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School-Level Correlates of Adolescent Tobacco, Alcohol and Marijuana Use

Danielle Hill and **Sylvie Mrug**

Department of Psychology, University of Alabama at Birmingham, Birmingham, Alabama, USA

Abstract

Background—School-level characteristics are related to students' substance use, but little research systematically examined multiple school characteristics in relation to different types of substance use across grade levels.

Objectives—This study examines multiple school-level characteristics as correlates of students' tobacco, alcohol, marijuana, and combined substance use across three grade levels.

Methods—Students ($N = 23,615$) from 42 urban and suburban middle schools and 24 high schools in the U.S. reported on their tobacco, alcohol, and marijuana use. Students' mean age was 14 years; 47% were male, 53% African American and 41% Caucasian. School-level data included poverty, racial composition, academic achievement, student-teacher ratio, absenteeism, and school size. Multilevel logistic and Poisson regressions tested associations between school-level predictors and adolescent substance use in middle school, early high school and late high school.

Results—School-level poverty, more ethnic minority students, low achievement, and higher absenteeism were related to alcohol, marijuana and combined substance use, particularly at lower grade levels. By contrast, cigarette smoking was more prevalent in more affluent high schools with more White students. After adjusting for other school characteristics, absenteeism emerged as the most consistent predictor of student substance use.

Conclusions/Importance—Interventions addressing absenteeism and truancy in middle and high schools may help prevent student substance use. Schools serving poor, urban, and mostly minority students may benefit from interventions targeting alcohol and marijuana use, whereas interventions focusing on tobacco use prevention may be more relevant for schools serving more affluent and predominantly White students.

Keywords

adolescence; school; alcohol; tobacco; marijuana

Early adolescent cigarette, alcohol, and marijuana use is associated with multiple detrimental outcomes in adulthood, including an increased likelihood of substance use disorders, delinquency, violent and aggressive behaviors, and risky sexual behavior (Guo et al., 2002; Odgers et al., 2008). Cigarette, alcohol, and marijuana are among the most

Address correspondence to Sylvie Mrug, University of Alabama at Birmingham, 1720 2nd Avenue South, CH 415, Birmingham, AL 35294-1200, USA; smrug@uab.edu.

commonly used drugs by adolescents between the ages 12 and 17 (SAMHSA, 2012). Recent national surveys indicate that among high school students, 39% used alcohol in the past month, 18% smoked cigarettes, and 23% used marijuana (CDC, 2011). Some students initiate substance use even before entering high school, with 4% middle school students reporting recent alcohol use, 1.4% cigarette smoking, and 1% marijuana use (SAMHSA, 2010).

Adolescent substance use is influenced by multiple factors at different levels, including the individual, family, and peers, as well as broader contexts of schools, communities, and public policies and regulations (Botticello, 2009; O'Malley, Johnston, Bachman, Schulenbery, & Kumar, 2006). Abundant literature has focused on individual, family, and peer predictors of adolescent substance use, as well as community factors, laws, and policies (Allison et al., 1999; Chuang, Ennett, Bauman, & Foshee, 2005). However, less is known about the relationships between school characteristics and adolescent substance use. Although a plethora of studies have examined individual students' characteristics (e.g., socioeconomic status or race/ethnicity) or school functioning (e.g., academic achievement) in relation to substance use (Diego, Field, & Sanders, 2003; Stern & Wiens, 2009), only a few studies have examined these characteristics at the school level (Botticello, 2009; Eitle & Eitle, 2004; O'Malley et al., 2006). Examination of unique school-level factors related to students' substance use is critical for identifying schools with the greatest needs for interventions. Malleable school-level predictors of substance use can also serve as intervention targets in substance use prevention efforts.

Prior research suggests that schools vary to a great extent in their levels of cigarette, alcohol, and marijuana use (Botticello, 2009; Ennett, Flewelling, Lindrooth, & Norton, 1997; O'Malley et al., 2006). For instance, the prevalence of students' recent use ranged from 9% to 43% for alcohol, 0% to 24% for cigarettes, and 0% to 11% for marijuana across elementary schools in one study (Ennett et al., 1997), and the proportion of students reporting marijuana use in the last year ranged from 0% to 64% among high schools in another study (O'Malley et al., 2006). Schools also vary greatly in characteristics that may be relevant for substance use, such as school SES, racial composition of the school, school size, or average academic achievement of the students (Eitle & Eitle, 2004; Johnson & Hoffmann, 2000; O'Malley et al., 2006).

