ARTICLE

Influence of Movie Smoking Exposure and Team Sports Participation on Established Smoking

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Objective: To examine the joint effects of movie smoking exposure and team sports participation on established smoking.

Design: Longitudinal study.

Setting: School- and telephone-based surveys in New Hampshire and Vermont between September 1999 through November 1999 and February 2006 through February 2007.

Participants: A total of 2048 youths aged 16 to 21 years at follow-up.

Main Exposures: Baseline movie smoking exposure categorized in quartiles assessed when respondents were aged 9 to 14 years and team sports participation assessed when respondents were aged 16 to 21 years.

Main Outcome Measure: Established smoking (having smoked ≥100 cigarettes in one's lifetime) at follow-up.

Results: At follow-up, 353 respondents (17.2%) were established smokers. Exposure to the highest quartile of movie smoking compared with the lowest increased the likelihood of established smoking (odds ratio=1.63; 95% confidence interval, 1.03-2.57), and team sports nonparticipants compared with participants were twice as likely to be established smokers (odds ratio=2.01; 95% confidence interval, 1.47-2.74). The joint effects of movie smoking exposure and team sports participation revealed that at each quartile of movie smoking exposure, the odds of established smoking were greater for team sports nonparticipants than for participants. We saw a dose-response relationship of movie smoking exposure for established smoking only among team sports participants.

Conclusions: Team sports participation clearly plays a protective role against established smoking, even in the face of exposure to movie smoking. However, movie smoking exposure increases the risk of established smoking among both team sports participants and nonparticipants. Parents, teachers, coaches, and clinicians should be aware that encouraging team sports participation in tandem with minimizing early exposure to movie smoking may offer the greatest likelihood of preventing youth smoking.

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NUMEROUS STUDIES HAVE established a direct association between movie smoking exposure and youth smoking initiation.[1-6] Thirty to fifty percent of adolescent smoking initiation has been attributed to movie smoking exposure.[2,3] Movie smoking exposure appears to increase the risk of smoking initiation by enhancing adolescents' perceived benefits of smoking and making them more susceptible to peer influences.[7,8] Furthermore, movie smoking exposure that occurs prior to and during early adolescence has as much influence on smoking initiation as movie smoking exposure that occurs during the middle to late teenage years when youths are most likely to initiate smoking.[1] Movie smoking exposure has also been associated with smoking in young adulthood.[9]

Youth team sports involvement is associated with many health benefits, including enhancing one's well-being, improving global physical self-concept, and preventing youth smoking.[10-20] Team sports involvement may confer more positive health benefits than other types of extracurricular activity, including other types of physical activity.[21] Therefore, encouraging youths to participate in team sports is an important strategy for smoking prevention efforts. However, we do not yet fully understand the ways in which other risk factors for youth smoking may counteract the protective nature of team sports participation.

Youths who participate in team sports may be less susceptible to the influence of movie smoking exposure for several reasons. First, team sports participants may have less time to watch movies and therefore may have less movie smoking exposure. Second, team sports participants may look up to role models who may be more likely to model healthy behaviors, such as athletes. Third, team sports participants' high levels of global physical self-

concept[19] may counteract the perceived need to smoke fostered by movie smoking exposure. Finally, team sports participants, bolstered by an environment where avoiding tobacco is socially acceptable,[22,23] may feel less inclined to smoke in the face of movie smoking exposure.

The purpose of our study was to examine the joint effects of early movie smoking exposure and team sports participation on established smoking. We first hypothesized that, consistent with prior research, team sports participants would be less likely than team sports nonparticipants to become established smokers. Then, assuming that team sports participants have competing demands on their time, we hypothesized that team sports participants would have lower levels of early movie smoking exposure than team sports nonparticipants. Finally, given the social and physical environment associated with team sports participation, we also hypothesized that team sports participants would be less vulnerable to early impressions of movie smoking compared with team sports nonparticipants.

