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The reciprocal relationships between changes in adolescent perceived prevalence of smoking in movies and progression of smoking status

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Abstract

Background—Smoking in movies is associated with adolescent smoking worldwide. To date, studies of the association mostly are restricted to the exposure to smoking images viewed by 9–15 year-olds. The association among older adolescents is rarely examined. In addition, the reciprocal effect of smoking behavior on subsequent reported exposure to smoking in movies has not been reported.

Methods—Data were from the Minnesota Adolescent Community Cohort Study collected every six months from 2000–2007 when participants were between the ages of 12 and 18 (n=4745). We estimated the prospective effect of the perceived prevalence of smoking in movies (four levels, from never to most of the time) on smoking stage measured six months later (six stages, from never smoker to established smoker), and the reciprocal prospective association between the two factors. Estimates were adjusted for demographic factors.

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Results—The perceived prevalence of smoking in movies measured between ages 13½–15½ consistently predicted subsequent smoking stage. The association was inconsistent after the age of 15½. Smoking stage did not consistently predict subsequent perception of the prevalence of smoking in movies.

Conclusions—Perceived exposure to movie smoking primarily influenced teenagers' smoking behavior at younger ages. If future studies confirm this finding, developing and evaluating interventions to improve young teenagers resistance to these images may complement policies to reduce smoking in movies to reduce prevalence of adolescent smoking.

Keywords

Adolescent; smoking; motion pictures; movies; tobacco

INTRODUCTION

Exposure to smoking in movies is associated with adolescent smoking worldwide. Findings from both cross-sectional and cohort studies from the United States have demonstrated that frequent exposure to smoking in movies increases the likelihood of both experimenting with cigarette smoking [1–4] and smoking >100 cigarettes in a lifetime [5, 6]. Studies from Germany [7, 8] and Mexico [9] also support the association between exposure to smoking images in movies and adolescent smoking. These findings, in part, led the National Cancer Institute to conclude a causal relationship between adolescent exposure to smoking in movies and smoking initiation [10], prompting the World Health Organization to release a report urging member countries to take action to reduce the influence of these images on adolescents [11].

To date, the prospective relationship between exposure to smoking in movies and subsequent smoking has been limited to 9–15 year-olds [1, 2, 5, 6]. One study examined the association between exposure to smoking in movies among young adolescents and their subsequent smoking behavior as older adolescents and young adults [5], but did not examine the prospective effect of the exposure as older adolescents (ages 16–18) on subsequent the smoking behavior. Two cross-sectional studies examined the association between exposure to smoking in movies and smoking behavior among young adults: one reported a positive association [12] but the other reported null findings [13]. It has been hypothesized that the effect of smoking images in movies on adolescent smoking may differ by age, because age-related brain changes have been suggested to moderate the effect of media messages on the audience [14]. Information about this association among older adolescents is important to guide the development of tobacco control policies and interventions targeting the age group that is particularly vulnerable to smoking images in movies. In addition, since most studies only measured participants' exposure to smoking in movies at one time point, they have been unable to address how changes in this exposure may affect adolescent smoking behavior, and vice versa.

To address this gap, we assessed the effect of changes in adolescents' perceived exposure to smoking in movies on their subsequent changes in smoking stage using data from the Minnesota Adolescent Community Cohort Study, where both the exposure and the outcome

were measured repeatedly throughout adolescence. We also investigated the reverse, namely, the extent to which adolescents' smoking stage prospectively predicted their perceived exposure to movie smoking. We also explored if these reciprocal associations between perceived exposure to smoking in movies and smoking stage varied by age. Thus, findings from this study provide insights into the relationship between perceived exposure to smoking in movies and progression of smoking from early to late adolescence.

METHODS

Study population

The Minnesota Adolescent Community Cohort (MACC) Study is a prospective cohort study designed to deepen the understanding of the transitional process from non-smoking to smoking in adolescence, and to examine the effect of state- and local-level tobacco prevention and control programs on youth in Minnesota. Details of the study design are published elsewhere [15]. Briefly, participants were selected through cluster random sampling from geo-political units (GPUs) in Minnesota, North and South Dakota, Michigan, and Kansas, using modified random digit dialing and a combination of probability and quota sampling methods to obtain an even distribution from ages 12 to 16 during 2000–2001. We recruited an additional cohort of 585 twelve year-olds in Minnesota using the same random digit dialing method during 2001–2002, resulting in an overall sample of 4826. Participants were surveyed every six months since recruitment through 2008, except in 2004 due to a gap in funding. In this analysis, participants had to have completed at least two surveys before the age of 18 (n=4760).

