteristics.

Generalized linear mixed models (hierarchical generalized linear models) using the SAS macro "glimmix" were computed to predict year 2 or 3 susceptibility to smoking from year 1 media exposure. We specifically examined (a) the unadjusted effects of exposure to pro- and anti-tobacco media (the effects without controlling for the other independent variables), (b) the statistical significance of those associations after controlling for ethnicity, gender, experimental condition, immigration status, and acculturation status, (c) the statistical significance of those associations after controlling for clustering of students within schools and within classrooms, for covariates, and for the other independent variables, and (d) the interaction between pro- and anti-tobacco media exposure. Because the data came from a longitudinal intervention study with three experimental conditions, we included experimental condition as an additional covariate. We also examined the interactions between slopes and treatment groups.

To test whether anti-tobacco media were able to lessen the impact of pro-tobacco media, we examined both moderating and confounding effects of anti-tobacco media on pro-tobacco media exposure. If anti-tobacco media exposure counteracted pro-tobacco exposure, the results of the tests for moderating or confounding effects or both would be significant. The moderation effect was tested using the interaction term in the generalized linear mixed model. In addition, the confounding effect was tested by comparing the change in odds ratio between the unadjusted and adjusted (multivariate) models. If a high correlation existed between anti-tobacco media and pro-tobacco media exposure (as measured by Spearman's ρ), the confounding test would be sensitive to the counteractive effect of anti-tobacco media on pro-tobacco media. However, if the correlation were small, then the moderating effect test would be more sensitive than the odds ratio comparison. In the present data, the correlation between pro- and anti-tobacco exposure was $\rho=0.3$, $p<.001$. Although $\rho=0.3$ was moderately large, the less-than-perfect relation meant there was still room to test the moderating effect. We conducted both the moderating test and the confounding test to assess the impact of anti-tobacco media on pro-tobacco media exposure.

Results

Description of the sample

Table 1 shows the demographic characteristics of the sample. Some 47.9% of the students were male, and the mean age of the sample was 11.3 years ($SD=0.5$). Latinos were the ethnic majority in this sample, followed by Asian Americans, multiethnic students, Whites, students belonging to other ethnic groups, and African Americans. With respect to acculturation status, slightly over half (50.8%) of the sample ($n=833$) was integrated, 735 (44.7%) were assimilated, 67 (4.1%) were separated, and 6 (0.4%) were

Table 1. Changes in smoking susceptibility by year 2 or year 3 in relation to demographic characteristics.

Characteristic	Total sample[a]	Susceptible to smoking by year 2 or year 3[b]	*p*-value
Gender			
Male	890	418 (47.9%)	.004
Female	1,136	468 (41.5%)	
Ethnicity			
Black	31	16 (53.3%)	.03
Asian	493	192 (39.1%)	
Latino	821	385 (47.8%)	
White	216	87 (41.2%)	
Multiethnic	337	148 (44.3%)	
Other	147	71 (48.6%)	
Acculturation status			
Assimilated	735	319 (44.2%)	.17
Integrated	833	355 (42.9%)	
Separated	67	24 (35.8%)	
Marginalized	6	2 (33.3%)	
Pro-tobacco media			
Nonexposure	128	37 (29.1%)	<.001
Exposure (either TV or market)	777	321 (41.7%)	
Exposure (both TV and market)	639	356 (56.3%)	
Other[c]	502	185 (37.7%)	
Anti-tobacco media			
Nonexposure	256	131 (52.0%)	.003
Exposure	1,526	673 (44.6%)	
Other[c]	264	95 (36.8%)	

Note. [a]Students who were not susceptible to smoking and reported never smoking at baseline. [b]Students who reported susceptibility to smoking at year 2 or 3 or both. [c]Students who answered, "I never watch TV" or "I don't know" or who had missing data.

marginalized. Only 128 students (6.3%) reported no exposure to pro-tobacco media, whereas 1,416 (69.2%) reported exposure to pro-tobacco images either on television or in market advertisements, or both. As for anti-tobacco media, 256 students (12.5%) reported no exposure, whereas 1,526 (74.6%) reported exposure to anti-tobacco television messages. Students whose answers were either "I never watch TV/I never go to …" or "I don't know," or whose answers were missing were coded into the "other" category. This category for pro- and anti-tobacco media consisted of 24.5% and 12.5% of the sample, respectively. Because our focus was to evaluate the levels of tobacco media exposure, we decided to pool all those answers listed above into the "other" category. We found no significant differences in risk for smoking susceptibility among the "other" group compared with the nonexposure group.