School Characteristics Associated with Student Substance Use

Students' SES is a salient characteristic that has been related to substance use. At the individual student level, the relationship appears to vary by substance and different aspects of SES. A recent review suggests that tobacco use is generally associated with lower SES across different measures of SES (Hanson & Chen, 2007a). The negative relationship between SES and smoking has been replicated among both middle school and high school students (Blum et al., 2000; Johnston, O'Malley, Bachman, & Schulenberg, 2005; Wallace et al., 1999), particularly when using family status based measures of SES (e.g., parental education or occupation). However, other studies found a positive relationship between SES and cigarette smoking using SES measures of students' family income (Hanson & Chen, 2007b). In contrast to smoking, alcohol and marijuana use are less consistently related to

SES across studies. When associations are found, alcohol and marijuana use appear related to lower parental education, but higher family income (Ellickson, McGuigan, Adams, Bell, & Hays, 1996; Ennett, Bauman, Foshee, Pemberton, & Hicks, 2001). Youth with poorer and less educated parents are exposed to greater parental modeling of and permissive attitudes toward substance use (Kalesan, Stine, & Alberg, 2006), and experience more stress which may promote substance use as a coping mechanism (Barrett & Turner, 2006; Hanson & Chen, 2007a). Higher parental education may be protective due to parents' greater disapproval of substance use, but higher family income may be a risk factor because it provides financial resources needed to purchase substances (Hanson & Chen, 2007a; Ellickson et al., 1996; Luthar & D'Avanzo, 1999).

Although there is some evidence of age differences in the role of SES in substance use, few studies have made such comparisons between younger and older adolescents. In general, the relationship between SES and substance use is stronger among younger adolescents and diminishes as age increases (Blum et al., 2000; Hanson & Chen, 2007a; Johnston et al., 2005), perhaps because peer influences progressively dominate over family factors (Hanson & Chen, 2007a; Ellickson, Tucker, Klein, & Saner, 2004). Corroborating studies on individual adolescents' SES, lower parental education at the school-level is associated with greater likelihood of using all substances among 8th grade students (O'Malley et al., 2006). However, by 12th grade, the negative relationship between parental education and substance use disappeared for cigarettes and reversed for alcohol and marijuana, and these differences persisted after accounting for other school-level characteristics. Similarly, students attending schools with lower levels of socioeconomic disadvantage were more likely to misuse alcohol, even after adjusting for other school-level variables (Botticello, 2009). Together, these studies demonstrate an association between school-level SES and students' substance use, but few studies have examined this relationship and whether it persists after adjusting for other school factors across grade levels.

Besides family SES, race/ethnicity is related to adolescent substance use (Blum et al., 2000; Griesler, Kandel, & Davies, 2002; Stern & Wiens, 2009). Although some studies with middle school students find no racial/ethnic differences (Shih, Miles, Tucker, Zhou, & D'Amico, 2010; Jones, 2008), most investigations indicate higher levels of use among White than African American middle school and high school students (Blum et al., 2000; Griesler et al., 2002; Stern & Wiens, 2009). These racial differences tend to increase with age (Johnston, O'Malley, Bachman, & Schulenberg, 2011), and could be explained by racial/ethnic differences in attitudes towards substance use, parenting practices, and peer factors (Barrett & Turner, 2006; Shih et al., 2010). Consonant with research at the individual level, schools with larger proportions of African American vs. White students have lower prevalence of cigarette, alcohol, and marijuana use (Botticello, 2009; Ennett et al., 1997), with racial differences being more pronounced in higher grades (O'Malley et al., 2006).

In addition to demographic variables, low academic achievement, disengagement and truancy among students are related to greater alcohol, cigarettes and marijuana use (Bryant, Schulenberg, O'Malley, Bachman, & Johnston, 2003; Diego et al., 2003). Academic failure may promote substance use directly as a coping mechanism with the stress of failing (Shippee & Owens, 2011), or indirectly by fostering disengagement from school, truancy,

and misbehavior (Bryant, Schulenberg, Bachman, O'Malley, & Johnston, 2000). In particular, truancy increases substance use through both disengagement from school and providing more unsupervised, risky time with friends (Henry & Thornberry, 2010). Low academic achievement and truancy are stronger predictors of substance use in middle school compared to high school, and in lower grades within high school (Bergen, Martin, Roeger, & Allison, 2005; Hallfors et al., 2002). These age differences may be explained by higher rates of drop out among failing and truant students in higher grades (Silver, Saunders, & Zarate, 2008) and by substance use becoming more normative among older students (Barnes, Welte, & Hoffman, 2002). Few studies have examined academic achievement or truancy at the school level in relation to students' substance use. One U.K. study found no associations between student cigarette use and school-level truancy or attainment of national education standards (Aveyard et al., 2004). However, it is not clear whether these relationships may emerge at different grade levels or for different types of substances.

Another school-level factor that has been linked with substance use is school size. Interestingly, higher levels of student substance use have been reported in both small schools (Botticello, 2009; O'Malley et al., 2006) and large schools (CASA, 2003; Page, 1991), compared to medium-sized schools. It is possible that students in large schools are exposed to more peer models of substance use, whereas youth in small schools may experience more peer pressure to use substances. Large school size is also associated with more problem behaviors that serve as risk factors for substance use, including truancy (Gardner, Ritblatt, & Beatty, 2000), antisocial behavior (Kaiser, 2005), and higher likelihood of dropping out of school (Werblow & Duesbery, 2009). It is not clear whether school size is differentially related to student substance use at different grade levels.