The University of Minnesota Institutional Review Board approved this study. Parents provided active informed consent for their children to participate in the study. Once study participants reached the age of consent, we obtained active informed consent for each survey completed.

Measures

We assessed adolescents' perceived exposure to smoking in movies and their smoking stage at every round of data collection. We asked the participants to report how often they saw actors and actresses smoking when they watched movies, with four response options: most of the time (4), some of the time (3), hardly ever (2), and never (1). This measure assessed participants exposure to smoking in movies and their recognition of these images, which was similar to the construct of receptivity to tobacco marketing [16].

We also asked them five questions pertaining to their smoking behaviors, including ever experimented with cigarette smoking, ever smoked a whole cigarette, ever smoked more than one cigarette, and number of days smoked in the past 30 days and in the past 7 days. Using these measures participants were classified into one of the six smoking stages representing their smoking intensity: 1) never smoker, 2) trier (smoked less than a whole cigarette in a lifetime), 3) less than monthly smoker (smoked a whole cigarette but not in the past 30 days), 4) experimental smoker (smoked less than 20 of the past 30 and not in the past seven days), 5) regular smoker (smoked less than 20 of the past 30 days but at least one in

the past seven days), and 6) established smoker (smoked more than 20 out of the past 30 days).

Statistical Analysis

Since participants were recruited into the study at different ages and reached the same ages at different chronological time, we pooled data measured at the same ages across different rounds of data collection to form the age-specific measurements of perceived exposure to smoking in movies and smoking stage, in six-month increments from age 12 to just before age 18. For example, to form the perceived exposure to smoking in movies at age 16, we pooled the first measurement of the perceived exposure to smoking in movies from those who were recruited to the study at age 16, the third measurement from those recruited at age 15, the fifth measurement from those recruited at age 14, and so on. Only a few participants provided data when they were younger than 12½ years old, so we restricted our analysis to data collected at ages 12½ or older (n=4745).

We assessed the prospective associations between the perceived prevalence of smoking in movies and smoking stage using an autoregressive crosslagged model [17, 18]. This type of model allows us to capture the longitudinal changes within factors and assess the prospective predictions between factors while maintaining the prospective relationship between factors. It also enables us to examine the variation of the prospective association by age. Figure 1 illustrates the regressions and correlations we simultaneously estimated between the perceived prevalence of smoking in movies and smoking stage from age 12½ to less than 14½ in the model. The full model extended the analysis to adolescents just under 18 years old. For each factor, temporal stability was modeled by regressing each of its age-specific measurements on its measurement assessed six months earlier (illustrated by the single-headed arrows, for example, from $PPSM_{Age\ 12.5–12.9}$ to $PPSM_{Age\ 13–13.4}$). Because data were collected every six months, we also estimated the effect of each age-specific measurement of a factor on its measurement assessed a year earlier to control for seasonal variation (illustrated by the curved single-headed arrows, for example, from $PPSM_{Age\ 12.5–12.9}$ to $PPSM_{Age\ 13.5–13.9}$).

To assess how the two factors prospectively predicted each other, we regressed each age-specific measurement of one factor on the age-specific measurement of the other factor assessed six months eariler (illustrated by the solid single-headed arrows, for example, from $PPSM_{Age\ 12.5–12.9}$ to $SS_{Age\ 13–13.4}$, and from $SS_{Age\ 12.5–12.9}$ to $PPSM_{Age\ 13–13.4}$). We delineated the cross-sectional association between the two factors by also simultaneously estimating the correlations between age-specific measurements of the two factors assessed at the same age (illustrated by the double-headed arrows, for example, $PPSM_{Age\ 12.5–12.9}$ with $SS_{Age\ 12.5–12.9}$). Regression coefficients were standardized and can be interpreted as a standard deviation increase in one factor corresponding to a standard deviation increase of the other factor. We adjusted for gender, race/ethnicity (white vs. non-white), parent education (high school graduate or less, some college, college graduate, and some graduate school or above), level of urbanization (9-levels) [19] and age cohort (defined by year enter the study and age at baseline) by estimating their effects on the baseline measurements of each factor. We did not include other commonly used predictors of adolescent smoking

(such as parent and sibling smoking, attitudes toward tobacco companies) because previous analysis showed that these variables were not associated with changes of perceived exposure to smoking in movies [20], and peer smoking was found to be a partial mediator on the association between exposure to smoking in movies and adolescent smoking [21].

