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## Substance Use, Academic Performance, and Academic Engagement Among High School Seniors

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### Abstract

**BACKGROUND:** Substance use is prevalent and is associated with academic performance among adolescents. Few studies have examined the association between abstinence from all substances and academic achievement.

**METHODS:** Data from a nationally representative sample of 9,578 twelfth graders from the 2015 Monitoring the Future survey were analyzed to examine relationships between abstinence from substance use and four academic variables: skipping school, grades, academic self-efficacy, and emotional academic engagement. Participants were categorized as lifetime non-users, former users, and past-year users based on the use of 14 substances.

**RESULTS:** Approximately one-quarter of participants had never used cigarettes, alcohol, or other drugs during their lifetime, and 8%<sub>wt</sub> used at least one substance during their lifetime but not during the past year. Adjusting for demographic variables, past-year substance users had 2.71 greater odds of skipping school during the past month than lifetime non-users and 1.74 greater odds of having low grades. Lifetime non-users reported greater academic self-efficacy and emotional academic engagement than past-year users.

**CONCLUSIONS:** Many twelfth graders have abstained from all substance use during their lifetime, and these adolescents experience better academic outcomes than their substance-using

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Human Subjects Approval Statement

Monitoring the Future is approved by the University of Michigan Institutional Review Board (IRB). The IRB at the University of Maryland determined that this secondary data analysis was exempt from IRB review.

peers. Substance use prevention programs should be evaluated as a way to promote academic achievement.

### Keywords

academic engagement; academic performance; adolescents; substance use; truancy

In the United States, approximately two-thirds of adolescents have consumed alcohol by their senior year of high school and about half have tried an illicit drug.<sup>1</sup> Substance use behaviors arise from a complex interplay between numerous risk and protective factors at the individual, family, social/peer, and environmental levels.<sup>2,3</sup> Some examples of risk factors include temperament characteristics such as impulsivity, sensation-seeking, being male, affiliating with peers who use substances, low religiosity, perceived approval of use by family members, child maltreatment, and living in affluent suburban neighborhoods.<sup>3-6</sup>

Whereas the health effects of substance use are well established,<sup>7-10</sup> comparatively less attention has been directed at the association between various forms of substance use and academic achievement. Several cross-sectional and prospective studies focusing on marijuana use have found an association with lower grades, lower scores on measures of academic functioning, a greater likelihood of skipping school and dropping out of high school, and a lower likelihood of enrolling in college.<sup>11-16</sup> For instance, Ellickson, Martino, and Collins<sup>15</sup> found that individuals who used marijuana fewer than ten times per year throughout adolescence had lower levels of educational attainment at age 29 compared with those who never used marijuana.

Other studies have examined the associations between past-month and past-year use of multiple substances and academic outcomes.<sup>16-19</sup> Henry<sup>18</sup> found that the past-month use of cigarettes, alcohol, and marijuana were each associated with an increased likelihood of skipping school among eighth and tenth grade students. Similarly, Cox et al.<sup>20</sup> observed that, among a sample of students in ninth through twelfth grades, having low average grades was significantly associated with binge drinking and using marijuana during the past month. Substance use has also been operationalized using continuous measures. Henry<sup>21</sup> computed a polysubstance use score (the mean of items to reflect tobacco, alcohol, and marijuana use), and found that it was significantly associated with poorer academic performance. Among students whose grades decreased during three years of junior high school, significant increases were seen in the polysubstance use score.

Most researchers would agree that substance use and academic performance are most likely related bidirectionally, such that substance use both influences and is influenced by academic performance.<sup>22</sup> Bachman et al.<sup>22</sup> concluded that academic experiences predict substance use more strongly than use predicts performance. However, significant findings linking substance use to subsequent academic outcomes have also been observed. Tobacco smoking at age 14 was associated with an increased likelihood of dropping out of high school by age 18, and smoking at age 18 was associated with lower educational attainment by age 22.

Complicating this bidirectional relationship are a number of common risk factors that affect risk for both substance use and academic difficulties. For example, boys are more likely than girls to both use substances and have lower grades in high school.<sup>3,23</sup> Externalizing disorders such as attention deficit/hyperactivity disorder and conduct disorder also increase risk for both substance use and decreased academic achievement.<sup>24–26</sup> However, studies controlling for such factors suggest that substance use is negatively associated with academic outcomes beyond the influence of shared risk factors.<sup>27–29</sup>

A compelling argument for the influence of substance use on academic achievement comes from evidence that substance use is associated with learning and memory deficits that can impede academic performance.<sup>30–34</sup> Brain imaging studies have found that substance use negatively affects structure and performance in the prefrontal cortex, which is responsible for decision-making, working memory, and self-control.<sup>35–39</sup> Studies comparing alcohol-dependent adolescents with non-dependent adolescents have also noted decreased performance on neuropsychological tests as well as lower volume of the hippocampus, which subserves long-term memory.<sup>30,31</sup>

Reward perception might also play a role in the relationship between substance use and academic performance.<sup>40</sup> Research has shown that the immediate rewarding effects of substance use creates an attentional bias among substance users, such that heightened attention is paid to drug-related cues. This heightened attention leads to cravings for the drug, which in turn increases the likelihood of repeated drug use.<sup>41</sup> This suggests that as adolescents become involved in substance use, their attention is shifted toward its immediate rewarding effects rather than longer-term rewards associated with academic endeavors. These academic endeavors might be de-prioritized and academic performance might suffer as a result. The notion that impaired reward perception might underlie the relationship between substance use and academic performance is supported by studies that have found an association between substance use and decreased academic engagement.<sup>42,43</sup> One longitudinal study using a school-based sample found that higher levels of school bonding, a dimension of academic engagement that refers to having a positive emotional connection to school, in fifth grade was associated with delayed initiation of alcohol use, which in turn predicted lower levels of alcohol misuse in twelfth grade.<sup>42</sup> A follow-up study found that students whose school bonding increased between seventh grade and twelfth grade were less likely to have used cigarettes or alcohol during their lifetime by twelfth grade.<sup>43</sup> School bonding in twelfth grade was also negatively associated with lifetime marijuana and other drug use.

