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Exposure to Peers who Smoke Moderates the Association between Sports Participation and Cigarette Smoking Behavior among Non-White Adolescents

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Abstract

Adolescent sports participants are less likely to smoke cigarettes, and sports participation may prevent young people from smoking. Research suggests that the relationship between sports participation and smoking may vary by race/ethnicity and is also possibly moderated by exposure to peer smoking. We investigated these relationships in a sample of 311 adolescents ages 13 – 21 presenting for well-visit medical appointments. Participants completed valid assessments of demographics, sports participation, exposure to peer smoking, and smoking behavior. The primary outcome was smoking status (never smoked, tried smoking, experimental/current smoker). Ordinal logistic regression was used separately for non-Hispanic White ($n = 122$) and non-White ($n = 189$; 70.4% Black, 14.3% Hispanic, and 15.3% other) adolescents. Among White adolescents, sports participants had significantly lower odds of smoking than non-sports participants, independent of age, gender, and peer smoking. For non-Whites, the adjusted effect of sports participation on smoking depended upon exposure to peers who smoke. Compared with non-sport participants with no exposure to peer smoking, sports participants with no exposure to peer smoking had significantly lower odds of smoking, whereas sports participants with exposure to peer smoking had significantly higher odds of smoking. Sports appear to be protective against smoking among non-Hispanic White adolescents, but among non-White adolescents exposure to peer smoking influences this protection. Interventions incorporating sports to prevent smoking should consider these racial/ethnic differences to address disparities in smoking-related disease.

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Disclosures

Contributors

Dr. Mays led the data analysis and preparation of this manuscript for publication. Dr. Luta contributed to data analysis and manuscript preparation. Dr. Walker contributed to study protocol development, data collection, and manuscript preparation. Dr. Tercyak designed the original study protocol, led data collection, and contributed to manuscript preparation. All authors have approved the final version of the manuscript.

Conflict of Interest

The authors have no conflicts of interest to disclose.

Keywords

adolescents; smoking; sports; prevention; race/ethnicity

1. Introduction

Cigarette smoking is the leading preventable cause of mortality in the United States, accounting for an estimated 440,000 deaths each year (Centers for Disease Control and Prevention [CDC], 2010a). Preventing adolescent smoking is a national public health priority (Koh, 2010) and is central to comprehensive tobacco control efforts (Viswanath et al., 2010). Despite important progress in reducing the prevalence of tobacco use at the national level, cigarette smoking among U.S. adolescents remains a public health concern. Recent national data suggest nearly half of all U.S. youths ages 12 – 18 have tried smoking during their lifetime and 20% have done so within the past month (CDC, 2010b). Many of these young people will go on to become lifetime smokers, as an estimated 90% of adult smokers initiate this habit before age 18 (Backinger, Fagan, Matthews, & Grana, 2003; DiFranza et al., 2007; Gilpin, Choi, Berry, & Pierce, 1999). These data highlight the critical need for effective adolescent smoking prevention strategies, including those which capitalize on naturally-occurring interests among young people, such as engaging in sports and other physical activities (deRuiter & Faulkner, 2006).

Sports are important contexts of physical, social, and cognitive development for young people, and research suggests that adolescent sports participation is associated with health and developmental benefits (Eccles, Barber, Stone, & Hunt, 2003). A majority of U.S. youths report some form of organized sports involvement and stand to benefit from participation (Eaton et al., 2008). With respect to smoking, cross-sectional studies have consistently demonstrated that adolescents who take part in sports are less likely to smoke cigarettes than their non-sports participant peers (Bovard, 2008; Kaczynski, Manske, Mannell, & Grewal, 2008; Lisha & Sussman, 2010), and some evidence also suggests that sports participation during adolescence may reduce the risk for regular smoking later in adulthood (Jamner et al., 2003; Terry-McElrath & O'Malley, 2011; Wichstrom & Wichstrom, 2009). While few longitudinal studies have examined this issue, available data suggest that consistent sports participation during adolescence may reduce the likelihood of progressing to regular smoking later in life, whereas no involvement in sports or quitting sports increases risk for progressing to regular smoking (Metzger, Dawes, Mermelstein, & Wakschlag, 2011; Rodriguez & Audrain-McGovern, 2004; Wichstrom & Wichstrom, 2009). These findings regarding smoking stand in sharp contrast to those related to other substance use behaviors among young people. Some evidence indicates that adolescent sports participants are more likely than non-sports participants to use smokeless tobacco (Castrucci, Gerlach, Kaufman, & Orleans, 2004). Moreover, research on adolescent alcohol use generally suggests that sports participants are more likely to drink alcohol than non-sports participants, and some studies also indicate that sports participants may be more likely to use illicit drugs, although findings in this area are less consistent (Bovard, 2008; Lisha & Sussman, 2010).