METHODS

CONTEXT AND PARTICIPANTS

The data analyzed for this study are from a longitudinal survey designed to investigate the association between movie viewing and smoking uptake in youths. The baseline survey was a self-administered written survey completed by 5473 adolescents in 15 New Hampshire and Vermont middle schools in 1999. Details of the baseline survey have been previously published.[2,4] The follow-up survey was a telephone survey conducted a mean (SD) of 6.7 (0.2) years after the baseline survey, from September 1999 through November 1999 and February 2006 through February 2007. It was administered by trained interviewers using a computer-assisted telephone interview system. Prior to conducting the telephone survey, we obtained verbal parental consent and respondent assent for respondents younger than 18 years. We obtained verbal consent for all other respondents. The respondents were offered $20 for completing the telephone survey. The study was approved by the Committee for the Protection of Human Subjects at Dartmouth College.

Of the 5473 respondents who completed the baseline survey in 1999, 3122 provided a telephone number for future contact, were not missing data for any of our key variables, and thus were eligible for the follow-up survey. Of the eligible sample, 2074 respondents (66.4%) completed the follow-up survey. We were unable to survey 469 (15.0%) of the eligible sample owing to incomplete or outdated contact information, 308 (9.9%) because they were unavailable at the time of survey administration, and 271 (8.7%) because they declined to participate.

Twenty-five of the 2074 participants were established smokers at baseline and thus were excluded from the current analysis. Additionally, 1 respondent was excluded because of missing data on the follow-up survey. The final sample size for this study was 2048.

EXPOSURE MEASURES

Movie Smoking

Movie smoking exposure was assessed at baseline using the previously described Beach method.[2] Briefly, each individual baseline survey contained a unique set of 50 movies randomly selected from a sample of 601 top box-office hit movies released between January 1, 1988, and December 31, 1999. This random selection of movies was stratified so that each list of 50 movies had the same proportion of movie ratings as the larger sample of top box-office hits: 45.3% rated R, 30.9% rated PG-13, 20.0% rated PG, and 3.8% rated G. Trained movie coders counted the number of smoking occurrences in the movies using methods previously described.[2,4,24] Survey responses were linked with information from a content analysis of smoking in movies to estimate an individual's movie smoking exposure.

We calculated early movie smoking exposure for each respondent by summing the number of smoking occurrences for each movie they had reported seeing at baseline. To adjust for possible variation in the movie lists, we expressed this sum as a proportion of the number of possible smoking occurrences they could have seen based on the movies in their survey. We then used this proportion to estimate their movie smoking exposure from the full sample of 601 movies.

Potential movie smoking exposure for the 601 movies was classified in quartiles based on the distribution for the 2048 participants with the following cutoffs: 0 to 522 occurrences for the first quartile, 523 to 947 for the second quartile, 948 to 1649 for the third quartile, and 1650 to 5308 for the fourth quartile.

Team Sports Participation

Team sports participation was assessed at follow-up using the following item drawn from the 2005 Youth Risk Behavior Survey: "During the past 12 months, on how many sports teams did you play? Please include teams run by your school, work, or community. (Do not include PE [physical education] classes)."[25] Possible response categories included none, 1 team, 2 teams, and 3 or more teams, which we collapsed into a dichotomous variable to reflect any team sports participation (none vs participation in ≥1 team sport in the past year).

Covariates

We also measured a number of covariates potentially related to adolescent smoking. Demographic covariates included age, sex, and race assessed at baseline as well as the highest level of education completed by 1 or both parents assessed at follow-up. Other covariates assessed at follow-up included the proportion of friends who smoke, smoking by parents, school enrollment, school performance, sensation seeking,[26,27] and rebelliousness.[28] Two items were used to assess sensation seeking and 7 items were used to assess rebelliousness. The average score for each characteristic was calculated by summing Likert scale responses for all items providing that at least 50.0% of the items were answered. These scores were then categorized by quartiles, with each increasing quartile indicating more of the characteristic. Cronbach α was 0.81 for sensation seeking and 0.72 for rebelliousness.