This study extends prior research on the association between substance use and academic performance in three important ways. First, we utilize a contemporary nationally representative secondary data source, the 2015 Monitoring the Future (MTF) survey. Second, the research question focuses on whether abstinence from all forms of substance use either in the students' lifetime or during the past year was associated with academic variables. Third, we examine academic engagement in a new way, using a multidimensional construct derived from items asked on the MTF survey. In summary, this study aimed to compare skipping school, grades, and academic engagement among three groups of high school seniors: (1) adolescents who had never used any substance in their lifetime; (2)

adolescents who had used at least one substance during their lifetime, but zero substances during the past year; and (3) adolescents who had used at least one substance during the past year. We hypothesized that adolescents who have never used alcohol, cigarettes, illicit drugs, and prescription medications nonmedically would be more academically engaged, less likely to skip school, and have higher grades than students who have used substances during their lifetime.

## METHODS

### Procedures

This is a cross-sectional secondary analysis from the 2015 MTF study,<sup>44</sup> an ongoing nationally-representative, classroom-based study of students at public and private schools in the contiguous United States.<sup>45</sup> Questionnaires are self-administered to a sample of students (or all students, in smaller schools) in eighth, tenth, and twelfth grades at schools selected through multistage random sampling. Further detail regarding the study design and methods is available elsewhere.<sup>1,45</sup>

### Participants

The analytic sample consisted of 9,578 twelfth graders with non-missing data for lifetime and past-year substance use. Twelfth grade was chosen because of the availability of data on academic engagement, which is not assessed for younger students.

### Instrumentation

**Substance use.**—Lifetime and past-year use was assessed for 14 substances, including cigarettes, alcohol, eight illicit drugs [marijuana/hashish, cocaine, heroin, inhalants, LSD or “acid,” hallucinogens other than LSD, methamphetamine, and 3,4-Methylenedioxymethamphetamine (MDMA or “ecstasy”)], and four classes of prescription drugs used nonmedically (amphetamines, narcotics, sedatives, and tranquilizers) with the questions “On how many occasions (if any) have you used [substance]: a: in your lifetime? b: during the last 12 months?” Responses were provided on a nine-point scale with options ranging from “0 occasions” to “40 or more,” and later dichotomized as “use” or “non-use.” Nonmedical use was defined as using a prescription medication “on your own—that is, without a doctor telling you to take them.”

A variable was computed to categorize participants into one of three mutually exclusive categories: (1) lifetime non-users of any substance; (2) former users (used at least one substance during their lifetime but no past-year use); and (3) users of at least one substance during the past year. Due to missing data for methamphetamine, MDMA, and inhalant use, participants were first categorized based on their use of the other eleven substances. Participants were only included in the analytic sample if they had non-missing data for lifetime and past-year use of these eleven substances. They were then reclassified as necessary based on responses for methamphetamine, MDMA, and inhalant use. Very few individuals used these three substances exclusively (N = 22 for lifetime use, N = 3 for past-year use). MTF does not assess past-year cigarette use; past 30-day use was substituted when computing this variable.

**Skipping school.**—Skipping school was assessed via the question “During the last four weeks, how many whole days of school have you missed because you skipped or ‘cut’?” Responses were provided on a seven-point scale ranging from “None” to “11 or more days” and later dichotomized as “None” or “One or more days.”

**Grades.**—To assess high school grades, students were asked, “Which of the following best describes your average grade so far in high school?” with nine response options ranging from “D” to “A.” These responses were dichotomized as “Low grades” (C+ or lower) or “High grades” (B- or higher).

**Academic engagement.**—Nine items assessed aspects of academic engagement. Table 1 lists these items and their response options. Because there are several recognized dimensions of academic engagement,<sup>46,47</sup> a principal components analysis (PCA) was conducted to determine whether more than one dimension was present among these nine items and to identify items that could be excluded. Factors with eigenvalues >1.0 were retained. Two items with factor loadings <0.6 were dropped. The resulting PCA identified two factors. The first factor was comprised of two items, both related to academic self-efficacy (ASE). These items were averaged to create an ASE score, with higher scores indicating greater self-efficacy in academic abilities. The second factor was comprised of five items related to emotional academic engagement (EAE), which is the positive and negative feelings a student has toward academic experiences.<sup>46,47</sup> These items were averaged to create an EAE score. Higher EAE scores indicated more positive feelings toward school.

**Covariates.**—Seven covariates were included due to their association with either substance use and/or academic performance: sex, age, race/ethnicity, highest level of parental education, hours worked per week during school year, geographic region of the participant’s school, and type of high school program. With the exception of geographic region, all covariates were self-reported. Race/ethnicity is a categorical variable computed by MTF based on self-report. Participants selected one or more responses from a list of nine race/ethnicity categories. The responses were recoded to include non-Hispanic black or African American, non-Hispanic white, or Hispanic. Participants who indicated other races or who indicated more than one race were coded by MTF as “Missing” for this variable. Participants originally coded as Missing were recoded as Other and included in these analyses.