There were two sources of missing data: missing by design (e.g., participants recruited when they were 14 years old did not provide data on their perceived exposure to smoking in movies and smoking intensity before the age of 14) and attrition (the response rate was 69.7% in 2007 data collection, before all participants become 18 years old). We used all available data (without removing participants lost to follow up) in estimating the autoregressive crosslagged model, and therefore included over 99% of all MACC study participants. We also used a maximum likelihood algorithm to handle the missing data in estimating the model while adjust for covariates, assuming data were missing at random [22].

Analysis was performed using Mplus® version 5.21 [23]. All variables were modeled as continuous variables. Because of model complexity, we were unable to control for the clustering effect of the variables by GPU. Since the intra-class correlations in the exposure and outcome variables were small (<0.02), the standard errors of our estimates should not be significantly biased by this limitation.

RESULTS

Table 1 shows the characteristics of the participants by age cohort. Of the 4745 participants, about half were male. The majority of them were white, and had parents who had at least graduated from college. At baseline, about half of the participants reported seeing smoking in movies some of the time in all age cohorts. In addition, another 30–40% reported this experience most of the time, depending on the age cohort. The proportion of participants who were never smokers in each age cohort varied between about 87% in the two youngest age cohorts to about 45% in the oldest age cohort.

In the crude model, five of the ten estimated prospective effects of the perceived prevalence of smoking in movies on smoking stage were statistically significant ($p<.05$). Adjusting for covariates did not change the magnitude and statistical significance of these estimates. After adjustment, a standard deviation increase in the perceived prevalence of smoking in movies predicted a 0.02–0.05 standard deviation increase in smoking stage measured six months later (Table 2). The association was consistently observed among younger ages (up to age 15½ years), but not among older adolescents.

In contrast, the reciprocal effect (i.e., smoking status predicting adolescent perception of smoking in movies) was not confirmed. Three of the ten estimated prospective associations were statistically significant in the crude model ($p<.05$), but only one of them remained significant ($p<.05$) after adjusting for covariates (Table 2). Furthermore, the variation in the magnitude of this association did not show an age-related pattern.

DISCUSSION

Existing research on exposure to smoking in movies and adolescent smoking has focused on exposure during younger adolescence[1–6], and found that exposure to smoking imagery in movies is associated with smoking initiation during this period of life. We expanded the current literature by examining the effect of perceived exposure to movie smoking throughout the entire adolescent period on smoking status, and also used a more detailed measure of smoking intensity. We found that an increase in the perceived exposure to depictions of smoking in movies was consistently associated with a subsequent increase in smoking intensity during younger adolescence (exposed up to the age of 15½ years); in other words, increasing perceived exposure to smoking in movies *intensified* younger adolescents' smoking behavior. In contrast, we did not observe a consistent association between the perceived exposure and smoking intensity during older adolescence (exposed after the age of 15½ years). This suggests that younger teenagers may be more vulnerable than older adolescents to the effect of exposure to smoking images in movies.

Our findings, together with the previous studies on this association, support the importance of eliminating or reducing teenagers' exposure to smoking images in movies. Scholars have advocated for an adult rating for all movies containing smoking images [24]. Although this strategy is also supported by the World Health Organization [11], it may not fully eradicate teenage exposure to smoking images in movies since 14–21% of 10–17 year-olds in the United States report watching R-rated movies [25, 26]. Furthermore, 64% of participants in the MACC study live in a smoke-free environment, where their parents, siblings, and friends do not smoke, and/or smoking is not allowed in homes at baseline; therefore smoking in movies may be the most prominent way for them to visualize smoking. A complete ban on smoking images in movies produced in the United States, as implied in Article 1 and 13 of the World Health Organization Framework Convention on Tobacco Control [27], would be a stronger policy strategy to protect teenagers from the negative influences of these images. Such a ban would also reduce teenage exposure to smoking images in movies worldwide since films produced in the United States are distributed globally [28]. In addition, providing media literacy training to help young teenagers to understand the use of smoking images in movies as a tobacco marketing tactic may improve teenagers' ability and motivations to resist the influences of these images [29].