Current Study

Existing literature has identified multiple school-level correlates of student substance use, including school SES, racial composition, academic achievement and truancy, and school size. Many of these effects appear to vary across substances and grade levels, but few studies have systematically examined these differences. Additionally, most investigations report on isolated school characteristics without adjusting for other school variables. Because many of the school factors reviewed above are interrelated, examining them in isolation may not identify the most important correlates of student substance use. Addressing these limitations, the current study investigates the role of multiple school-level characteristics in adolescent substance use across different grade levels. Specifically, we examine the effects of school-level SES, race/ethnicity, school size, academic achievement, and absenteeism on students' use of tobacco, alcohol, marijuana, and a total number of substances used. As a proxy of school resources and adult supervision, we also include student-teacher ratio which has not been examined in previous research. The relationships between school characteristics and student substance use are examined across three grade levels – middle school, early high school and late high school. We hypothesize that, in general, higher levels of student substance use will be reported in schools that have lower SES, fewer African American students, lower achievement, higher absenteeism, small or large size, and higher student to teacher ratios. Specific differences by grade level and type of substance are also expected, based on the reviewed literature.

Method

This study utilized data collected with the PRIDE Survey in a single metropolitan area in the Southeastern U.S. The PRIDE Survey is a school-based assessment adopted by many school districts to monitor students' substance use and violence (www.pridesurveys.com). The present data were collected in the spring of 2005 from students attending 6th through 12th grade in two large public school districts covering urban and suburban areas in the Southeastern U.S. Across the two school districts, 53% of students were eligible for free or reduced lunch. Paper surveys were administered to students in their classrooms by teachers or school counselors who explained the purpose of the survey, voluntary nature of participation, and confidentiality of answers. The surveys were anonymous and did not collect any identifying information. Participating students completed the survey privately at their desks and were able to ask questions if they needed help. The surveys were administered by the school districts to satisfy a federal Title IV requirement to measure students' substance use, and as such were not subject to federal research regulations. Secondary analyses of the data were approved by the Institutional Review Board at the University of Alabama at Birmingham.

The sample includes 23,615 middle school and high school students attending grades 6–12 (approximately 80% participation rate). The mean age of the students was 14 years old. The sample comprised 47% males and 53% females. Racial/ethnic composition of the sample was 53% African-American, 41% Caucasian, 2% mixed, 2% Hispanic, and 2% other. Information on school racial composition, poverty, average student academic achievement, student-teacher ratio, absenteeism, and size of each school in that academic year was collected from the Alabama State Department of Education. School-level data were obtained from 42 middle schools (grades 6–8, ages 12 to 14) and 24 high schools (grades 9–12, ages 15–18).

Measures

Student substance use—The use of alcohol, tobacco and marijuana was measured with items from the Pride Surveys. The questions included: "Within the past year how often have you: smoked cigarettes; drank beer; drank wine or wine coolers; drank liquor; and smoked marijuana?" All items were rated on an 8-point scale ranging from 'did not use' (1) to 'everyday' (8). The responses were highly positively skewed, so all items were recoded into dichotomous variables indicating whether or not each student used cigarettes, any alcohol, and marijuana in the last year. The total number of substances used in the last year was computed as the sum of these three individual substance use indicators.

School-level poverty was measured as the percentage of students eligible for free or reduced lunch at each school.

School racial composition of the school was determined by the percentage of non-White students at each school.

School-level achievement for middle schools was obtained by averaging the 6th through 8th grade reading and math Stanford Achievement Test-10 Edition (SAT-10) scores. The

SAT-10 is a national norm-referenced test assessing academic achievement in reading, math, language, and science that is completed annually by all Alabama students in grades 3–8. For high schools, school-level achievement was computed as the percentage of students passing the Alabama High School Graduation Exam, averaged across the reading and math portions of the test. This exam was developed by committees of Alabama educators to measure proficiency in material covered by high school core courses. Passing the exam has been a requirement for high school graduation since 2001.

School size was coded into two dichotomous variables indicating small and large schools. The cutoffs used to define small and large schools have varied widely in prior research, from <300 (O'Malley et al., 2006) to <800 (CASA, 2003) for small schools, and from > 776 (Botticello, 2009) to >1,000 (Page, 1991) to >2,000 (CASA, 2003) for large schools. We selected cutoffs that fell within the ranges used in these prior studies and that resulted in relatively even subgroups of small, mid-sized, and large schools. Thus, we defined small schools as those with <500 students for middle schools and <700 for high schools, and large schools as those with >700 students for middle schools and >1,100 for high schools.