## Data Analysis

Data were analyzed using SPSS (IBM SPSS Statistics Version 24.0, IBM Corporation). Means for academic engagement items and prevalence estimates for the substance use groups, covariates, skipping school, and grades were computed using sampling weights provided by MTF. All variables were examined for differences between the three groups of interest using *z*-tests to compare proportions for categorical variables. Logistic regression models for skipping school and high school grades were developed, and linear regression models were developed for the ASE and EAE scores. Unweighted data were used for the regression modeling. All regression models were adjusted for covariates. Sex, age, and race/ethnicity were retained in these models regardless of statistical significance. Estimated marginal means measuring the likelihood of skipping school, likelihood of getting low

grades, mean ASE score, and mean EAE score (adjusted for covariates) were obtained from the regression models.

## RESULTS

As shown in Table 2, approximately one-quarter (28.8%<sub>wt</sub>) of the sample had never used any substances during their lifetime. Former substance use was less common (7.8%<sub>wt</sub>), and the majority (63.4%<sub>wt</sub>) used at least one substance during the past year. Half of the sample was male (46.9%<sub>wt</sub>) and self-identified as non-Hispanic white (54.5%<sub>wt</sub>). Approximately one-quarter (28.3%<sub>wt</sub>) of the sample skipped at least one day of school during the past four weeks. High average grades (B- or higher) were reported by 85.1%<sub>wt</sub> of the sample. Non-Hispanic white adolescents, adolescents from the Northeast, and adolescents who worked during the school year were overrepresented among the past-year users, relative to lifetime non-users. A greater proportion of lifetime non-users had at least one parent with a college degree compared with former users and past-year users.

### Descriptive Results of Academic Engagement Items

Means and standard deviations for the academic engagement items are presented in Table 1. In general, high levels of perceived academic ability were observed as were satisfaction with educational experiences and enjoyment of the school experience. Lower ratings were observed for items relating to school courses, such as interest in courses, importance of courses for later life, and meaningfulness of schoolwork.

### Skipping School

Table 3 presents the findings of the regression models. As hypothesized, past-year users had nearly three times greater odds of skipping school than lifetime non-users (adjusted odds ratio [AOR]=2.71; 95% confidence interval [CI]=2.39–3.07). Former users were also significantly more likely to skip school than lifetime non-users (AOR=1.39; 95% CI=1.11–1.73). All results were robust to the inclusion of covariates. As presented in Figure 1, 16.7% of lifetime non-users skipped school during the past month, compared with 21.7% of former users and 35.1% of past-year users.

### High School Grades

As hypothesized, past-year users had significantly greater odds of getting low grades compared with lifetime non-users (prevalence 20.1% compared with 12.6%; AOR=1.74; 95% CI=1.47–2.06), even after adjusting for covariates. Former users were not significantly different from lifetime non-users or past-year users. All covariates, with the exception of age, were significantly associated with grades in this model.

### Academic Self-Efficacy and Emotional Academic Engagement Scores

Compared with past-year users, lifetime non-users had significantly higher scores for both measures of academic engagement, after adjustment for covariates. As shown in Figure 2, former-users had significantly higher EAE scores than past-year users but did not differ from lifetime non-users, and the former users did not differ from either group on ASE scores.

## DISCUSSION

Utilizing a large, nationally representative sample of high school seniors, we examined the associations between abstinence from substance use and academic variables. Although most of the sample had used at least one substance during the past year, a sizeable minority (28.8%<sub>wt</sub>) had abstained from all forms of substance use during their lifetime. The results provide support for the hypothesized association between lifetime abstinence from substance use and academic variables. Specifically, lifetime abstinence was significantly associated with a decreased likelihood of skipping school during the past four weeks and an increased likelihood of having average grades of B- or higher. The current findings confirm previous evidence for an association between substance use and poorer grades,<sup>48-51</sup> as well as increased risk for skipping school among adolescents.<sup>18</sup>

This study extends the existing literature by demonstrating differences in academic engagement between substance users and non-users. Specifically, lifetime non-users of alcohol and all other drugs had greater self-efficacy in their academic abilities and more positive feelings toward their education relative to past-year substance users, even after adjustment for a number of demographic variables. This finding extends previous research observing similar relationships in relation to illicit drug use.<sup>52</sup> To our knowledge, the present study is the first to evaluate the relationship between substance use and a multi-dimensional measure of academic engagement using a nationally representative sample of youth.

Interestingly, enjoyment of school was rated generally high, whereas engagement with schoolwork was comparatively low. Given the positive relationship between school bonding and academic performance,<sup>53</sup> the development of interventions to increase school bonding could be informed by further research on how aspects of engagement affect enjoyment of school.

The present findings fit within the context of Problem Behavior Theory (PBT),<sup>54,55</sup> which posits that problem behaviors such as skipping school and substance use tend to cluster together as a result of a general tendency to avoid engagement in prosocial or conventional behaviors.<sup>56</sup> The current findings support the notion that substance use and poor academic outcomes, namely skipping school and disengagement, “cluster” among adolescents. Interestingly, skipping class was the only academic variable measured that was different between former substance users and lifetime abstainers. Skipping class could be seen as more closely related to the problem behavior syndrome, as described by Jessor,<sup>54</sup> than academic engagement and grades. For these latter variables, former users of substances and students who were lifetime abstainers could not be distinguished, lending support to the notion that substance use *per se* might be an important influence on academic performance, over and above associated risk factors for substance use. This finding is consistent with previous studies utilizing addiction treatment samples of youth that found improvement in academic outcomes, namely school attendance and high school completion, after abstaining from substance use.<sup>57-59</sup> However, because the present data are cross-sectional, we cannot make conclusions regarding the temporality of the association between substance use and academic performance.