OUTCOME MEASURE

The outcome was established smoking assessed at follow-up. We defined an established smoker as someone who has smoked 100 or more cigarettes in his or her lifetime.[29] Because our outcome was the incident development of established smoking between baseline and follow-up, we did not include those who were established smokers at baseline in our analysis (n=25).

STATISTICAL ANALYSIS

We initially compared characteristics of established smokers using χ^2 tests for categorical data. We used 2-tailed $P<.05$ to

Table 1. Characteristics of 2048 Respondents and Their Association With Established Smoking at Follow-up in 353 Respondents

Characteristic	No.[a]	Established Smoker, No. (% in Row)[b]
Sex		
Male	956	203 (21.2)
Female	1092	150 (13.7)
Age at follow-up, y		
16-17	291	19 (6.5)
18	528	67 (12.7)
19	678	142 (20.9)
20-21	551	125 (22.7)
Parental education		
High school diploma or less	351	94 (26.8)
Some college, technical school, or associate's degree	513	107 (20.9)
College or graduate degree	1119	135 (12.1)
Unknown	65	17 (26.2)
Proportion of close friends who smoke		
None	792	22 (2.8)
<One-quarter	462	23 (5.0)
One-quarter to one-half	289	60 (20.8)
>Half	489	245 (50.1)
Parent smokes		
No	1436	175 (12.2)
Yes	611	178 (29.1)
Enrolled in school at follow-up		
No	375	167 (44.5)
Yes	1672	185 (11.1)
School performance		
Excellent	443	39 (8.8)
Good	1012	144 (14.2)
Average or below average	590	169 (28.6)
Sensation seeking quartile		
1	527	50 (9.5)
2	602	84 (14.0)
3	468	72 (15.4)
4	451	147 (32.6)
Rebelliousness quartile		
1	665	68 (10.2)
2	562	70 (12.5)
3	391	76 (19.4)
4	430	139 (32.3)
Baseline movie smoking exposure quartile		
1	512	44 (8.6)
2	512	66 (12.9)
3	513	101 (19.7)
4	511	142 (27.8)
Played team sports in past year		
No	885	228 (25.8)
Yes	1163	125 (10.8)

[a] Sample size may not always total 2048 owing to missing values.
[b] All χ^2 comparisons are significant with $P<.001$.

define statistical significance for these and all subsequent analyses. We used multiple logistic regression analysis to assess the association between movie smoking exposure and team sports participation on established smoking while adjusting for all covariates except race, which was not significantly associated with established smoking ($P=.32$). We then modeled the joint effects of movie smoking exposure and team sports participation using an 8-level interaction term between team sports (2 levels: no team sports and played team sports) and the baseline quartiles of movie smoking exposure (4 levels). Those who played team sports and were in the lowest quartile of movie smoking exposure were used as the reference group for the interaction term. We adjusted for all covariates significantly associated with established smoking. Tests of trend were conducted for all multivariate analyses. Odds ratios (ORs) with 95% confidence intervals (CIs) are reported. Data were analyzed using SAS version 9.1 statistical software (SAS Institute, Inc, Cary, North Carolina) and Stata version 10.0 statistical software (StataCorp LP, College Station, Texas).

RESULTS

OVERALL CHARACTERISTICS

At baseline, respondents were aged 9 to 14 years and most of the sample (1798 respondents [87.8%]) had never tried a cigarette. Approximately half (1092 respondents [53.3%]) were female and the majority (1943 respondents [94.9%]) were white. One-fifth (351 respondents [17.1%]) reported that high school was the highest level of education completed by 1 or both of their parents. At follow-up, respondents were aged 16 to 21 years and 1672 (81.6%) were still enrolled in school (433 in high school, 1200 in college, 33 in technical school, and 6 did not report school type) (**Table 1**). Compared with respondents who did not complete the follow-up survey, respondents who completed the follow-up survey were more likely to be white, be female, report that high school was the highest level of education for both parents, see slightly fewer movies, and be exposed to less movie smoking ($P<.001$ for all).