School absenteeism was calculated as 100 minus the Average Daily Attendance rate reported by each school. Average Daily Attendance rate is computed as the number of days each student attended school during the academic year, summed across all students and divided by the number of students and the number of school days in the academic year. Thus, school absenteeism indicates the average percentage of school days missed by an average student during the school year. Although this measure does not distinguish between excused and unexcused absences, both types of absences are positively correlated (Burton, Marshal, & Chisolm, 2014) and total absenteeism is related to behavior problems and school dropout (Alexander, Entwisle, & Kabbani, 2001; Wood et al., 2012).

Student-teacher ratio was determined by dividing the number of students at each school by the number of teachers and instruction assistants.

Statistical Analyses

Descriptive statistics examined all individual student and school-level variables. Bivariate associations among school-level variables were tested with correlations. The zero-order (unadjusted) relationships between school level variables and students' substance use could not be tested with correlations due to the clustered nature of the data. Thus, these relationships were evaluated with simple multilevel logistic regressions for students' tobacco, marijuana, and alcohol use, and with multilevel Poisson regressions for the total number of substances used, entering each school variable at a time as the only predictor. Besides providing important information about the simple relationships between each school characteristic and student substance use that are not affected by overlap among school-level variables, these analyses allow comparisons with other studies that did not adjust for multiple school characteristics. The unique roles of each predictor within the context of other school characteristics were then tested in multiple (adjusted) models that included all school-level variables, again using multilevel logistic regressions for each substance and multilevel Poisson regressions for the total number of substances used. Separate analyses were conducted for each school level: middle school, early high school (grades 9–10), and

late high school (grades 11–12). All multilevel analyses were conducted using Mplus 7 (Muthén & Muthén, 2013).

Results

School-Level and Individual Descriptives

Descriptive statistics for school-level characteristics are shown in Table 1 and individual student characteristics are shown in Table 2. There was substantial variability in all school characteristics across the included schools. The average number of students attending each middle school was 634 students (range 76 to 1487 students). The average number of students attending each high school was 989 students (range 489 to 1487 students). At the level of participating students, alcohol was the most commonly used substance in both middle and high school, with 32% of middle school students and 59% of those in 11th and 12th grades reporting some alcohol use in last year. Cigarettes were used by more students than marijuana in middle school (15% vs. 10%), but the rates for these two substances were nearly identical in high school (24% in grades 9 and 10, 28%-29% in grades 11 and 12). The total number of substances used generally increased with age, with a more substantial shift from middle school to high school.

Correlations

At both middle and high school level, school poverty was strongly correlated with the proportion of non-White students (see Table 3). Higher student poverty and the proportion of non-White students were also associated with lower academic achievement, lower student to teacher ratio, smaller middle schools, and higher high school absenteeism. Higher academic achievement was related to lower absenteeism and larger middle schools. Student to teacher ratios were lower in small schools. At the student level, the use of each substance was moderately correlated with the use of every other substance within each grade level (r's ranged from .40 to .48, $p<.001$).

Multilevel Models

Results of all multilevel models linking school characteristics with student substance use are presented in Table 4. In the simple, unadjusted models, schools with more non-White and poor students had higher rates of student alcohol use in middle school and grades 9 and 10, higher rates of student marijuana use across all grade levels, and greater number of substances used in middle school. In grades 9 and 10, only school poverty, but not racial composition, was associated with greater number of substances used. By contrast, school poverty and proportion of non-White students were related to fewer students smoking cigarettes in high school. By itself, lower school-level academic achievement was related to higher rates of marijuana use across all grade levels, and to greater number of substances used in middle school and early high school. Student-to-teacher ratio showed few associations with student substance use; having more students per teacher was related to lower rates of marijuana use in middle school and higher rates of cigarette smoking in grades 11 and 12. School-level absenteeism was a strong correlate of student substance use, particularly in the lower grades: schools with higher absenteeism had higher rates of cigarette, alcohol and marijuana use in middle school, alcohol and marijuana use in grades 9

and 10, and marijuana use in grades 11 and 12, as well as greater number of substances used in middle school and grades 9 and 10. School size was not related to any type of student substance use.

After adjusting for all school characteristics, schools with more poor students had higher rates of alcohol use in middle school, and schools with more non-White students had lower rates of cigarette smoking in grades 11 and 12. Absenteeism emerged as a unique predictor of cigarette and alcohol use across all grade levels, marijuana use in middle school, and greater number of substances used in middle school and grades 9 and 10.

Discussion

The purpose of this study was to examine the relationships between multiple school-level characteristics and cigarette, alcohol and marijuana use among middle and high school students. When school-level factors were examined separately, schools with more poor and non-White students had higher rates of student alcohol use in middle school and early high school, higher rates of marijuana use across all grade levels, and greater number of substances used in middle school; school poverty (but not race) was also associated with more substances used in early high school. However, schools with more poor and non-White students had lower rates of cigarette smoking in high school. Schools with higher academic achievement had lower rates of marijuana use across all grade levels, and lower number of substances used in middle school and early high school. Schools with higher absenteeism had higher rates of all types of substance use (and more substances used) in middle school; higher rates of alcohol, marijuana, and more total substances used in early high school; and higher rates of marijuana use in late high school. Higher teacher to student ratio was linked with lower rates of marijuana use in middle school and higher rates of cigarette use in late high school. School size was not related to student substance use.