Although “experimentation” with substance use is considered to be a common behavior during adolescence,<sup>60</sup> cessation of substance use was less common among this sample than persistence (7.8%<sub>wt</sub> vs. 63.4%<sub>wt</sub>). Risk factors that contribute to both substance use and academic performance, beyond those that were controlled for in the present study, might differentiate the former substance users from current or lifetime non-users. Given the uniqueness of the former users, future research is warranted to further describe this group with respect to the risk and protective factors that differentiate them from the past-year users. The former users subsample might reflect adolescents who ceased using substances following treatment for a substance use disorder or those who naturally stopped using substances. It is also plausible that this group stopped using substances after experiencing consequences, such as decreased academic performance or being caught by their parents or school officials. These former users could have also engaged in transient substance use resulting from peer pressure. Characterizing the nature and reasons for persistence and cessation of substance use involvement during adolescence is an area worthy of future exploration. Qualitative methods might be especially appropriate for this purpose.

In a similar way, research to describe motivations for not using any substances is warranted to inform efforts to prevent adolescent substance use. Concerns about psychological and physical harms were paramount among the reasons cited by high school seniors for abstaining from marijuana use.<sup>61</sup> Research is needed to understand whether or not messages about the impact of substance use on academic achievement would resonate with adolescents.

Shifting attitudes towards marijuana use and changes in the nonmedical use of prescription medications represent a new “drug landscape” for high school students in the United States.<sup>1</sup> This study included nonmedical use of four types of prescription drugs, including prescription stimulants in the definition of substance use. In contrast to the common perception that nonmedical use of prescription stimulants can increase cognitive performance,<sup>62,63</sup> studies of college students have found that this behavior is not associated with a higher GPA, in part because of the overlap between nonmedical use of prescription drugs and multiple other substances.<sup>64,65</sup> Given that high school students engage in nonmedical prescription stimulant use to get high as well as for studying,<sup>66</sup> the current findings that substance use is associated with poorer grades is especially relevant.

The finding that lifetime users differed from former users and past-year users on demographic characteristics aligns with known risk factors for substance use during adolescence.<sup>2,3</sup> However, significant differences in academic outcomes remained even when controlling for these characteristics. Future studies should examine the potential moderating effects of these demographic characteristics. Understanding the role that race, sex, and socioeconomic status play in the relationship between substance use and academic achievement will allow schools to better tailor prevention and intervention efforts to their student population. Additionally, given the number of environmental factors that increase risk for substance use, future research could also evaluate the interrelationships between social context, school environment, substance use, and academic achievement. Furthermore, additional research is needed to evaluate factors that might mediate the relationship between substance use and academic outcomes. In particular, peer and parental factors should be



considered, as they have been shown to affect both risk for substance use and academic performance. Affiliation with deviant peers is a risk factor for substance use during adolescence,<sup>67</sup> and association with these peers might negatively affect academic engagement.<sup>68</sup> By contrast, positive family relationships and parental monitoring during high school appear to be protective factors related to substance use.<sup>67,69–71</sup>

Given the implications of academic performance during adolescence for degree attainment, earning potential, and later health status, these findings underscore the importance of preventing adolescent substance use.<sup>72–74</sup> As described below, strengthening the capacity for schools to prevent use and intervene with students who are at risk for escalation of substance use problems should be viewed as a way to support and promote students' academic success.

## Limitations

Several limitations of the present study must be noted. First, we are unable to infer causality in differences in academic outcomes by substance use group due to the cross-sectional nature of the data. Future research should utilize longitudinal designs to examine temporality in the relationship between substance use and subsequent changes in academic engagement and academic outcomes. Second, self-report data might be influenced by recall or social desirability bias. Third, we had to make inferences regarding group membership if a student had missing data on MDMA, methamphetamine, or inhalant use. However, it is unlikely that this decision impacted our results given that the use of illicit drugs other than marijuana rarely occurs in the absence of alcohol, cigarette, or marijuana use.<sup>75,76</sup> In order to answer our particular research question, the current study compared groups of adolescents based on their abstinence from any form of substance use. Using more continuous measures such as the number of illicit drugs used during the lifetime is an alternative way of operationalizing substance use severity. Although we controlled for a variety of covariates, we were unable to account for the effects of externalizing behaviors and conduct problems, which are more common among substance users than non-users and are negatively associated with academic achievement.<sup>26,77</sup> To ease interpretation of estimates from the regression models, dichotomized variables were used for skipping school and grades. It is possible that using continuous variables for these measures could alter the interpretation of the results.

Finally, adolescents who dropped out of high school or were not present in class on the day of data collection are not included among this sample. Adolescents who skip school are more likely to be substance users than students who do not skip,<sup>16,78</sup> and high school students who have a substance use disorder or experience serious academic failure might drop out prior to their senior year. Therefore, these results might underestimate the prevalence of substance use, skipping school, and low grades. Further research on this topic utilizing community-based samples, rather than school-based, is needed to avoid possible bias from absenteeism and dropout.

## Conclusions

A sizeable minority of high school seniors have abstained from all substance use during their lifetime. Our findings suggest that lifetime non-users are less likely to skip school or get low grades and have higher levels of academic engagement relative to current substance users.

Interventions to prevent substance use during adolescence might be useful in promoting academic achievement. Further research is needed to describe the mechanisms that might explain the observed relationship between substance use, academic engagement, and academic achievement.