Changes in susceptibility over time

Table 1 also describes changes in smoking susceptibility over time, by demographic characteristics and baseline media exposure. At baseline, all 2,026 students in the analysis were considered nonsusceptible to smoking. A higher proportion of males (47.9%) relative to females (41.5%) were susceptible to smoking by year 3 ($p<.01$). African Americans (53.3%), other ethnic groups (48.6%), and Latinos (47.8%) were more susceptible relative to Whites (41.2%) and Asian Americans (39.1%; $p<.05$). Those who reported as assimilated and integrated were more susceptible to smoking by year 3 relative to those who reported as separated and marginalized. However, this difference was not significant ($p<.17$).

Differences in exposure to pro-tobacco media

Table 2 presents the observed differences in exposure to pro-tobacco media by ethnicity and acculturation to the United States. A higher proportion of Asian (75.0%) and White (74.7%) students, relative to all other ethnic groups, reported exposure to at least one or two sources of pro-tobacco media ($p<.01$), whereas the "other" ethnic group and Latinos reported the lowest exposure. Students with assimilated (69.6%) or integrated (70.9%) acculturation status more often reported exposure to at least one source of pro-tobacco media relative to those with separated (49.4%), marginalized (55.6%), and "not applicable" (49.3%) acculturation status. We found no gender differences.

Differences in exposure to anti-tobacco media

Table 2 also presents differences in exposure to anti-tobacco media by ethnicity and acculturation to the United States. Specifically, a higher proportion of Asian students (83.9%) reported exposure to anti-tobacco media, relative to African Americans (66.7%) and other ethnic groups (62.4%; $p<.001$). Acculturation to the United States was associated with higher exposure to anti-tobacco media. Specifically, those students who were integrated (75.8%) or assimilated (75.3%) more often reported exposure, whereas those who were separated (53.3%) or marginalized (44.4%) less often reported exposure ($p<.001$). Again, we found no gender differences.

Generalized linear mixed model for smoking susceptibility

Table 3 presents the generalized linear mixed models for year 3 smoking susceptibility on baseline pro- and anti-tobacco media exposure. These models adjust for the similarities among students within the same classroom by including classroom as a random effect covariate. The unadjusted odds ratios indicated that higher exposure to pro-tobacco media was a risk factor for smoking susceptibility, whereas higher exposure to anti-tobacco media was a protective factor against smoking susceptibility. In other words, increased levels of pro-tobacco media exposure at baseline were positively associated with susceptibility

Table 2. Differences in baseline exposure to pro- and anti-tobacco media by gender, ethnicity, and acculturation status.