Many of the school-level factors were highly correlated; in particular, poverty was strongly associated with more racial minorities across middle and high school, and with low academic achievement and higher absenteeism in high school. Although these strong correlations attenuated the extent to which these school-level factors could uniquely relate to substance use, absenteeism remained a significant predictor of all types of substance use in middle school and of alcohol use and total substance use in early high school. However, it is notable that adjusting for other school-level factors made the important role of absenteeism in student substance use more apparent at the high school level. Specifically, when considered on its own, absenteeism was not related to cigarette smoking across high school and alcohol use in late high school, suggesting that absenteeism alone at the high school level provides few clues to student substance use. However, absenteeism emerged as a predictor of both high school cigarette and alcohol use when other school characteristics were adjusted for, suggesting that among high schools that have similar levels of poverty, academic achievement, and racial composition, those with higher absenteeism have greater prevalence of student smoking and alcohol use. In addition, poverty continued to uniquely predict higher rates of alcohol use in middle school, and higher proportion of minority students remained as a predictor of lower rates of cigarette smoking in late high school,

indicating the salience of these factors even within the context of highly related school characteristics.

Our findings of school-level absenteeism as a consistent, unique predictor of student substance use extend previous results of truancy as a salient individual-level risk factor for adolescent substance use (Hallfors et al., 2002; Henry & Huizinga, 2007; Henry & Thornberry, 2010). It is likely that schools with higher absenteeism have higher rates of student truancy, which promotes substance use by creating unstructured and unsupervised time with friends (Henry & Thornberry, 2010; Osgood & Anderson, 2004). The behavior of truant students may have ripple effects at the school level by modeling truancy, substance use and other rule breaking behaviors and providing substances, as well as opportunities and social incentives for substance use to other students. Our results, together with reports of positive correlations between excused and unexcused absences (Burton et al., 2014), suggest that absenteeism may be used as a marker of risk when more specific measures of truancy are not available.

However, our findings also suggest that considering absenteeism in isolation from other school factors may not be sufficient, particularly at the high school level. In middle school, absenteeism was relatively independent of other school-level factors and served as a marker of higher substance use whether considered by itself or in combination with other school-level variables. In high school, however, absenteeism became strongly correlated with poverty, poor achievement and proportion of non-White students, and these correlated factors sometimes masked its role in student substance use. These results suggest that absenteeism may have different causes or correlates, some of which are related to substance use, but others are a function of other factors, such as low achievement or poverty. As a result, the associations of absenteeism with cigarette and alcohol use at the high school level become apparent only when some of the other correlates (e.g., achievement and poverty) are taken into account (e.g., by comparing schools that are similar in poverty and academic achievement, or by statistically adjusting for these variables). These findings suggest that at the high school level, absenteeism alone may not be a reliable marker of substance use risk, but instead may need to be interpreted in the context of other school-level characteristics.

Low school-level achievement was associated with more prevalent marijuana use across grade levels and with fewer substances used in middle and early high school in the unadjusted analyses, reflecting the well-replicated associations between adolescents' low academic achievement and substance use at the individual level (Bryant et al., 2003; Diego et al., 2003). Greater prevalence of substance use, and particularly marijuana use, in poorly achieving middle and high schools may be due to student disengagement from academic goals, or to socioeconomic factors (e.g., poverty, low school resources) and stress associated with low achievement. After adjustment for other school characteristics, however, low school-level academic achievement was not uniquely related to any substance use outcomes. This may be partly a function of the substantial overlap between low achievement and poverty across middle and high school, as well as low achievement and absenteeism in high school. The discrepancies between the unadjusted and adjusted results for achievement suggest that low achievement, poverty, and non-White race represent a combination of risk factors that together increase the risk of student marijuana and total substance use, but that

neither of these factors plays a more salient role than the others. Thus, combining these correlated risk factors into a composite measure of risk would serve as a stronger marker of student substance use.