Multiple factors may influence the observed protective relationship between adolescent sports participation and cigarette smoking. Smoking has an immediate deleterious impact on athletic performance due to negative effects on respiratory and cardiovascular systems (Pederson, Poulin, Lefcoe, Donald, & Hill, 1992), which may deter young people who are concerned with athletic performance from smoking (Lisha & Sussman, 2010; Wichstrom & Wichstrom, 2009). Historically, tobacco and sports have also been intimately connected due to tobacco company sponsorship and advertising during sporting events (Blum, 2005).

However, recent policy changes may be indicative of broader societal views that are now less favorable of this association between sports and tobacco use, especially among young people (Lisha & Sussman, 2010). Policy examples include the 2009 U.S. Family Smoking Prevention and Tobacco Control Act, which prohibits tobacco companies from advertising and sponsoring during sporting events (Gostin, 2009), and local outdoor smoking bans, many of which forbid smoking in outdoor recreational spaces where young people spend time (e.g., parks, sports fields) (Colgrove, Bayer, & Bachynski, 2011).

Research also points to specific individual- and environmental-level factors that may affect the relationship between adolescent sports participation and cigarette smoking. At the individual level, available data suggest that both sports participation and cigarette smoking behaviors differ based on gender and race/ethnicity (Castrucci et al., 2004; Davis et al., 1997; Escobedo, Marcus, Holtzman, & Giovino, 1993; Rodriguez & Audrain-McGovern, 2004). Studies examining gender differences have also shown that males are more likely to participate in sports and outcomes associated with sports participation—such as substance use behaviors—typically differ between young males and females (Eccles et al., 2003; Mays & Thompson, 2009; Miller, Melnick, Barnes, Farrell, & Sabo, 2005).

With respect to race/ethnicity, most prior studies in this area have been conducted among samples of predominantly non-Hispanic White adolescents, and race/ethnicity has been almost exclusively considered as a covariate, rather than a potential moderating factor (Castrucci et al., 2004; Davis et al., 1997; Escobedo et al., 1993; Garry & Morrissey, 2000; Rodriguez & Audrain-McGovern, 2004). While research on the mechanisms underlying racial/ethnic differences in the relationship between sports participation and smoking are not well understood, evidence suggests that non-White youths are likely to participate in sports inconsistently or drop out, which are patterns that have been associated with greater risk for progressing to regular smoking (Rodriguez & Audrain-McGovern, 2004). Unfortunately, however, the lack of studies examining race/ethnicity as a moderator may mask potential differences between racial/ethnic groups in the relationship between sports participation and smoking behaviors that are important to inform the development of targeted prevention efforts involving sports and other forms of physical activity.

Research also suggests that exposure to peers who smoke may affect the relationship between adolescent sports participation and tobacco and other substance use behaviors (Barber, Eccles, & Stone, 2001; Dams-O'Connor, Martin, & Martens, 2007; Kaczynski et al., 2008; Lisha & Sussman, 2010; Mays et al., 2010). Adolescents' exposure to peers who smoke is a well-established predictor of cigarette smoking behavior (Buller et al., 2003; Tyas & Pederson, 1998), and one of the primary peer groups with which adolescents identify is based around sports participation (Sussman, Pokhrel, Ashmore, & Brown, 2007). However, some researchers have speculated that exposure to peer smoking may moderate the protective impact of sports participation on substance use behaviors, such as cigarette smoking. One hypothesis is that subgroups of adolescents, such as racial/ethnic minority groups, may be more strongly drawn to the social aspects of substance use behaviors emphasized in the culture of adolescent sports (Miller et al., 2003), suggesting that the degree of protection that sports may have on smoking behavior is dependent on peer smoking behaviors (Turner, Mermelstein, & Flay, 2004). While these findings suggest that exposure to peers who smoke may moderate the association between adolescent sports participation and smoking behavior, this issue has not yet been investigated empirically (Lisha & Sussman, 2010).

Sports and other physical activities have been identified as potential strategies to prevent youth smoking initiation and to reduce tobacco-related harm (deRuiter & Faulkner, 2006). To our knowledge, however, no prior study has examined differences in the relationship

between sports participation and cigarette smoking based on adolescents' race/ethnicity and exposure to peers who smoke. Improving our understanding of these relationships may help to inform sports-based smoking prevention interventions by identifying populations for which these efforts may be particularly impactful (Lisha & Sussman, 2010). In light of this, we examined whether the relationship between adolescent sports participation and smoking behavior differs based on race/ethnicity. We further assessed whether exposure to peers who smoke moderates the relationship between sports participation and smoking behavior.