TEAM SPORTS PARTICIPATION AND MOVIE SMOKING EXPOSURE

More than half of the respondents (1163 respondents [56.8%]) reported in the follow-up survey that they had participated in 1 or more team sports in the past year. Compared with team sports nonparticipants, team sports participants were more likely to be male, younger, and enrolled in school ($P<.001$ for all). On average, respondents had seen 16 of the 50 movies on their baseline survey, which translates to an average exposure of 1191 smoking occurrences from 601 movies. There was no significant difference between the average number of movies seen at baseline by team sports participants and nonparticipants (mean [SD], 16.0 [8.3] vs 15.5 [7.6] movies, respectively; $P=.17$). There was also no significant difference between the mean number of movie smoking occurrences to which team sports participants and nonparticipants were exposed (mean [SD], 1201.7 [928.5] vs 1175.9 [862.0] occurrences, respectively; $P=.52$).

ESTABLISHED SMOKING AT FOLLOW-UP

At follow-up, 353 respondents (17.2%) were established smokers. Compared with the other respondents, established smokers were significantly more likely to be male, be older, have parents with lower levels of education, have a higher proportion of close friends who smoke, have parents who smoke, report lower school performance, have higher levels of sensation seeking and re-

belliousness, and be less likely to be enrolled in school at the time of follow-up (Table 1).

Compared with the other respondents, established smokers had a higher baseline movie smoking exposure and were significantly less likely to have participated in team sports in the year preceding the follow-up survey ($P<.001$ for all) (Table 1).

TEAM SPORTS PARTICIPATION, MOVIE SMOKING EXPOSURE, AND ESTABLISHED SMOKING

In a multivariate analysis adjusting for all characteristics in Table 1, the odds of established smoking increased across levels of movie smoking exposure (test of trend, $P=.01$). When compared with quartile 1, the increase in the odds of being an established smoker was not significant for quartiles 2 and 3 (quartile 2: OR=0.98; 95% CI, 0.60-1.60; quartile 3: OR=1.29; 95% CI, 0.81-2.07). Exposure to the highest level of movie smoking (quartile 4) compared with the lowest (quartile 1) significantly increased the likelihood of established smoking (OR=1.63; 95% CI, 1.03-2.57). In the same model, team sports nonparticipants were twice as likely to be established smokers compared with team sports participants (OR=2.01; 95% CI, 1.47-2.74).

In both team sports participants and nonparticipants, the proportion of established smokers increased from lowest to highest levels of movie smoking exposure by the same amount, 19.3% (**Figure**). However, the unadjusted percentage of established smoking was lower in team sports participants than nonparticipants across all levels of movie smoking exposure. Team sports participants, owing to their smaller proportion of established smokers in the lowest level of movie smoking exposure (quartile 1), had a 7-fold increase in the proportion of established smokers between the lowest and highest levels of movie smoking exposure (from 3.5% to 22.8%) compared with a 2-fold increase among team sports nonparticipants (from 15.1% to 34.4%). This association is examined further using a single reference category in the fully adjusted logistic regression analysis.

The joint effects of movie smoking exposure and team sports participation using a common low-risk reference category representing the lowest level of movie smoking exposure (quartile 1) and team sports participation, adjusted for covariates, are detailed in **Table 2**. The interaction of playing team sports and movie smoking exposure was significant for both unadjusted and adjusted models (unadjusted, $P=.01$; adjusted, $P<.001$). For team sports participants, the odds of established smoking increased across levels of movie smoking exposure (test of trend, $P=.005$), suggesting a dose response. Relative to the reference category, the increase in odds of being an established smoker did not reach statistical significance for quartiles 2 and 3 among team sports participants. However, team sports participants had a 3-fold greater risk of established smoking at the highest level of movie smoking exposure (quartile 4) compared with the lowest (quartile 1 [reference category]) (OR=3.04; 95% CI, 1.39-6.61). Relative to the reference category, the odds of established smoking among team sports nonparticipants were significantly elevated at each level of movie smoking exposure. However, there was no evidence of a dose response across quartile of movie smoking exposure among team sports nonparticipants (test of trend, $P=.27$); the odds of established smoking were similar for the highest (OR=3.82; 95% CI, 1.76-8.28) and lowest (OR=3.54; 95% CI, 1.57-8.02) movie smoking exposure levels (Table 2). Comparing the odds of established smoking within each quartile, we see that at every level of movie smoking exposure, the odds of established smoking were greater for team sports nonparticipants than for participants (Table 2).