School SES and racial composition were highly interrelated in our sample. When considered as single correlates of student substance use (i.e., not adjusting for other school-level factors), school SES and racial composition showed the same patterns of associations with most substance use variables. Consistent with other studies using income-based measures of SES (Hanson & Chen, 2007b), school poverty was associated with lower prevalence of cigarette use in high school students. This relationship became stronger at higher grade levels, perhaps as a function of increasing cigarette use with age in schools serving more affluent student populations. In contrast to cigarette smoking, low school SES was associated with higher prevalence of alcohol and marijuana use, and with greater number of substances used; these relationships diminished at higher grade levels, particularly for alcohol and total number of substances. These results may reflect greater modeling of and permissive attitudes toward substance use encountered by students living in poor families and communities (Kalesan et al., 2006), or efforts to cope with the stress of living in poverty (Barrett & Turner, 2006; Hanson & Chen, 2007a). The diminishing, and eventually disappearing relationships between school poverty and alcohol and total substance use in older youth is also consistent with other research (e.g., Johnston et al., 2005) and may result from increasing prevalence of alcohol and other substance use among older youth living in more affluent communities (Luthar & Latendrasse, 2005). The opposite relationships of school SES with cigarette vs. alcohol and marijuana use may be partly explained by the different nature of use of these substances. Whereas cigarette smoking is more individual and frequent, requiring individuals to buy one's own cigarettes, alcohol and marijuana may be more likely to occur less frequently and in groups (including parties) where others may be providing the substances. Thus, poverty may make it more difficult for students to smoke, but they may still have access to alcohol and marijuana through others. However, it should be noted that the negative association between school poverty and cigarette use in this study is contrary to results from other studies that linked lower SES status with higher tobacco use (Hanson & Chen, 2007a). These differences may be explained by regional cultural differences; anecdotal evidence suggests that local poor minority students consider cigarette smoking "not cool".

Our results for school racial composition and student cigarette use are consistent with previous reports of lower cigarette use in non-White students (Blum et al., 2000; Griesler et al., 2002; Stern & Wiens, 2009) and findings of minority students being more sensitive to norms that oppose cigarette use (Stern & Wiens, 2009). Our results further suggest that racial differences in cigarette use increase with age. However, our findings of greater alcohol, marijuana, and total substance use in schools with more non-White students contrast with those of previous studies (Botticello, 2009; Ennett et al., 1997), as does the decreasing relationships between race and alcohol, marijuana, and total substance use in higher grades (O'Malley et al., 2006). Because our results parallel more closely previous reports of associations between SES and substance use, it is likely that the effects of SES on substance use are more powerful than the role of race in communities where poverty and race are as closely intertwined as in those studied here.

When considered together with each other and other school-level variables, school SES and racial composition yielded few unique effects. School poverty uniquely predicted higher rates of alcohol use in middle school, whereas more non-White students predicted lower rates of cigarette smoking in late high school. These results suggest that SES may play a stronger role in alcohol use of younger students, whereas race may play a more important role in cigarette smoking among older youth. However, it is important to reiterate that the high overlap among poverty, race and other school-level variables made it difficult to detect their unique predictive effects, and future studies should investigate whether aggregate measures of risk that combine these variables serve as stronger predictors of substance use and other adverse outcomes.

Student-teacher ratios showed few associations with student substance use. Higher student-teacher ratios in late high school were associated with more students smoking cigarettes, which may reflect less adult supervision and monitoring of students enabling smoking on school grounds. By contrast, lower student-teacher ratios in middle school were associated with more students using marijuana. This relationship may be a function of school poverty, as lower SES schools had lower student-teacher ratios in our sample. Moreover, student-teacher ratio did not uniquely predict student substance use over other school characteristics. Thus, student-teacher ratios may not be as important for student substance use once other school factors are taken into account.

School size was not related to any substance use variables in this study, contrasting with previous results of higher levels of student substance use in small schools (Botticello, 2009; O'Malley et al., 20006) and large schools (CASA, 2003; Page, 1991). Because each study used different cutoffs for small and large schools, comparisons are difficult to make. Nevertheless, the two studies that reported more substance use in small schools used lower cutoffs for small schools (<300 or 350) than studies that did not find this relationship (e.g., <500 or 800). Together, these results suggest that student substance use may be facilitated only by very small school size (e.g., <350 students). It is not clear why our results did not show more substance use in larger schools, despite using similar cutoffs to CASA and Page (>1,000 or >1,200 students). We conclude that school size may not be a consistent correlate of student substance use across different settings, and other factors, such as school resources, absenteeism, and achievement may be more important.

Implications, Limitations, and Future Directions

These results underscore the importance of the school context as a part of a multi-level ecological system that shapes students' substance use behaviors. Schools are nested within broader communities, and thus are affected by community-level factors, such as culture, laws and resources, that may have implications for student substance use. On the other hand, schools serve as catalysts for more proximal interactions of students with peers, teachers, and other individuals that may promote or deter students from using substances. Various factors at the school level, such as structure, climate, and policies and their enforcement, affect students' perceptions of norms, interactions with others and behavior (Aveyard et al., 2004; Sellstrom & Bremberg, 2006). In terms of school-level factors examined in this study, the findings point to absenteeism as a key malleable risk factor for all types of substance use

from middle school through high school. Multiple evidence-based strategies can be used to improve school attendance, from contingency management (e.g., incentives, behavior contracts), support and monitoring provided to truant students, and school-level reorganization (e.g., creating smaller learning groups, offering supervised after-school programs) to partnering with families and communities to address truancy (e.g., informing and supporting parents, police and court involvement) (Maynard, McCrea, Pigott, & Kelly, 2013; Sutphen, Ford, & Flaherty, 2010). Utilizing evidence-based strategies to reduce truancy is likely to translate into lower levels of student substance use.