2. Methods

2.1. Participants and Setting

Our analysis included 311 healthy adolescents between the ages of 13 and 21 years. Participants were recruited for the study at the time of their general medical check-ups at an adolescent medicine clinic within a large, urban, tertiary care hospital in Washington, DC. Adolescents were eligible to participate if they were: (1) between ages 13 and 21, (2) able to provide informed consent/assent, and (3) in good general health, as determined by parental or adolescent self-report.

2.2. Procedures

All procedures were approved by the Georgetown University Institutional Review Board, and a full description of the study methodology has been published previously (Tercyak, Abraham, Graham, Wilson, & Walker, 2009). Briefly, potentially-eligible adolescents and/or their parents were approached regarding the study at the time of their adolescent medicine clinic appointments. Designated research staff determined adolescents' interest in participating, screened for eligibility, and obtained written informed consent/assent. Enrolled participants then completed a comprehensive self-administered assessment of their participation in sports and other activities, tobacco use, risk factors for tobacco use, and other health behaviors related to the study (Tercyak et al., 2009). Participants received a modest incentive to acknowledge their time for taking part in the study. Overall, 88% of potentially eligible adolescents participated in the study, and a majority of those who declined participation did so due to lack of time (Tercyak et al., 2009).

2.3. Measures

2.3.1 Demographic Characteristics—Demographic information including age, gender, and race/ethnicity (dichotomized as non-Hispanic White or non-White) was collected from each participant.

2.3.2. Sports Participation—Sports participation was assessed with a single item from the U.S. Centers for Disease Control and Prevention Youth Risk Behavior Survey (Eaton et al., 2010). The item asked participants "How many organized sports teams are you involved in?" Response options ranged from "0" to "4 or more", and a dichotomous variable indicating any sports participation was created for analyses. This measure has been demonstrated to have good reliability (test-retest Cohen's κ 0.56-0.75) (Brener et al., 2002; Zullig, Pun, Patton, & Ubbes, 2006) and has been widely used in studies of adolescent sports participation and tobacco and other substance use behaviors (Lisha & Sussman, 2010; Mays, Gatti, & Thompson, 2011).

2.3.3. Exposure to Peer Smoking—Exposure to peers who smoke cigarettes was assessed using four items that are widely used in research on risk factors for adolescent smoking (Castrucci, Gerlach, Kaufman, & Orleans, 2002; Kremers, Mudde, & de Vries, 2001). Questions assessed whether participants' best friend, best male friend, best female friend, and girlfriend/boyfriend, partner, or spouse smoked. A dichotomous variable was

created based on participant responses, which reflected whether participants endorsed that at least one of their friends smoked. This operationalization of exposure to peer smoking has been a strong predictor of adolescent smoking behavior and other risk factors for smoking (e.g., sensation-seeking) in prior research (Audrain-McGovern et al., 2004), and was positively correlated with smoking behavior in the study sample as well (Pearson's $r=0.45$, $p<.001$).

2.3.4. Smoking Behavior—Standard epidemiological items were used to measure smoking behaviors, including lifetime smoking, smoking within the past month, and lifetime number of cigarettes smoked (Eaton et al., 2010). These items have been demonstrated to have good reliability for assessing adolescent smoking behavior (test-retest Cohen's $\kappa > 0.70$) (Brener et al., 2002; Zullig et al., 2006). Guided by prior research (Audrain-McGovern, Rodriguez, & Moss, 2003; Audrain-McGovern, Lerman, Wileyto, Rodriguez, & Shields, 2004; Rodriguez & Audrain-McGovern, 2004), we used these items to create an ordered categorical smoking status outcome variable: (0) Never smoked – never smoked a cigarette, not even a puff; (1) Tried smoking – tried smoking a cigarette, but never smoked a whole cigarette; (2) Experimenter – smoked 1 whole cigarette but < 100 cigarettes total during their lifetime; or smoked 1 whole cigarette during their lifetime but have not smoked within the last 30 days; (3) Current smoker – smoked 1 cigarette in the past 30 days and 100 total cigarettes during their lifetime. For analyses, experimenters and current smokers were combined into a single category due to the small number of current smokers within the sample ($n = 16$, 5.1%).

2.4. Analyses

We first used bivariate tests (e.g., t-tests, χ^2 tests) to examine associations between demographic characteristics, sports participation, and exposure to peer smoking, and smoking behavior. Based on bivariate analyses, we used ordinal logistic regression models to examine the relationship between sports participation and smoking behaviors, assess differences based on race/ethnicity, and investigate exposure to peers who smoke as a moderating variable. Models adjusted for demographic characteristics that were identified as potential confounding variables in bivariate analyses. Our initial step was to test for a 3-way interaction between sports participation, race/ethnicity, and exposure to peers who smoke among the entire study sample with and without adjustment for age and gender. This allowed us to determine simultaneously whether race/ethnicity and exposure to peer smoking were possible moderators of the relationship between sports participation and smoking behavior. For completeness, we also tested 2- and 3-way interactions between sports participation, exposure to peers who smoke, and the other demographic characteristics included in our model (i.e., gender, age), but there was no evidence that gender or age were moderators. Our findings (described below) suggested that race/ethnicity and exposure to peer smoking were moderators, therefore we stratified our final models by race/ethnicity (non-Hispanic White ($n = 122$) and non-White ($n = 189$)).