To our knowledge, this is the first study to report an age-related difference in the effect of perceived exposure to smoking in movies on adolescent smoking. Previous studies suggested that the effect of exposure to smoking in movies is larger on smoking initiation than on progression of smoking [30, 31]; however we conducted additional analysis to examine effect of perceived exposure to smoking in movies on smoking initiation and progression of smoking after initiation separately, and found age-related pattern similar to findings presented in this paper. This age-related pattern could be explained by the differential interpretation of smoking images in movies between younger and older adolescents. Older teenagers interpret smoking images in movies as the industry's means to promote cigarette use [32], and claim resilience to these images. Therefore, they may be less likely to be influenced by smoking images. However, younger teenagers interpret these images as accurate reflections of reality [33], which may make them more receptive, and

more vulnerable to the influences of these images. In addition, movies may be more important references for social norms of smoking for younger teenagers but not for older teenagers. This is supported by a previous report demonstrating that young children (ages 9–15) with higher exposure to smoking in movies were more likely to perceive a higher prevalence of adult smoking than those with lower exposure [34]. Smoking images in movies may also provide an "affordance" [35], in other words, suggest the possibility of smoking as a behavioral option for younger adolescents who are largely unexposed to smoking in real life. Such an affordance may influence the exposed adolescents to smoke cigarettes when opportunities for smoking arise. In contrast, as teenagers age, they are more likely to have more friends who smoke, and their peer environment may become a more salient reference than smoking in movies for smoking-related social norms. If it is true that younger adolescents are more vulnerable to smoking images in movies, tobacco control measures on smoking in movies should focus on reducing exposure to these images during younger adolescence.

Although the current results show a statistically significant prospective association between exposure to smoking in movies and subsequent smoking behavior, the magnitude of the effect is smaller than in previous studies. The discrepancy in the size of the association could be because our research question is different from that of the previous studies: we assessed the effect of *changes in the perceived prevalence of smoking in movies* on *changes in smoking intensity* among adolescents, instead of the effect of *high exposure* to smoking in movies on *smoking initiation* as in previous reports [1–4]. Consequently, we measured perceived prevalence of smoking in movies by asking the participants to estimate how often they saw smoking in movies, instead of conducting a content analysis on movies they recall watching. This measure of exposure has only four levels, which may not have adequate sensitivity to capture the variation of the exposure to smoking in movies. In addition, communication scholars suggested that receivers of media messages process the information through a more conscious central route and a less conscious peripheral route [36]. The perceived prevalence of smoking in movies may represent the portion of exposure to smoking in movies processed through the central route but exclude the portion processed through the peripheral route, therefore leading to an underestimation of the total effect of the exposure to smoking in movies. We also used a different, but more detailed, six-level measure of smoking stage as an outcome instead of a dichotomous measure of smoking used in previous research. Given these depictions are prevalent in movies [37–40] and movies are ubiquitously available to adolescents, this small effect could still have a significant impact on adolescent smoking at a population level.

When examining the prospective effect of progression in smoking intensity on the subsequent perceived exposure to smoking in movies, we did not find a consistent association. This finding may imply that despite the progression in smoking intensity, teenagers who smoke more do not increasingly prefer movies that contain more depictions of smoking, such as drama and adventure [38, 41]. It may also imply that they did not increasingly identify themselves with the smoking actors and actresses in movies and therefore did not differentially remember those depictions better than teenagers who smoked less.

A limitation of our analysis was that we could not control for cluster sampling because of model complexity. However, we were able to control for cluster sampling in our crude model and the estimates were comparable with the results shown in this report. The accuracy of self-reported perceived exposure to smoking in movies may also be a concern, since this measure of perceived exposure has not been validated against the conventional content-analysis-based measure of exposure to movie smoking; such validation study should conducted in the future. However, it is the only way to assess the exposure to smoking in movies at a cognitive level, as depictions that participants remembered may have a stronger influence on their smoking behaviors than those they did not remember. And we would expect any misclassification of exposure to attenuate the observed effect size. In contrast, the strength of our study over previous research is that we were able to capture changes in the exposure and the outcome since they were both measured every six months during the study period. This allowed us to examine how changes in the perceived exposure to movie smoking affected changes in the smoking behavior (and vice versa), which was not possible in previous studies. Thus, our findings potentially strengthen the temporality of the known association between exposure to smoking in movies and adolescent smoking among younger adolescents.

In conclusion, we found that an increase of perceived exposure to smoking in movies was associated with a subsequent increase in smoking intensity among adolescents, and the association was more consistent among younger than older adolescents. Furthermore, this relationship was not reciprocal. If future studies confirm the observed age variation in the effect of perceived exposure to smoking in movies on adolescent smoking, providing effective interventions to improve young adolescents' resistance to these images (e.g., media literacy training) may complement the public health policy initiative to eliminate depictions of smoking in movies to reduce the influences of these images on adolescents.