Because school-level poverty and proportion of non-White students also emerged as simple risk factors for student alcohol, marijuana, and total substance use, particularly at lower grade levels, students attending schools in areas with high rates of poverty and ethnic minorities may derive the most benefit from school-based interventions to prevent and reduce alcohol and illicit drug use. Implementing universal interventions in high-risk schools may be less stigmatizing than targeting high-risk individuals (Ennett et al., 1997). Our findings suggest that these interventions may need to be implemented early, before or immediately after the transition to middle school, and continue through at least early high school years. On the other hand, more affluent high schools may benefit from interventions focused on smoking prevention. However, because different types of substance use are generally positively related in adolescence (O'Malley et al., 2006; Wallace et al. 1999), comprehensive prevention programs targeting multiple substances may be most desirable and effective. For instance, the Life Skills Training is a comprehensive, universal prevention program that reduces short-term and long-term use of multiple substances (Botvin et al., 2000; Botvin, Griffin, Paul, & Macaulay, 2003).

Although this study provides interesting insights into school-level correlates of students' cigarette, alcohol and marijuana use across grade levels, the findings need to be interpreted in the context of the study's limitations. First, the sampled schools included primarily White and African American students, so findings may not generalize to settings with other racial/ ethnic groups. School SES was highly related to student race and other school variables, particularly at the high school level, which made it difficult to ascertain unique effects of these variables. The results may not apply to geographic areas where SES, race, and other indicators of school risks are more independent. The single geographic location of the study in an area with generally low quality of public education also is a limitation; the results may not generalize to schools in other regions that have different cultural values, political influences, and resources. Similarly, the results are limited by the historical context in which the data were collected (in 2005). More recent trends related to substance use (e.g., legalization of marijuana in some states, availability of electronic cigarettes) may affect the studied relationships. Another limitation is the limited measurement of SES; it is likely that using different measures of school-level SES (e.g., parental education, income) and distinguishing between poverty and affluence may yield different results. The absenteeism measure was also limited, as it did not distinguish between unexcused absences or truancy, which represents greater risk for substance use, vs. excused absences that may confer less risk. Additionally, the cutoffs used to define small and large schools differed from those used in some prior studies; in general, the wide variation of the cutoffs used across studies makes comparisons of results regarding school size difficult. This study only addressed the

prevalence of cigarette, alcohol, and marijuana use among students. The results may not generalize to other types of substances or facets of substance use, such as quantity and frequency of use or heavy drinking. Finally, the purpose of the study was to examine publicly available school characteristics as predictors of student substance use. School-level substance use may serve as a more proximal predictor of individual students' use, and it should be evaluated together with other school variables in future studies.

Future research on school-level correlates of substance use should include multiple measures of SES, assess different aspects of substance use, and include a greater variety of racial/ethnic groups. Studies should also examine the processes and mediators that link school-level characteristics with student substance use. Intervention research should evaluate whether truancy interventions reduce student substance use, and whether some truancy interventions are more effective for substance use outcomes than others. It would be important to assess substance use both for the truant students and at the whole school level. Finally, research should address whether schools at greater risk for substance use (e.g., those with higher absenteeism and lower achievement) benefit more from universal prevention and intervention programs.

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Glossary

School-level factors	composite indicators of the characteristics of all students attending a given school (e.g., race, achievement), or a characteristic of the school itself (e.g., size)
Student substance use	defined as any use of cigarettes, alcohol, or marijuana within the past year
Multilevel logistic regression	analysis predicting a dichotomous outcome (e.g., any vs. no alcohol use) of individuals nested within larger groups (e.g., schools)
Multilevel Poisson regression	analysis predicting an outcome that follows a Poisson distribution (e.g., count variables) among individuals nested within larger groups

Table 1

School-Level Characteristics

	Middle School (*n* = 42) M (*SD*) (Range)	High School (*n* = 24) M (*SD*) (Range)
Non-White students	67% (39) (1 – 100%)	63% (38) (1 – 100%)
Poverty (free or reduced lunch)	60% (28) (13 – 95%)	42% (23) (7 – 77%)
Academic achievement [a]	38 (15) (14 – 89)	76% (13) (45 – 100%)
Student-teacher ratio	17:1 (5:1) (9:1 – 34:1)	18:1 (4:1) (10:1 – 26:1)
Absenteeism	4% (2) (2 – 16%)	6% (2) (2 – 10%)
	N (%)	N (%)
School size[b]		
Small	17 (40%)	5 (21%)
Medium	10 (24%)	11 (46%)
Large	15 (36%)	8 (33%)

Note:

[a] School-level achievement was measured as the average reading and math SAT-10 scores for middle schools and as the percentage of students passing the reading and math portions of the Alabama High School Graduation Exam for high schools;

[b] Middle school: <500 = small, >700 = large; high school: <700 = small, >1,100 = large.