We created our final regression models through several steps. Demographic characteristics, sports participation, and exposure to peer smoking were first included as predictors of smoking behavior. We then added an interaction term between sports participation and exposure to peers who smoke, assessing whether this interaction term contributed significantly to the model by examining Wald χ^2 statistic for the interaction and the change in the log likelihood ratio χ^2 statistic between models (Tabachnick & Fidell, 2006). For each model, we determined whether it was appropriate to estimate one regression equation across levels of the ordered smoking behavior outcome variable by examining the Score χ^2 Test of the Proportional Odds Assumption (Tabachnick & Fidell, 2006), and we computed a modified Pearson χ^2 statistic to assess model fit (Pulkstenis & Robinson, 2004). Non-

significant p -values for both χ^2 tests ($> .40$) confirmed that ordered logit models were appropriate and fit the data well. Similar to binary logistic regression, odds ratios from the ordinal logistic models reflect the odds of being in a higher smoking risk category for the dependent variable (i.e., tried smoking or experimenter/established smoker) relative to all lower risk categories, for each level or unit change in the independent variable. Finally, because our sample included a relatively wide age range (13-21 years), we conducted ancillary analyses to examine whether the results of the final model were consistent when restricted to only those participants ages 13 to 18 ($n = 263$).

3. Results

3.1. Sample Characteristics

Table 1 displays characteristics of the sample. Participants averaged 16.4 ($SD = 2.0$) years of age, and most were non-White (60.8%), female (71.0%), and reported sports participation (54.7%). Non-White participants were mostly Black/African American ($n = 133$, 70.4%), followed by Hispanic/Latino ($n = 27$, 14.3%), Asian/Pacific Islander ($n = 7$, 3.7%), Middle-Eastern ($n = 3$, 1.6%), and 19 who identified with another unspecified racial/ethnic group (10.0%). With respect to smoking behaviors, 186 participants (59.8%) were never smokers, 51 (16.4%) had tried smoking, and 74 (23.8%) were experimenters or current smokers.

3.2. Bivariate Analysis

Bivariate associations with smoking behaviors are displayed in Table 1. Characteristics significantly associated with smoking behaviors included older age, non-sports participation, and exposure to peers who smoke ($p < .001$; Table 1). As is illustrated in Table 1, there was significant variability in the proportion of participants reporting smoking behaviors based on sports participation and exposure to peers who smoke, and this was evident among both non-Hispanic White and non-White participants (Table 1).

Sample characteristics by participants' race/ethnicity are displayed in Table 2. White adolescents were significantly more likely than non-Whites to be female and to report sports participation (Table 2). A greater proportion of White participants were also experimenters/current smokers (29.5%) compared with non-Whites (20.1%), however this difference was not statistically significant ($p = .09$) (Table 2). Bivariate analyses examining factors associated with sports participation revealed that sports participants were significantly younger ($M = 15.8$, $SD = 1.8$) than non-sports participants ($M = 17.1$, $SD = 2.1$, $p < .001$) and were more likely to identify as White compared with non-sports participants (47.1% and 29.8%, $p = .002$). Sports participants were also significantly less likely than non-sports participants to report exposure to peers who smoke (45.3% vs. 60.3%, $p = .008$).

3.3. Regression Analysis

Results of our initial model, which included the entire study sample, confirmed a statistically significant 3-way interaction between sports participation, exposure to peers who smoke, and race/ethnicity. The 3-way interaction was significant prior to ($\chi^2 = 4.7$, 1 df, $p = .030$) and after adjustment for age and gender ($\chi^2 = 4.4$, 1 df, $p = .036$). We stratified our final models by race/ethnicity, which are displayed in Table 3.

Among non-Hispanic White adolescents, the interaction between sports participation and exposure to peer smoking was not statistically significant ($\chi^2 = .002$, 1 df, $p = .98$) and did not improve the model (Table 3, Δ Log likelihood $\chi^2 = .002$, 1 df, $p = .48$), therefore it was excluded from the final model. Among non-Hispanic White participants, the final model indicates that sports participants had significantly lower odds of smoking than non-sports participants (OR = 0.39, 95% CI 0.17, 0.89, $p = .014$), independent of the effects of age,

gender, and exposure to peers who smoke. White adolescents reporting exposure to peers who smoke had a significantly higher odds of smoking (OR = 6.54, 95% CI 2.71, 15.74, $p < .001$), and risk for smoking also increased significantly with age (Table 3).