	Baseline exposure to pro-tobacco media					Baseline exposure to anti-tobacco media			
Characteristic	Nonexposure	Exposure[a] (either TV or market)	Exposure[b] (both TV and market)	Other[c]	*p* value	Nonexposure	Exposure	Other[c]	*p* value
Gender									
Male	57 (5.5%)	388 (37.3%)	350 (33.7%)	245 (23.6%)	0.3	151 (14.5%)	749 (72.0%)	140 (13.5%)	.18
Female	76 (6.2%)	476 (38.8%)	368 (20.0%)	307 (25.0%)		150 (12.2%)	924 (75.3%)	153 (12.5%)	
Ethnicity									
Black	2 (5.1%)	10 (25.6%)	16 (41.0%)	11 (28.2%)	0.001	8 (20.5%)	26 (66.7%)	5 (12.8%)	<.0001
Asian	39 (7.4%)	225 (42.5%)	172 (32.5%)	93 (17.6%)		59 (11.2%)	444 (83.9%)	26 (4.9]%)	
Latino	48 (5.1%)	342 (36.3%)	291 (30.9%)	261 (27.7%)		119 (12.6%)	670 (71.1%)	153 (16.2%)	
White	10 (4.2%)	89 (37.6%)	88 (37.1%)	50 (21.1%)		34 (14.4%)	178 (75.1%)	25 (10.6%)	
Multiethnic	24 (6.4%)	149 (39.7%)	117 (31.2%)	85 (22.7%)		57 (15.2%)	270 (72.0%)	48 (12.8%)	
Other	11 (6.7%)	53 (32.1%)	46 (27.9%)	55 (33.3%)		27 (16.4%)	103 (62.4%)	35 (21.2%)	
Acculturation status									
Assimilated	51 (6.2%)	307 (37.5%)	263 (32.1%)	197 (24.1%)	<0.001	110 (13.5%)	616 (75.3%)	92 (11.3%)	<.0001
Integrated	55 (5.9%)	370 (39.8%)	289 (31.1%)	216 (23.2%)		106 (11.4%)	705 (75.8%)	119 (12.8%)	
Separated	3 (3.9%)	20 (26.0%)	18 (23.4%)	36 (46.8%)		11 (14.3%)	41 (53.3%)	25 (32.5%)	
Marginalized	1 (11.1%)	1 (11.1%)	4 (44.4%)	3 (33.3%)		2 (22.2%)	4 (44.4%)	3 (33.3%)	
Not applicable	3 (3.9%)	20 (25.9%)	18 (23.4%)	36 (46.8%)		59 (19.3%)	222 (72.8%)	24 (7.9%)	
Incomplete	14 (4.6%)	113 (37.1%)	121 (39.7%)	57 (18.7%)		3 (10.3%)	13 (44.8%)	13 (44.8%)	

Note. [a]Exposure to either TV smoking or market advertising. [b]Exposure to both TV smoking or market advertising. [c]Students who answered, "I never watch TV" or "I don't know" or who had missing data.

($p<.001$), whereas increased levels of exposure to anti-tobacco media at baseline were associated with lower rates of smoking susceptibility ($p<.01$). These effects remained the same even after controlling for covariates and the other independent variables. Additional analyses indicated that all the trends for associations remained similar when media exposure items were treated as continuous measures. Smoking susceptibility did not vary by acculturation status.

We found no significant interactions between pro- and anti-tobacco media exposure on smoking susceptibility. This finding suggests that the magnitude of the protective effect of anti-tobacco media exposure does not vary according to the level of pro-tobacco media exposure. Furthermore, ethnicity and acculturation did not moderate the associations between media exposure variables and smoking susceptibility, which indicates that our results generalize across ethnic groups and acculturation status in our sample.

Discussion

Most adolescents in the United States are exposed to pro-tobacco images and advertising in many

Table 3. Generalized linear mixed models of smoking susceptibility by year 2 or 3 with baseline pro- and anti-tobacco media exposure as predictors.[a]

	Sample	Unadjusted multilevel odds ratio	95% Confidence interval[b]	Adjusted multilevel odds ratio	95% Confidence interval[c]	Adjusted multivariate multilevel odds ratio	95% Confidence interval[d]
Anti-tobacco media							
Nonexposure	252	Reference		Reference		Reference	
Exposure	1509	0.75*	(0.57, 0.99)	0.77	(0.58, 1.02)	0.74*	(0.55, 0.99)
Other[e]	258	0.54**	(0.37, 0.77)	0.53**	(0.36, 0.76)	0.62*	(0.41, 0.94)
Pro-tobacco media							
Nonexposure	127	Reference		Reference		Reference	
Exposure (either TV or market)	769	1.81**	(1.19, 2.76)	1.84**	(1.20, 2.83)	1.89**	(1.23, 2.91)
Exposure (both TV and market)	632	3.24***	(2.11, 4.97)	3.25***	(2.11, 5.02)	3.33***	(2.16, 5.16)
Other[e]	491	1.40	(0.85, 2.30)	1.43	(0.88, 2.33)	1.56	(0.94, 2.59)