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WHAT THIS PAPER ADDS

Current literature on the association between smoking in movies and adolescent smoking mainly focuses on young children. Little is known about the association in older adolescents. This study aimed to examine the associations between, and the variation of, the prospective relationships between the exposure to smoking in movies as perceived by teenagers and their smoking behavior throughout adolescence.

We found that perceived exposure to smoking in movies primarily influenced teenagers' smoking behavior during younger adolescence. If future studies confirm this finding, providing intervention to younger adolescents to improve their resistance to smoking in movies (e.g. media literacy training) may complement the effort to eliminate smoking in movies to reduce teenage exposure to these images.

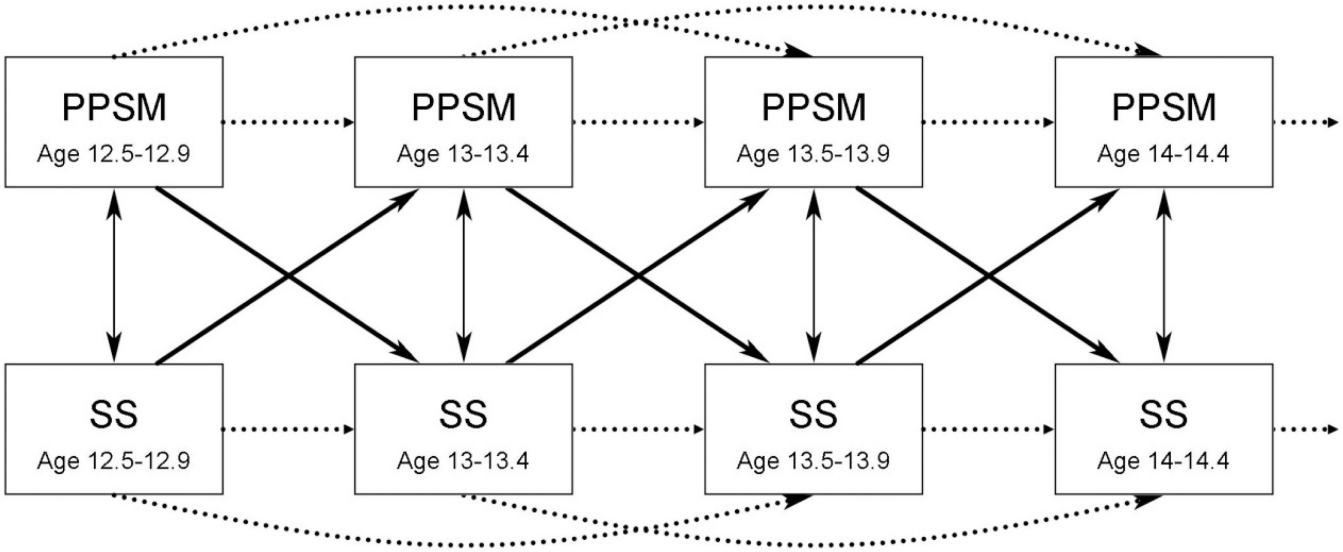

Figure 1.

Autoregressive crosslagged model between the perceived prevalence of smoking in movies (PPSM) and smoking stage (SS) (truncated).Single-headed arrows represent regressions and double headed arrows represent correlations.

Table 1

Participants' characteristics by age cohort.