The final model for non-White adolescents is displayed in Table 3. The interaction between sports participation and exposure to peer smoking was statistically significant (Wald $\chi^2 = 8.44$, 1 df, $p < .001$) and improved the model among non-white adolescents (Table 3, Δ Log likelihood ratio $\chi^2 = 11.0$, 1 df, $p < .001$). Results of the final model suggest that non-White sports participants who were not exposed to peers who smoke have significantly lower odds of smoking (OR = 0.13, 95% CI = 0.03, 0.64, $p = .012$), compared with non-sports participants who were not exposed to peers who smoke. In contrast, non-White sports participants who reported exposure to peer smoking had significantly higher odds of smoking (OR = 3.96, 95% CI = 1.61, 9.75, $p < .001$) when compared with the same reference group, after adjusting for age and gender. After adjusting for other variables in the model, smoking risk also increased significantly with each year increase in age (OR = 1.27, 95% CI 1.08, 1.51, $p = .005$).

When we replicated our final models among participants who were ages 13-18 years ($n = 263$), the findings were not substantively changed. This suggests that our results were not substantially impacted by the inclusion of older adolescents in the study sample.

4. Discussion

This study investigated differences in the relationship between adolescent sports participation and cigarette smoking behaviors based on race/ethnicity and exposure to peers who smoke. Consistent with prior research, our bivariate analysis showed that sports participants were significantly less likely to report cigarette smoking than non-sports participants (Lisha & Sussman, 2010). However, our multivariable analyses revealed that the relationship between sports participation and cigarette smoking differed for non-Hispanic White and non-White adolescents. Specifically, we found that non-Hispanic White adolescents who participate in sports have lower odds of smoking, independent of the influence of gender, age, and exposure to peers who smoke. Further, among this group, exposure to peers who smoke significantly increased the odds of smoking, independent of sports participation and other demographics. Among non-White adolescents, however, we found that the potential protective effect of sports participation on smoking behavior was influenced by exposure to peers who smoke. Non-White sports participants who were exposed to peer smoking had a higher odds of smoking compared with non-sports participants without exposure to peers who smoke, whereas non-White sports participants without exposure to peers who smoke had smoking significantly lower odds of smoking. Available research points to potential explanations of these findings that should be investigated in future studies. Our results may also help to inform interventions designed to leverage sports and other forms of physical activity as strategies to prevent and reduce adolescent smoking (deRuiter & Faulkner, 2006).

One possible explanation for these findings is that variation in the contexts of sports participation across racial and ethnic groups affects adolescents' exposure to peers who smoke, in turn influencing their cigarette smoking behaviors. Evidence from prior studies suggests that substance use behaviors, including cigarette smoking, vary by adolescents' participation in different sports across school-based and non-school based settings (Moore & Werch, 2005). For example, one study found that risk for smoking was increased among males engaged in school-based wrestling and non-school based tennis and among females who skateboarded outside of school (Moore & Werch, 2005). Across these different sports contexts, social norms encouraging or discouraging smoking may vary, in turn influencing

adolescents' smoking behaviors (deRuiter & Faulkner, 2006; Lisha & Sussman, 2010). Some have hypothesized, for example, that school-based sports are more likely to include homogenous groups of young people (e.g., similar age, gender-specific sports, enrolled in school), while informal sports occurring in community settings may involve more heterogeneous groups, including both males and females and peers who are older and not in school, and may be more likely to smoke (Moore & Werch, 2005). Additional research is needed to investigate variation in contexts of sports participation and exposure to peer smoking based on adolescents' race/ethnicity, and whether this variation influences smoking behaviors.

Adolescents' identification with sports-related social identities and peer groups may also influence the relationships among race/ethnicity, exposure to peers who smoke, and cigarette smoking (Miller et al., 2005). Many adolescent sports participants self-identify with an abstract "athlete identity" (Sussman et al., 2007), and normative beliefs about substance use among "typical athlete" peers have been demonstrated to predict substance use behaviors among older adolescents (Dams-O'Connor et al., 2007). Adolescents who perceive themselves to be "jocks" have also been shown to have poorer academic outcomes (Miller et al., 2005) and engage in risky substance use behaviors (Miller et al., 2003), and this is particularly the case among non-White adolescents (Miller et al., 2003; Miller et al., 2005). Taken together, this research indicates that both organizational (e.g., school-based sports) and social (e.g., identifying as a "jock") constructs of sports participation may influence smoking behavior, and suggests the methods by which sports participation is measured are critical to understanding the relationships among race/ethnicity, sports participation, exposure to peer smoking, and smoking behaviors (Lisha & Sussman, 2010). In future studies, there is an important need to bring to bear rigorous, multidimensional assessments that capture both adolescent participation in organized sports and their affiliation with sports-related social identities in order to fully understand these relationships (Bohnert, Fredricks, & Randall, 2010).