Note. After adjusting for acculturation status, we found that the odds ratios for pro- and anti-tobacco media exposure changed only slightly. Hence, acculturation was not a mediator in this model. Furthermore, acculturation did not moderate the association between pro- ($p=.97$) or anti-tobacco ($p=.55$) media exposure and smoking susceptibility. The findings of these analyses were similar when continuous measures of media exposure were used. [a]For those students who reported nonsusceptibility toward smoking at year 1 and reported susceptibility by year 2 or 3. [b]Multilevel: Hierarchical nonlinear model, considering the school as a random effect. [c]Covariates: Ethnicity, gender, immigration, and acculturation status. [d]Multivariate: Independent variables (pro-tobacco exposure and anti-tobacco exposure) adjusted by each others. [e]Students who answered, "I never watch TV" or "I don't know" or who had missing data. *$p<.05$; **$p<.01$; ***$p<.001$.

locations in their daily lives. Anti-tobacco campaigns are not as extensive and are intended to counter the effects of pro-tobacco marketing and social influences to smoke (Lee et al., 2004). Therefore, it is important to study the direct and interactive effects of both types of tobacco-related media over time on smoking susceptibility in adolescents. We focused on effects of exposure to anti-tobacco advertising and to pro-tobacco portrayals on television and in stores. In addition, we considered the moderating effects of ethnicity and acculturation on these outcomes. Our results indicate that exposure to both pro- and anti-tobacco advertisements predict changes in smoking susceptibility. Exposure to pro-tobacco media at baseline was associated with an increased risk of smoking susceptibility in years 2 and 3, whereas exposure to anti-tobacco media at baseline was associated with a decreased risk of smoking susceptibility in year 2 or 3. However, we did not find that pro- and anti-tobacco media interacted in their effects on susceptibility. Neither ethnicity nor acculturation moderated the effects of media exposure.

These results suggest that adolescents are more likely to be susceptible to smoking when they report having been exposed to smoking on television or to tobacco brand advertisements in stores during the past 2 years. What is particularly important, however, is that the odds of being susceptible almost doubled for those who reported being exposed to both forms of pro-tobacco media as opposed to just one type. Our results are consistent with previous research, in that media influences are important contributors to an adolescent's intention to smoke. Young observers adopt behaviors that they admire in advertisements (Arnett & Terhanian, 1998; Feighery et al., 1998; Pierce et al., 1998; Unger et al., 1997). The marketing strategies used by the tobacco industry appear to be effective in reducing intent to refuse cigarettes among adolescents. Pro-tobacco messages on television and in stores usually feature figures and images that are appealing to young people. Adolescents are inspired to emulate the models (Distefan, Gilpin, Sargent, & Pierce, 1999; Sargent, Dalton, & Beach, 2000; Tickle, Sargent, Dalton, Beach, & Heatherton, 2001).

We also found a significant protective effect of anti-tobacco media, in that nonsusceptible 6th-grade students who were exposed to television anti-tobacco advertisements were more likely to remain nonsusceptible in 7th and 8th grades, relative to those who were not exposed to anti-tobacco advertisements. This finding is supported by evidence from both cross-sectional and longitudinal studies that have observed inverse associations between anti-tobacco television advertising and smoking initiation (Siegel & Biener, 2000). Additionally, exposure to anti-tobacco advertising showed an independent strong inverse association with smoking susceptibility (Straub et al., 2003). Our results, together with the previous evidence, suggest that anti-tobacco media campaigns may reduce smoking susceptibility among youth. Further research is needed to examine the relative effectiveness of different types of anti-tobacco advertising messages.

Our findings on the countereffects of anti-tobacco media on pro-tobacco media exposure indicated that the anti-tobacco media exposure did not mitigate the harmful effects of the pro-tobacco media. The results of our longitudinal study are consistent with the results of a cross-sectional study (Straub et al., 2003) that found anti-tobacco advertising failed to diminish the harmful impact of pro-tobacco advertising but appeared to have a protective role against smoking intention.