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## IMPLICATIONS FOR SCHOOL HEALTH

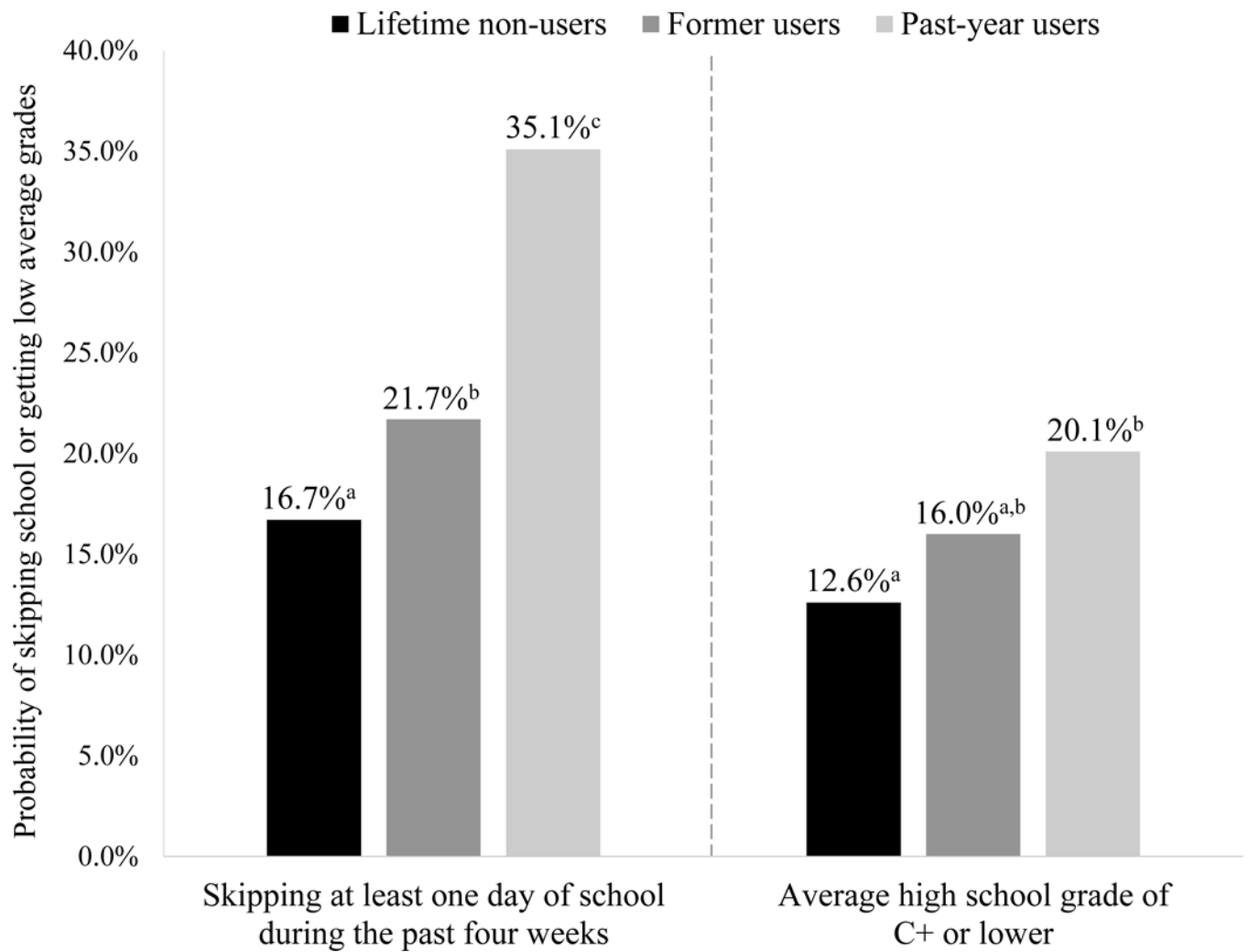
Students might not perform well academically for a number of health-related reasons, and substance use appears to be one possible contributing factor. School health programs, therefore, play an essential role in promoting academic performance by addressing multiple reasons for academic difficulties, including substance use. A comprehensive approach to addressing substance use requires a continuum of strategies, includes education, screening, intervention, and making referrals and should be seen as a priority for schools, to promote not only student health but also academic success.<sup>79</sup> The following suggestions are offered as starting points for developing an overall strategy:

- Resources to support school-based substance use prevention programs, including funding and staff time are essential. Emphasizing that there is evidence for a link between academic achievement and substance use can be a compelling argument to allocate new resources for prevention and intervention efforts. Leveraging the expertise of local public health and substance use prevention practitioners might help make this case to policymakers who are responsible for funding decisions.
- Ongoing training for teachers and other educational professionals regarding the identification of early warning signs of substance use allows for interventions of at-risk students to occur at the earliest point possible, before problems escalate.
- Teachers, school administrators, and school health professionals should coordinate to ensure that messaging from the school about substance use and relevant policies are implemented consistently and comprehensively throughout a student's academic experience. A "no tolerance" message is recommended.<sup>80</sup>
- School-based prevention programs are effective at preventing substance use during adolescence,<sup>81-83</sup> and programs as early as first and second grade are associated with less substance use during late adolescence.<sup>84</sup> Programs that address social influences, norms, and commitment not to use, in addition to using peer leaders and interactive delivery methods, are the most effective.<sup>81</sup>
- Substance use screening can be adapted for administration in a variety of settings, such as visits to the school nurse, meetings with school counselors, or through athletics. In particular, school-based health centers are well-positioned to provide screening and other substance use services.<sup>85</sup> The American Academy of Pediatrics recommends using the CRAFFT, which takes less than five minutes to administer, to screen adolescents for alcohol and drug use,<sup>72,86</sup> and previous studies have recommended the CRAFFT as an efficient, valid tool for use in high schools.<sup>87</sup>
- Developing relationships with community-based resources and local health care professionals who specialize in the care and management of adolescent