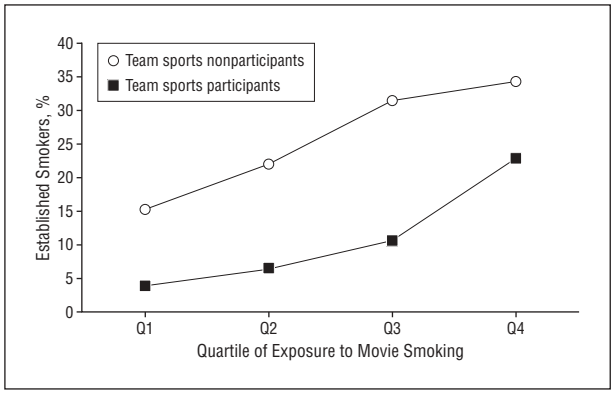

Figure. Prevalence of established smokers across quartiles of movie smoking exposure stratified by team sports participation.

COMMENT

Consistent with previous research that has found an inverse association between team sports participation and youth smoking,[13-18,21] we found that respondents who did not participate in team sports were twice as likely to be established smokers at follow-up. Contrary to our second hypothesis, team sports participants and nonparticipants had similar amounts of early movie smoking exposure. For the third hypothesis, we found mixed results. We found that greater levels of movie smoking exposure were associated with a greater likelihood of established smoking and that at every level of movie smoking exposure, team sports participation was protective for youth smoking. However, we saw a dose-response relationship of movie smoking exposure for the odds of established smoking only among team sports participants.

This is the first study to examine the joint effects of movie smoking exposure with team sports participation on established smoking in youths. One area for future investigation is to determine whether the protective influence of team sports participation prevails beyond a certain threshold level of movie smoking exposure. For example, in the Figure, there is the suggestion of a steeper ascent of established smoking between the third and fourth quartiles among team sports participants compared with team sports nonparticipants. Similarly, in the fully adjusted analysis examining the joint effects of movie smoking exposure and team sports participation, there was a sharp increase in the odds of established smoking among team sports participants in the highest quartile of movie

Table 2. Joint Effects of Movie Smoking Exposure and Team Sports Participation on Established Smoking at Follow-up

Team Sports Participation	AOR (95% CI) by Quartile of Movie Smoking Exposure[a]			
	Quartile 1	Quartile 2	Quartile 3	Quartile 4
Yes	1 [Reference][b]	1.45 (0.61-3.46)	1.57 (0.69-3.56)	3.04 (1.39-6.61)
No	3.54 (1.57-8.02)	2.87 (1.29-6.38)	4.40 (2.01-9.63)	3.82 (1.76-8.28)

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval.
[a] Adjusted for sex, age, parental education, friend and parent smoking, school enrollment, school performance, sensation seeking, and rebelliousness.
[b] A single reference group was used so that all ORs in the table compare the odds for established smoking with those for team sports participants with the lowest quartile of movie smoking exposure.

smoking exposure. It is important to note that the risk of established smoking among team sports participants with the highest level of movie smoking exposure was similar to that among team sports nonparticipants in the lowest quartile of movie smoking exposure. This highlights the importance of both encouraging team sports participation and minimizing movie smoking exposure as a way to reduce smoking.