As hypothesized, our findings suggest that nonsusceptibility to smoking at baseline and changes in susceptibility at years 2 and 3 vary among ethnic groups. Similar to smoking prevalence rates reported from previous studies, Asian American adolescents reported the lowest prevalence of susceptibility to smoking at baseline and at years 2 and 3, whereas African American and Latino adolescents had relatively higher prevalence rates of susceptibility to smoking. Compared with youths from other ethnic groups, Asian American adolescents tend to have late smoking onset because of traditional cultural and parental restrictions (Chen, Unger, Cruz, & Johnson, 1999b).

The results of the present study did not support our hypotheses that ethnicity and acculturation status moderate the effects of tobacco media exposure on smoking susceptibility. This may be because the majority of students reported the U.S.-oriented acculturation status (i.e., assimilation or integration), so there was little variation in this characteristic. Another potential explanation is that the tobacco media (on television and in stores) were visual, so their interpretation may not be limited by cultural background and English proficiency. Thus acculturation status may not change the effect of visual tobacco-related media on susceptibility among adolescents.

Limitations

The present study has several limitations. First, our measures of tobacco media exposure are based on self-reported perceived pervasiveness of tobacco marketing, not on actual measures of exposure. One potential limitation of this method is that the questionnaire items do not prompt memories of specific ads to which respondents have been exposed.

Therefore, respondents may fail to retrieve from memory all the different tobacco media messages, which may limit the accuracy of the answers (Unger et al., 2001). In addition, these measures require respondents to make subjective ratings about the frequency of tobacco ads. Thus we cannot rule out possible recall bias because of selective perception and attention (Feighery et al., 1998; Lam, Chung, & Betson, 1998). For example, respondents who have strong negative opinions about pro-tobacco marketing may rate pro-tobacco marketing as more pervasive, whereas respondents with strong anti-tobacco attitudes may be more attentive to anti-tobacco media and may rate them as more pervasive. More direct measures of exposure would require intrusive and expensive observations. Researchers might be able to control short bursts of exposure, but they are not in a position to control the environment. Nevertheless, our results add to the body of knowledge about the effects of exposure to pro- and anti-tobacco media on adolescent smoking behavior.

Second, our measure of exposure to anti-tobacco media was limited to television messages. Although our survey contained items that estimated the frequency of exposure to anti-tobacco media through radio and billboards, they were excluded from this analysis. Earlier studies suggest that television, in comparison to radio, billboards, and other channels of exposure, is a more pervasive communication medium; thus the effects of messages disseminated through these channels may have limited effects on adolescent smoking behavior (Siegel & Biener, 2000; Wakefield et al., 2003). Further, the item selected for analysis referenced a recent timeframe of exposure, a factor that may have facilitated the recall of anti-tobacco messages. Despite the merits of the televised exposure measure, we acknowledge that the impact of anti-tobacco media on smoking behavior may have been greater had a more comprehensive measure of exposure been adopted.

Third, this is a secondary analysis of data obtained from a longitudinal intervention trial rather than from a behavioral cohort study. Although we adjusted for the intervention effect statistically, we cannot assume an absence of confounding effect. Further, although these results demonstrate that exposure to tobacco-related media preceded changes in susceptibility to smoking, they do not confirm that media exposure caused these changes. Without random assignment to groups with different amounts of exposure to tobacco-related media, establishing a casual relationship is not possible. However, the benefits of being able to use this rich dataset to answer other research questions outweigh the limitations in study design and measurement.

Finally, our results are based on a sample of students from schools in California. California has extensive public anti-tobacco campaigns and strict no-smoking policies. This anti-tobacco environment may have affected respondents' attitudes toward smoking or toward reporting their own smoking behavior. Additionally, our sample is culturally diverse, since the schools were selected to focus on Asian American and Latino adolescents' smoking behavior. Therefore, caution is needed before generalizing these results to adolescents from other ethnic groups and in other areas of the United States.

Conclusions

The present longitudinal study provides evidence for the impact of pro-tobacco media on adolescents' intentions to smoke and the potential for anti-tobacco advertisements to limit adolescents' susceptibility to smoking. More important, the results indicate that an anti-tobacco campaign alone is unlikely to negate the large effect of pro-tobacco media exposure. To reduce adolescent smoking, stronger measures, such as controlling pro-tobacco advertising and tobacco-supportive media portrayals, are warranted.

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