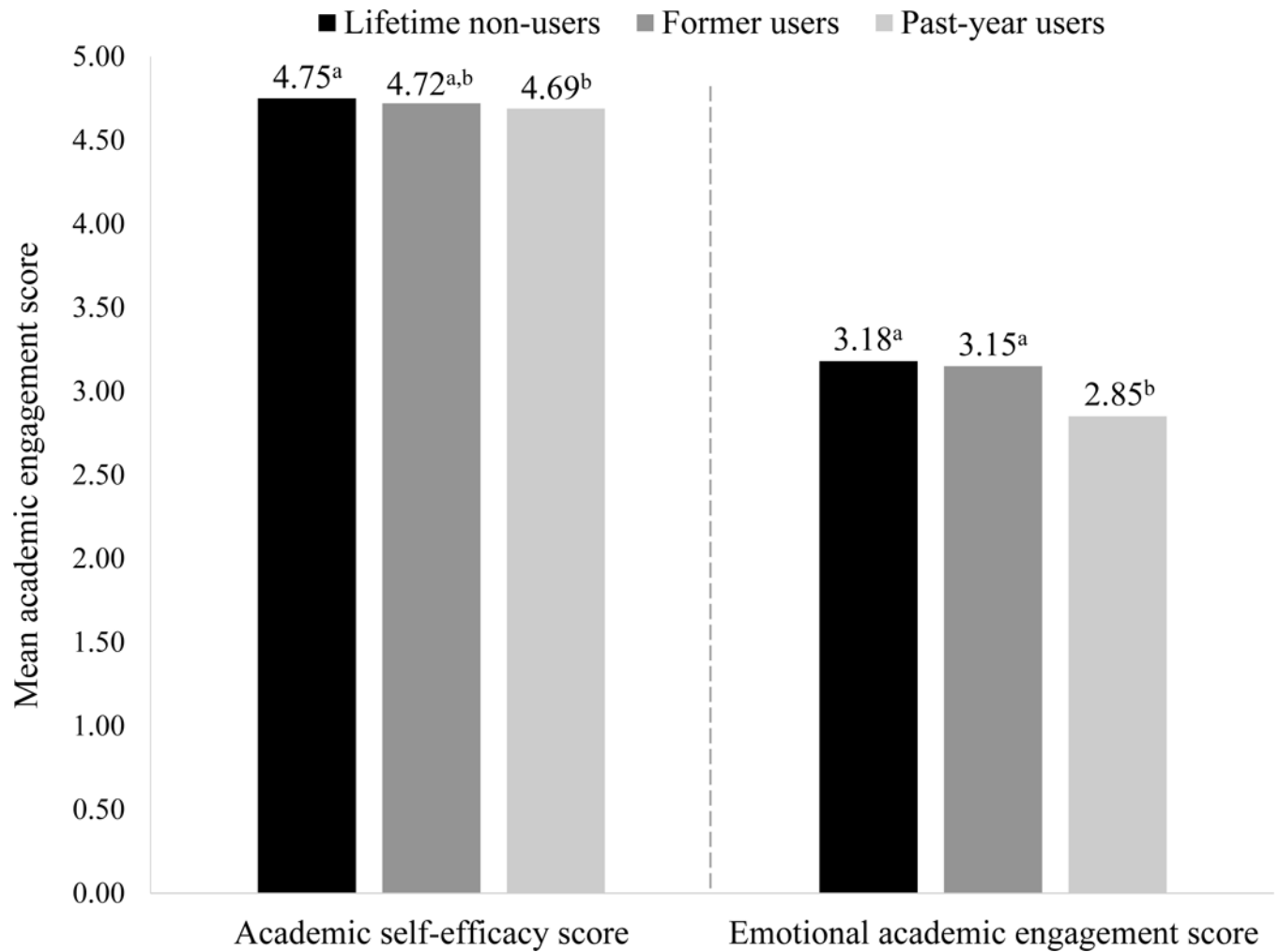
substance use problems is essential so that students can be appropriately referred when there is a need for additional assessment or treatment.<sup>79</sup>

- Schools can utilize the six strategies outlined by the Centers for Disease Control and Prevention as a guide for implementing programs to foster school connectedness, an important component of academic engagement.<sup>53</sup> Increasing school connectedness can protect against health risk behaviors, including substance use.
- Educational messaging to parents about the consequences of substance use should specifically include reference to possible benefits of abstaining from substance use on promoting student academic performance and engagement.





**Figure 1.** Estimated Marginal Means for Probability of Skipping School or Getting Low Average Grades., Note. Estimates are adjusted for covariates. Bars within the same academic variable not sharing the same superscript are significantly different than each other at  $p < .05$ .



**Figure 2.** Estimated Marginal Mean Academic Engagement Scores., Note. Estimates are adjusted for covariates. Academic self-efficacy scores ranged from one to seven, with higher scores indicated greater self-efficacy in academic abilities. Emotional academic engagement scores ranged from one to five, with higher scores indicating greater positive feelings toward school. Bars within the same score not sharing the same superscript are significantly different than each other at  $p < .05$ .