Table 2

Individual Student Characteristics

	Middle School (*n* = 12,798) *N* (%)	HS 9th and 10th (*n* = 6,189) *N* (%)	HS 11th and 12th (*n* = 4,628) *N* (%)
Male	5,961 (49%)	2,746 (46%)	1,947 (44%)
Female	6,287 (51%)	3,261 (54%)	2,534 (57%)
African American students	7,081 (56%)	3,194 (52%)	2,230 (49%)
White	4,893 (38%)	2,569 (42%)	2,107 (46%)
Other	767 (6%)	361 (6%)	248 (5%)
Smoked cigarettes in last 12 months	1,882 (15%)	1,573 (24%)	1,293 (28%)
Used alcohol in last 12 months	4,070 (32%)	3,310 (51%)	2,730 (59%)
Used marijuana in last 12 months	1,266 (10%)	1,553 (24%)	1,335 (29%)
Used no substances in last 12 months	8,186 (65%)	2,564 (42%)	1,705 (38%)
Used one substance in last 12 months	2,418 (19%)	1,500 (25%)	1,118 (25%)
Used two substances in last 12 months	1,273 (10%)	1,062 (18%)	924 (20%)
Used three substance in last 12 months	711 (6%)	898 (15%)	771 (17%)

Note: HS = high school.

Table 3

Correlations of School-level Variables for Middle Schools (Below Diagonal) and High Schools (Above Diagonal)

Variable	1	2	3	4	5	6	7
1. Non-White students	-	.85***	−.55**	−.42*	.57**	.10	.05
2. Poverty	.75***	-	−.74***	−.46*	.79***	.13	−.18
3. Academic achievement	−.48***	−.67***	-	.22	−.67***	.17	.14
4. Student-teacher ratio	−.16	−.54***	.25	-	−.24	−.54**	.37
5. Absenteeism	.13	.16	−.33*	−.25	-	−.27	−.06
6. Small School	.38*	.56***	−.41**	−.58***	.21	-	−.36
7. Large School	−.45**	−.69***	.39*	.73***	−.06	−.62***	-

Note:

*
p<.05,

**
p<.01,

***
p<.001

Table 4

Multilevel Logistic Regressions Modeling Student Substance Use from School-Level Variables

	Cigarette use		Alcohol use		Marijuana use		Number of substances	
	Simple b	Adjusted b	Simple b	Adjusted b	Simple b	Adjusted b	Simple b	Adjusted b
Middle School								
Non-White	.000	−.003	.005**	.000	.007***	.000	.004**	.000
Poverty	.001	.004	.008***	.012*	.012***	.010	.005***	.005
Achievement	−.007	−.004	−.008	.009	−.020**	.001	−.009**	.001
Student-teacher	.000	.011	−.019	.020	−.047**	−.002	−.012	.006
Absenteeism	.134***	.132***	.106***	.105**	.201***	.176***	.110***	.093***
Small school	.030	−.072	.214	.115	.232	−.036	.095	.027
Large school	.089	.007	−.104	−.006	−.276	−.055	−.084	.010
High School 9th and 10th								
Non-White	−.006***	−.004	.003*	.004	.006***	.003	.001	.001
Poverty	−.007***	−.010	.004*	−.002	.011***	−.002	.002*	−.003
Achievement	.007	−.007	−.003	.009	−.018***	−.009	−.003*	−.001
Student-teacher	.021	.010	−.010	−.001	−.027	.007	−.005	.002
Absenteeism	−.041	.096*	.065***	.074*	.129***	.092	.029**	.047*
Small school	−.037	.269	−.113	−.082	.009	.251	−.041	.060
Large school	−.131	−.097	−.062	−.100	−.033	.052	−.072	−.046
High School 11th and 12th								
Non-White	−.013***	−.010*	−.001	−.002	.005***	.001	−.001	−.002
Poverty	−.017***	−.009	−.001	.002	.009***	.007	−.001	−.001
Achievement	.020	.002	.005	.014	−.011*	.005	.002	.003
Student-teacher	.085**	.038	.020	.010	−.003	.017	.011	.005
Absenteeism	−.092	.159*	.033	.102*	.110***	.056	.007	.049

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	Cigarette use		Alcohol use		Marijuana use		Number of substances	
	Simple b	Adjusted b	Simple b	Adjusted b	Simple b	Adjusted b	Simple b	Adjusted b
Small school	−.525	.057	−.230	−.130	−.194	−.073	−.134	−.056
Large school	−.168	−.162	.016	.023	−.015	.042	−.037	−.031

Note:

*
p<.05,

**
p<.01,

***
p<.001.

Significant effects are printed in **boldface**. Simple models test one predictor at a time; adjusted models test all predictors simultaneously.