We were surprised to discover that team sports participants and nonparticipants had similar amounts of early movie smoking exposure. One possible explanation is that team sports nonparticipants at follow-up were involved in team sports at baseline. Other possible explanations are that some team sports players may have more movie smoking exposure in their off-season or that team sports nonparticipants spend their extra time in activities other than movie viewing. We also expected team sports participants to be less vulnerable to early impressions of movie smoking compared with team sports nonparticipants. Instead, we found that they may be more vulnerable to movie smoking exposure, although overall they are still at lower risk for established smoking than team sports nonparticipants. Social cognitive theory purports that those with high perceived similarity to those modeling a behavior will be more susceptible to that behavior.[30] It is possible that the role models associated with team sports enable youths who participate in team sports to identify somewhat less strongly with certain movie characters who smoke on screen. Furthermore, it is possible that because the risk of established smoking is much higher among team sports nonparticipants, their odds of smoking are less likely to be elevated by other risk factors such as movie smoking. Our results are consistent with our previous study[2] that showed a similar dose-response effect of movie smoking exposure in lower-risk children but not higher-risk children as defined by parental smoking status. Overall, higher-risk children were at higher risk for smoking initiation but appeared to be less susceptible to movie smoking exposure. However, that finding has not been replicated in other studies.

Our sample was limited in that it was predominantly white and geographically constrained to northern New England. Respondents in the follow-up survey differed from the baseline sample in that they had fewer risk factors for established smoking: being female,[31] having both parents who completed high school, and having less movie smoking exposure. These differences may indicate that our findings are more applicable to a population that is overall at lower risk for smoking, thereby making our estimates slightly higher than what they would be for the general population. Our outcome of established smoking was necessarily based on self-report. However, most of the respondents were aged 18 years or older at the time of follow-up and therefore would have been less likely to underreport their smoking behavior. We were unable to identify youths who participated in team sports at an earlier age because team sports participation was only assessed at follow-up. Therefore, we are unable to assess whether the effects were the same at baseline. We did not have specific information regarding the type of team sports played and so were unable to determine whether some types of team sports confer more protection from established smoking than others. Additional research is needed to uncover what, if any, protective differences exist among types of team sports.

This study adds to the mounting evidence pointing to the need for explicit policies addressing ways to minimize youth exposure to movie smoking. Included among these is the recommendation to eliminate smoking from youth-rated movies,[32] supported by data from our previous study,[1] and a call for new movies to be rated R if they contain smoking.[33,34] Additionally, there are actions that clinicians, teachers, coaches, and parents can take to help minimize youth movie smoking exposure. Clinicians, teachers, and coaches can help raise awareness of the strong association between movie smoking exposure and youth smoking. Parents can minimize youth movie smoking exposure by restricting the number of R-rated movies they allow their children to see and by monitoring their children's movie viewing.[35] To assist with age-appropriate movie selection, parents can also access online tools such as http://www.screenit.com and http://www.commonsensemedia.org, which were created specifically to inform parents of the amount of smoking in a given movie.

In summary, this study supports the benefits of youth participation in team sports, which appears to protect against established smoking even in the face of movie smoking exposure. However, movie smoking exposure increases the risk of established smoking among both team sports participants and nonparticipants. Parents, teachers, coaches, and clinicians should be aware that encouraging team sports participation in tandem with minimizing early exposure to movie smoking may offer the greatest likelihood of preventing youth smoking.

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Author Contributions: Dr Adachi-Mejia had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Adachi-Mejia, Primack, and Dalton. *Acquisition of data:* Adachi-Mejia and Dalton. *Analysis and interpretation of data:* Adachi-Mejia, Primack, Beach, Titus-Ernstoff, Longacre, Weiss, and Dalton. *Drafting of the manuscript:* Adachi-Mejia, Primack, and Dalton. *Critical revision of the manuscript for important intellectual content:* Adachi-Mejia, Primack, Beach, Titus-Ernstoff, Longacre, Weiss, and Dalton. *Statistical analysis:* Adachi-Mejia, Primack, Beach, Weiss, and Dalton. *Obtained funding:* Adachi-Mejia and Dalton. *Administrative, technical, and material support:* Adachi-Mejia, Titus-Ernstoff, Longacre, and Dalton. *Study supervision:* Adachi-Mejia, Primack, Beach, Titus-Ernstoff, and Dalton.

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