**Table 1.** Monitoring the Future Items Assessing Academic Engagement and Principal Components Analysis (PCA) Results

Variable	Question	Response Options	M (SD)	PCA Factor Loadings		Final Result
				Factor 1	Factor 2	
Intelligence	Compared with others your age throughout the country, how do you rate yourself on school ability?	1 (Far below average) to 7 (Far above average)	4.99 (1.21)	0.922	-	Retained in academic self-efficacy score
Ability in school	How intelligent do you think you are compared with others your age?	1 (Far below average) to 7 (Far above average)	4.88 (1.20)	0.908	-	Retained in academic self-efficacy score
Interest in courses	How interesting are most of your courses to you?	1 (Very dull) to 5 (Very exciting and stimulating)	2.87 (0.99)	-	.781	Retained in emotional academic engagement score
Likes going to school	How much do you agree or disagree with each statement below? Going to school has been an enjoyable experience for me.	1 (Disagree) to 5 (Agree)	3.06 (1.03)	-	.754	Retained in emotional academic engagement score
Importance of school topics for later life	How important do you think the things you are learning in school are going to be for your later life?	1 (Not important) to 5 (Very important)	2.96 (1.18)	-	.733	Retained in emotional academic engagement score
School work is meaningful	How often do you feel that the school work you are assigned in meaningful and important?	1 (Never) to 5 (Almost always)	2.99 (1.07)	-	.731	Retained in emotional academic engagement score
Enjoyment of school experience	Some people like school very much. Others don't. How do you feel about going to school?	1 (I don't like it at all) to 5 (I like it very much)	3.39 (1.23)	-	.639	Retained in emotional academic engagement score
Satisfaction with educational experiences	How satisfied are you with your educational experiences?	1 (Completely dissatisfied) to 7 (Completely satisfied)	5.07 (1.59)	-	-	<i>Dropped</i>
Importance of doing well in school for getting a good job	How much do you agree or disagree with each statement below? Doing well in school is important for getting a good job.	1 (Disagree) to 5 (Agree)	4.23 (1.01)	-	-	<i>Dropped</i>

Seven of these items were form-specific and were not asked of all participants. The PCA and subsequent academic engagement analyses were restricted to participants with non-missing data for these items (N = 1536). Only factor loadings > |0.6| are displayed.

M, mean; SD, standard deviation.

Table 2.

## Overall Sample Characteristics and Comparisons Between Substance Use Groups

	Overall (N = 9,578)		Lifetime Non-users (N = 2,758; 28.8% wt)		Former Users (N = 747; 7.8% wt)		Past-year Users (N = 6,073; 63.4% wt)	
	%wt	N	%wt	N	%wt	N	%wt	N
Sex (% male)	46.9	4262	47.9 <sup>a</sup>	1242	50.0 <sup>a</sup>	357	46.1 <sup>a</sup>	2663
Age (% 18 years or older)	56.0	5322	55.4 <sup>a</sup>	1517	58.3 <sup>a</sup>	433	56.0 <sup>a</sup>	3372
Race/ethnicity								
Non-Hispanic white	54.5	5217	51.2 <sup>a</sup>	1412	43.5 <sup>b</sup>	325	57.3 <sup>c</sup>	3479
Non-Hispanic black	13.0	1245	16.8 <sup>a</sup>	463	18.5 <sup>a</sup>	138	10.6 <sup>b</sup>	643
Hispanic	16.4	1568	14.4 <sup>a</sup>	397	20.5 <sup>b</sup>	153	16.8 <sup>c</sup>	1018
Other/biracial/missing	16.2	1548	17.6 <sup>a</sup>	485	17.5 <sup>a,b</sup>	130	15.4 <sup>b</sup>	932
Highest level of education completed by a parent								
Less than a high school degree	19.6	1786	17.1 <sup>a</sup>	440	23.9 <sup>b</sup>	164	20.3 <sup>b</sup>	1181
High school degree	32.2	2930	29.9 <sup>a</sup>	771	32.9 <sup>a,b</sup>	226	33.2 <sup>b</sup>	1933
Some college	19.9	1806	21.1 <sup>a</sup>	544	19.7 <sup>a</sup>	136	19.3 <sup>a</sup>	1126
College degree or higher	28.3	2569	32.0 <sup>a</sup>	827	23.5 <sup>b</sup>	162	27.2 <sup>b</sup>	1580
Hours worked per week during school year								
0 hours	39.7	3659	50.2 <sup>a</sup>	1332	42.4 <sup>b</sup>	301	34.7 <sup>c</sup>	2027
Up to 10 hours	19.0	1745	20.6 <sup>a</sup>	546	17.2 <sup>a</sup>	122	18.4 <sup>a</sup>	1077
11 to 20 hours	20.6	1894	16.0 <sup>a</sup>	425	20.8 <sup>b</sup>	147	22.6 <sup>b</sup>	1321
More than 20 hours	20.8	1911	13.1 <sup>a</sup>	349	19.6 <sup>b</sup>	139	24.3 <sup>c</sup>	1424
Geographic region of school								
Northeast	17.0	1631	13.3 <sup>a</sup>	367	12.2 <sup>a</sup>	91	19.3 <sup>b</sup>	1173
North Central	21.2	2029	22.7 <sup>a</sup>	627	21.0 <sup>a</sup>	157	20.5 <sup>a</sup>	1245
Southeast	38.5	3691	41.5 <sup>a</sup>	1143	45.3 <sup>a</sup>	338	36.4 <sup>b</sup>	2210