The results of our study may help to inform interventions seeking to leverage sports and other physical activities as strategies to prevent youth smoking. Prior research suggests that sports and other contexts of physical activity may be important opportunities to intervene on smoking and other related behavioral outcomes. For example, the Adolescents Targeting Healthy Exercise and Nutrition Alternative (ATHENA) curriculum is a multi-session, peer-facilitated program administered during school-based sports practices among adolescent females (Elliot et al., 2004). Through a randomized controlled trial, ATHENA was demonstrated to reduce female sports participants' risk for smoking and other health risk behaviors relevant to the intervention (Elliot et al., 2004). A similar school-based intervention program for males was also demonstrated to reduce substance use (e.g., anabolic steroids, illicit drug use), although outcomes regarding smoking were not reported (Goldberg et al., 2000).

In a related study, a life-skills and community service enhancement program offered through the First Tee youth golf academy – a community-based initiative targeting socioeconomically disadvantaged youth – led to positive improvements on adolescents' pro-social developmental outcomes (e.g., social responsibility) (Brunelle, Danish, & Forneris, 2007). While these may be relevant precursors to smoking behavior among young people, the study did not specifically target cigarette smoking as an outcome (Brunelle et al., 2007). Finally, emerging research demonstrates that the effects of an evidence-based adolescent smoking cessation intervention called "Not-On-Tobacco" can be enhanced by adding a brief physical activity motivation component, particularly among young males (Horn et al., 2011). While limited to a small number of studies, these results are promising and suggest that

sports and other physical activities may be important contexts to prevent and reduce cigarette smoking among youths.

To inform future smoking prevention efforts built around sports participation, it will be critical to identify mediating variables that may be modifiable targets for intervention. For example, some have hypothesized that depressive symptoms may be a mediating mechanism through which physical activities, such as sports participation, protect against smoking behavior (Audrain-McGovern et al., 2003). Depressive symptoms are a risk factor for adolescent smoking, and physical activities may represent a replacement “reward” for smoking among those with depressive symptoms (Audrain-McGovern et al., 2003). Tailoring sports-based interventions to target depressive symptoms may be one approach to enhance their impact.

Particularly among young females, which comprised a majority of our study sample, perceptions of body image may be another important target for intervention efforts. Body dissatisfaction is associated with disordered eating among female athletes (Nichols, Rauh, Lawson, Ji, & Barkai, 2006), and both body dissatisfaction and disordered eating have been associated with an increased risk for smoking among this group (Stice & Shaw, 2003). While we did not assess body image perceptions in the present study, preliminary evidence from prior work indicates that sports-based interventions can effectively improve both body satisfaction and smoking-related outcomes among adolescent female sports participants (Elliot et al., 2008), suggesting this may be an important intervention target to be examined in future studies.

The efficacy of preventive interventions built around sports and other physical activities could also be enhanced by specifically adapting these programs for implementation in both school- and community-based contexts and to be culturally targeted for diverse racial/ethnic groups (Kreuter, Lukwago, Bucholtz, Clark, & Sanders-Thompson, 2003). Community-based research and intervention development models may be especially important to design approaches for implementation within non-school based settings, which offer less formal structure for administration than school-based sports, but may be critical to reach adolescents who are at risk for smoking. In the absence of school-based sports organizational structure to facilitate implementation (e.g., scheduled practices, presence of coaches and other adults), engaging key community members in the intervention development and delivery process may be critical to success (Aguirre-Molina & Gorman, 1996). This will likely include involving adolescents, leaders of community-based organizations that serve youths, and other potentially influential figures in the intervention development and implementation process (Aguirre-Molina & Gorman, 1996). Peer-facilitated intervention approaches have been found to be efficacious for reducing risk for smoking in school-based sports contexts among adolescent females (Elliot et al., 2004) and may also be vital to reduce smoking risk among high-risk, non-White adolescents encountered in both school and community-based settings. Finally, parental involvement may also be an important intervention component, including parental encouragement of youth sports involvement and monitoring of friends and peer group affiliations (Rodriguez, Tscherne, & Audrain-McGovern, 2007).

4.1. Limitations

While our results point to potentially important areas of future research, they should be interpreted in light of important study limitations. We used brief measures of self-reported sports participation, exposure to peers who smoke, and cigarette smoking behaviors, and while evidence supports the reliability of these measures they may introduce bias. With respect to our measure of sports participation, it was a single item drawn from an epidemiologic survey that did not capture specific aspects of sports involvement such as

intensity of participation, types of different sports, or settings of participation (Bohnert, Fredricks, & Randall, 2010). The prevalence of smoking behaviors was lower in our sample than among youths nationally (CDC, 2010b), which may be due to the fact that the sample was comprised primarily of females and non-White adolescents, who are typically groups that are less likely to smoke cigarettes. It will therefore be important to examine these relationships in other adolescent samples with diverse smoking risk profiles.