	Age cohort [n(%)]						
Characteristics	**2001 12-year-old cohort**	**2000 12-year-old cohort**	**2000 13-year-old cohort**	**2000 14-year-old cohort**	**2000 15-year-old cohort**	**2000 16-year-old cohort**	**Total [n(%)]**
Gender							
Male	274 (47.8%)	390 (47.4%)	450 (52.6%)	417 (50.3%)	408 (48.8%)	387 (47.2%)	2326 (49.1%)
Female	299 (52.2%)	432 (52.6%)	405 (47.4%)	412 (49.7%)	428 (51.2%)	433 (52.8%)	2409 (50.9%)
Race/ethnicity							
White	466 (83.4%)	667 (81.2%)	729 (85.4%)	709 (85.5%)	732 (87.6%)	712 (86.6%)	4015 (85.1%)
Non-white	93 (16.6%)	154 (18.8%)	125 (14.6%)	120 (14.5%)	104 (12.4%)	108 (13.2%)	703 (14.9%)
Parent education							
High school or less	103 (22.1%)	157 (22.7%)	138 (19.7%)	130 (19.9%)	125 (19.9%)	132 (22.0%)	785 (21.0%)
Some college	73 (15.7%)	139 (20.1%)	168 (24.0%)	177 (27.1%)	163 (26.0%)	144 (24.0%)	864 (23.1%)
College graduate	213 (45.7%)	272 (39.3%)	246 (35.1%)	206 (31.5%)	176 (28.1%)	190 (31.7%)	1303 (34.9%)
Graduate school	77 (16.5%)	124 (17.9%)	148 (21.1%)	141 (21.6%)	163 (26.0%)	133 (22.2%)	786 (21.0%)
Level of urbanization[1]	7.0 ± 2.5	6.8 ± 2.6	6.8 ± 2.6	6.8 ± 2.6	6.7 ± 2.6	6.8 ± 2.5	6.8 ± 2.6
Perceived prevalence of smoking in movies at baseline							
Never	5 (0.9%)	9 (1.1%)	11 (1.3%)	5 (0.6%)	6 (0.7%)	4 (0.5%)	40 (0.8%)
Hardly ever	121 (21.2%)	124 (15.2%)	121 (14.2%)	94 (11.4%)	83 (10.0%)	85 (10.4%)	628 (13.3%)
Some of the time	270 (47.3%)	418 (51.2%)	431 (50.6%)	414 (50.4%)	436 (52.4%)	400 (49.0%)	2369 (50.3%)
Most of the time	175 (30.6%)	265 (32.5%)	289 (33.9%)	309 (37.6%)	307 (36.9%)	327 (40.1%)	1672 (35.5%)
Smoking stage at baseline							
Never	503 (86.3%)	735 (87.9%)	683 (79.1%)	555 (66.1%)	494 (58.1%)	375 (44.5%)	3300 (69.2%)
Trier	66 (11.3%)	82 (9.8%)	134 (15.5%)	182 (21.7%)	197 (23.2%)	194 (23.0%)	855 (17.9%)
Less than monthly	6 (1.0%)	9 (1.1%)	16 (1.9%)	36 (4.3%)	52 (6.1%)	101 (12.0%)	220 (4.6%)
Experimental smoker	3 (0.5%)	4 (0.5%)	15 (1.8%)	18 (2.1%)	33 (3.9%)	35 (4.2%)	108 (2.3%)
Regular smoker	4 (0.7%)	5 (0.6%)	9 (1.0%)	22 (2.6%)	34 (4.0%)	46 (5.5%)	120 (2.5%)
Established smoker	1 (0.2%)	1 (0.1%)	6 (0.7%)	27 (3.2%)	40 (4.7%)	91 (10.8%)	166 (3.5%)

[1]Means and standard deviations

Table 2

Prospective effect of the perceived prevalence of smoking in movies on smoking stage and vice versa.[1]

Effect of …	Perceived prevalence of smoking in movies	Smoking stage
On…	**Smoking stage measured six months later**	**Perceived prevalence of smoking in movies measured six months later**
Age 12.5–12.9	0.027 (−0.002, 0.056)	0.037 (−0.010, 0.084)
Age 13.0–13.4	**0.046 (0.022, 0.070)**	0.006 (−0.039, 0.051)
Age 13.5–13.9	**0.022 (0.002, 0.042)**	−0.008 (−0.047, 0.031)
Age 14.0–14.4	0.021 (−0.001, 0.043)	0.021 (−0.016, 0.058)
Age 14.5–14.9	**0.035 (0.015, 0.055)**	0.017 (−0.596, 0.630)
Age 15.0–15.4	**0.019 (0.001, 0.037)**	0.028 (−0.003, 0.059)
Age 15.5–15.9	0.009 (−0.007, 0.025)	0.023 (−0.006, 0.052)
Age 16.0–16.4	0.003 (−0.013, 0.019)	0.008 (−0.019, 0.035)
Age 16.5–16.9	**0.025 (0.011, 0.039)**	**0.033 (0.006, 0.060)**
Age 17.0–17.4	0.014 (0.000, 0.028)	0.001 (−0.026, 0.028)

[1] Standardized regression coefficients (and 95% confidence intervals) presented. Adjusted for gender, race/ethnicity, parent education, level of urbanization, and age cohort.Bolded estimates are statistically significant ($p<0.05$).