	Overall (N = 9,578)		Lifetime Non-users (N = 2,758; 28.8% <sub>wt</sub> )		Former Users (N = 747; 7.8% <sub>wt</sub> )		Past-year Users (N = 6,073; 63.4% <sub>wt</sub> )	
	% <sub>wt</sub>	N	% <sub>wt</sub>	N	% <sub>wt</sub>	N	% <sub>wt</sub>	N
West	23.3	2227	22.5 <sup>a</sup>	621	21.6 <sup>a</sup>	161	23.8 <sup>a</sup>	1445
High school program								
College preparatory	51.9	4853	55.9 <sup>a</sup>	1505	45.9 <sup>b</sup>	331	50.9 <sup>c</sup>	3017
General	35.2	3292	30.8 <sup>a</sup>	828	36.9 <sup>b</sup>	267	37.0 <sup>b</sup>	2197
Vocational/technical	3.0	279	2.1 <sup>a</sup>	56	3.5 <sup>a,b</sup>	25	3.3 <sup>b</sup>	198
Other/don't know	9.9	921	11.2 <sup>a</sup>	302	13.7 <sup>a</sup>	99	8.8 <sup>b</sup>	519
Skipped school (% skipped at least one day during the past four weeks)	28.3	2548	14.9 <sup>a</sup>	384	21.2 <sup>b</sup>	150	35.2 <sup>c</sup>	2014
Average high school grade (% B- or higher)	85.1	7900	89.5 <sup>a</sup>	2387	84.5 <sup>b</sup>	615	83.1 <sup>b</sup>	4898

<sup>a</sup> Cells within the same row not sharing a common superscript are significantly different at  $p < .05$ .

<sup>b</sup> Monitoring the Future does not assess past-year cigarette use; past-30 day use was substituted when categorizing participants into the substance use groups.

**Table 3.** Results of Regression Models Evaluating the Association Between Substance Use and Academic Variables

	Skipping school AOR (95% CI)	Low average grades AOR (95% CI)	Academic self- efficacy score AOR (95% CI)	Emotional academic engagement score AOR (95% CI)
Sex (Ref = Male)	1.07 (0.97, 1.18)	0.70 (0.61, 0.80)**	0.79 (0.76, 0.83)**	1.00 (0.92, 1.08)
Race (Ref = Non-Hispanic white)				
Non-Hispanic black	0.83 (0.70, 0.98)*	2.25 (1.84, 2.76)**	0.92 (0.86, 0.99)*	1.18 (1.04, 1.34)*
Hispanic	1.27 (1.10, 1.45)**	1.26 (1.04, 1.53)*	0.88 (0.72, 0.82)**	1.11 (0.99, 1.24)
Other/missing	1.12 (0.97, 1.29)	1.03 (0.84, 1.27)	1.00 (0.94, 1.07)	1.03 (0.92, 1.16)
Age (Ref = Less than 18 years old)	1.13 (1.02, 1.25)*	0.96 (0.84, 1.10)	0.96 (0.92, 1.01)	1.08 (1.00, 1.17)
Parents' highest level of education completed (Ref = Less than a high school degree)				
High school degree	--	0.81 (0.68, 0.97)*	1.13 (1.50, 1.72)**	--
Some college	--	0.61 (0.49, 0.75)**	1.30 (1.21, 1.40)**	--
College degree or higher	--	0.40 (0.32, 0.50)**	1.61 (1.06, 1.20)**	--
Hours worked per week during school year (Ref = 0 hours)				
Up to 10 hours	1.12 (0.98, 1.30)	0.71 (0.58, 0.88)**	--	1.05 (0.94, 1.17)
11 to 20 hours	1.19 (1.04, 1.36)*	0.78 (0.65, 0.95)*	--	0.86 (0.78, 0.96)**
More than 20 hours	1.53 (1.34, 1.74)**	1.04 (0.87, 1.23)	--	0.91 (0.82, 1.02)
Geographic region (Ref = Northeast)				
North Central	0.81 (0.69, 0.94)**	1.65 (1.33, 2.05)**	0.99 (0.90, 1.04)	--
Southeast	1.12 (0.97, 1.28)	0.85 (0.69, 1.05)	1.08 (1.02, 1.15)*	--
West	1.11 (0.95, 1.30)	2.05 (1.64, 2.56)**	0.97 (0.92, 1.06)	--
High school program (Ref = College preparatory)				
General	1.34 (1.20, 1.49)**	2.88 (2.47, 3.35)**	0.61 (0.58, 0.64)**	0.85 (0.78, 0.93)**
Vocational/technical	1.17 (0.88, 1.57)	3.49 (2.49, 4.89)**	0.52 (0.45, 0.59)**	0.57 (0.45, 0.71)**
Other/don't know	1.02 (0.86, 1.22)	4.15 (3.36, 5.14)**	0.47 (0.44, 0.51)**	0.86 (0.75, 1.00)*

	Skipping school AOR (95% CI)	Low average grades AOR (95% CI)	Academic self- efficacy score AOR (95% CI)	Emotional academic engagement score AOR (95% CI)
Substance use (Ref = Lifetime non-users)				
Former user	1.39 (1.11, 1.73) **	1.31 (0.99, 1.73)	0.97 (0.89, 1.06)	0.97 (0.84, 1.12)
Past-year user	2.71 (2.39, 3.07) **	1.74 (1.47, 2.06) **	0.94 (0.90, 0.99) *	0.72 (0.66, 0.79) **

CI, confidence interval; AOR, adjusted odds ratio.

\* p < .05

\*\* p < .01

-- Non-significant variables were dropped from the final models. Age, sex, and race were retained regardless of significance.