The setting and convenience sample also limit generalizability to broader populations. Due to sample size limitations, we were not able to conduct reliable subgroup analyses of non-White racial/ethnic groups, and our power to detect interactions (particularly in subgroup analyses) was very limited due to small cell size counts. Additional research is needed to specifically investigate differences in the relationships examined here across diverse populations, with sufficient sample size. Finally, study participants were adolescents of an age range that likely spanned developmentally diverse groups, which may have influenced the findings. In particular, contexts of sports participation and factors influencing smoking behavior likely differ by these developmental stages (Audrain-McGovern et al., 2004). While we accounted for the influence of age in multivariable analyses and confirmed that our findings were not substantively changed when older adolescents were excluded from analyses, future studies are needed to investigate age-related differences in the relationships examined here.

4.2 Conclusions

Our findings suggest that sports participation is protective against cigarette smoking among non-Hispanic White adolescents, but this may not be the case among non-White adolescents, where exposure to peer smoking influences the potential protective benefits gained through sports participation. The findings of this study add to a growing literature which suggests that the often-observed protective effect of adolescent sports participation on smoking behavior is complex and varies based on a number of factors (Lisha & Sussman, 2010). Understanding the factors that affect this relationship is critical to leverage sports participation as a context for interventions to reduce smoking and other substance use behaviors, and to improve sports programs for young people. Our results highlight the need for additional research to further examine the relationship between sports participation, peer smoking, and smoking behavior in other adolescent samples, focusing on aspects of sports participation that may help to explain these findings and modifiable targets of interventions (e.g., depressive symptoms, body satisfaction). Our findings further suggest that smoking prevention interventions incorporating sports participation and other physical activities should consider race/ethnicity-based differences to address disparities in smoking-related disease. Community-based interventions may be needed to reach adolescents with preventive interventions leveraging sports as a context to prevent and reduce cigarette smoking. Peer smoking may be an especially important target to reduce smoking among minority adolescents who engage in sports.

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Highlights

- We studied the link between adolescent sports participation and smoking behaviors
- Sports appear to be protective against smoking among non-Hispanic White adolescents
- However, among non-White adolescents exposure to peer smoking may influence protection
- These differences may be important for preventive interventions involving sports

Table 1
Bivariate Relationships with Smoking Behavior and Hypothesized Interaction Relationships

	Study Sample (<i>n</i> = 311)	Never Smoked (<i>n</i> = 186)	Tried Smoking (<i>n</i> = 51)	Experimenter/ Current Smoker (<i>n</i> = 74)	<i>P</i> -value
Demographics					
Age (<i>M</i> , <i>SD</i>)	16.4 (2.0)	15.8 (2.0)	16.7 (1.9)	17.6 (1.7)	<.001
13-14 years	64, 20.6%	57, 30.7%	6, 11.8%	1, 1.4%	<.001
15-16 years	103, 33.1%	62, 33.3%	20, 39.2%	21, 28.3%	
17-18 years	96, 30.9%	51, 27.4%	12, 23.5%	33, 44.6%	
19-21 years	48, 15.4%	16, 8.6%	13, 25.4%	19, 25.7%	
Gender (<i>N</i> , %)					.75
Male	90, 29.0%	52, 28.0%	17, 33.3%	21, 28.4%	
Female	221, 71.0%	134, 72.0%	34, 66.7%	53, 71.6%	
Race/Ethnicity (<i>N</i> , %)					.32
Non-Hispanic White	122, 39.2%	71, 38.2%	15, 29.4%	36, 48.6%	
Non-White	189, 60.8%	115, 61.8%	36, 70.6%	38, 51.4%	
Sports Participation (<i>N</i>, %)					
1 Organized Sport	170, 54.7%	117, 62.9%	21, 41.1%	32, 43.2%	<.001
No Organized Sports	141, 45.3%	69, 37.1%	30, 58.8%	42, 56.8%	
Peer Smoking					
1 Friend Smokes	162, 52.1%	64, 34.4%	34, 66.7%	64, 86.5%	<.001
No Friends Smoke	149, 47.9%	122, 65.6%	17, 33.3%	10, 13.5%	
Sports by Peer Smoking					
Non-Hispanic White (<i>N</i>, %)	<i>n</i> = 122	<i>n</i> = 71	<i>n</i> = 15	<i>n</i> = 36	<.001
<u>Non Sports Participants</u>					
No Peer Smoking	18, 14.8%	12, 16.9%	2, 13.3%	4, 11.1%	
Peer Smoking	24, 19.7%	4, 5.6%	4, 26.7%	16, 44.4%	
<u>Sports Participants</u>					
No Peer Smoking	46, 37.7%	40, 56.3%	3, 20.0%	3, 8.3%	
Peer Smoking	34, 27.9%	15, 21.1%	6, 40.0%	13, 36.1%	
Non-White (<i>N</i>, %)	<i>n</i> = 189	<i>n</i> = 115	<i>n</i> = 36	<i>n</i> = 38	<.001
<u>Non Sports Participants</u>					

	Study Sample (<i>n</i> = 311)	Never Smoked (<i>n</i> = 186)	Tried Smoking (<i>n</i> = 51)	Experimenter/ Current Smoker (<i>n</i> = 74)	<i>P</i> -value
No Peer Smoking	38, 20.1%	25, 21.7%	10, 27.8%	3, 7.9%	
Peer Smoking	61, 32.3%	28, 24.3%	14, 38.9%	19, 50.0%	
<u>Sports Participants</u>					
No Peer Smoking	47, 24.9%	45, 39.1%	2, 5.6%	0, 0%	
Peer Smoking	43, 22.8%	17, 14.8%	10, 27.8%	16, 42.1%	

Notes: *P*-values for continuous variables are based on *F*-tests; *P*-values for categorical variables are based on chisquare tests taking into account the ordinal nature of the smoking behavior variable. Percentages for interaction terms are based on non-Hispanic white (*n* = 122) and non-white (*n* = 189) subgroups.

Table 2

Sample characteristics by race/ethnicity

	Non-Hispanic White (<i>n</i> = 122)	Non- White (<i>n</i> = 189)	<i>P</i> -value
<u>Demographics</u>			
Age (<i>M</i> , <i>SD</i>)	16.4 (2.0)	16.4 (2.1)	.76
13-14 years	27, 22.1%	37, 19.5%	.67
15-16 years	36, 29.5%	67, 35.5%	
17-18 years	41, 33.6%	55, 29.1%	
19-21 years	18, 14.8%	30, 15.9%	
Gender (<i>N</i> , %)			.008
Male	25, 20.5%	65, 34.4%	
Female	97, 79.5%	124, 65.6%	
<u>Sports Participation</u> (<i>N</i> , %)			.002
1 Organized Sport	80, 65.7%	90, 47.6%	
No Organized Sports	42, 34.3%	99, 52.4%	
<u>Peer Smoking</u>			.20
1 Friend Smokes	58, 47.5%	104, 55.0%	
No Friends Smoke	64, 52.5%	85, 45.0%	
<u>Smoking Behavior</u>			.09
Never smoked	71, 58.2%	115, 60.9%	
Tried smoking	15, 12.3%	36, 19.0%	
Experimenter/Current Smoker	36, 29.5%	38, 20.1%	

Notes: *P* value for age is based on a *t*-test; *P* values for categorical variables are based on chi-square tests.

Table 3

Sports participation, peer smoking, and smoking behavior among non-Hispanic White and non-White adolescents

Non-Hispanic White Adolescents (n = 122)		Non-White Adolescents (n = 189)	
<u>Demographics</u>		<u>Demographics</u>	
Age	1.37** 1.08, 1.74	Age	1.27** 1.08, 1.51
Male Gender	1.70 0.63, 4.55	Male Gender	1.18 0.60, 2.32
<u>Sports Participation</u>	0.39* 0.17, 0.89	<u>Sports Participation</u>	--
<u>Peer Smoking</u>	6.54*** 2.71, 15.74	<u>Peer Smoking</u>	--
<u>Sports x Peer Smoking Interaction</u>	--	<u>Sports x Peer Smoking Interaction</u>	--
<u>Non Sports Participants</u>		<u>Non Sports Participants</u>	
No Peer Smoking	--	No Peer Smoking	1.00
Peer Smoking	--	Peer Smoking	2.31 0.94, 5.37
<u>Sports Participants</u>		<u>Sports Participants</u>	
No Peer Smoking	--	No Peer Smoking	0.13** 0.03, 0.64
Peer Smoking	--	Peer Smoking	3.96*** 1.61, 9.75
Score Proportional Odds χ^2 [df]	0.54 [4], $p = .97$	Score Proportional Odds χ^2 [df]	6.2 [5], $p = 0.29$
Modified Pearson χ^2 [df]	22.7 [26], $p = .65$	Modified Pearson χ^2 [df]	25.8 [25], $p = .42$
Sports x Peer Smoking Interaction Δ Log Likelihood χ^2 [df]	0.002 [1], $p = .48$	Sports x Peer Smoking Interaction Δ Log Likelihood χ^2 [df]	11.0 [1], $p < .001$

Notes: Odds ratios for age are based on 1 unit increase in age. Dependent variable is ordered smoking behavior: never smoked, tried smoking, experimenter/current smoker. Odds ratios and 95% confidence intervals are displayed for each variable.

*
 $p < .05$

**
 $p < .01$

 $p < .001$.