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Alcohol and Marijuana Use Trajectories in a Diverse Longitudinal Sample of Adolescents: Examining Use Patterns from Age 11 to 17

Elizabeth J. D'Amico[1], **Joan S. Tucker**[1], **Jeremy N.V. Miles**[1], **Brett A. Ewing**[1], **Regina A. Shih**[2], and **Eric R. Pedersen**[1]

[1]RAND Corporation; 1776 Main St., Santa Monica, CA 90407

[2]RAND Corporation; 1200 S. Hayes St., Arlington, VA 22202

Abstract

Aims—We tested race/ethnic differences in alcohol and marijuana (AM) trajectories (comprising an intercept term; reflecting overall probability of use, and a slope term; reflecting change in probability of use) during adolescence, whether AM use trajectories predicted high school outcomes, and whether outcomes differed by race/ethnicity after controlling for trajectory of AM use.

Design—This longitudinal study involved n=6,509 youth from 16 middle schools in Southern California surveyed from age 11.5 (2008) to age 17 (2015); all surveys assessed AM use, and the final survey also examined high school outcomes.

Setting—Youth completed five surveys in middle school and two online surveys in high school.

Participants—The sample was 50% male and 80% non-White.

Measurements—Intercept (at 2.75 years post baseline) and slope of AM use were examined as outcomes for race/ethnic differences. AM use trajectories were examined as predictors of academic performance and unpreparedness, social functioning, mental and physical health, and delinquency.

Findings—We found differences in trajectories of use by race/ethnicity with white youth reporting a higher overall intercept of alcohol use compared to all other groups (v. Asian p<.001, Black p=.001, Multi-ethnic p=.008). Overall, examination of trajectories of use showed that adolescents with a higher alcohol use intercept term reported greater academic unpreparedness (p<.001) and delinquency (p<.001) at wave 7 in high school. In addition, youth with a higher intercept for marijuana use reported greater academic unpreparedness (p<.001) and delinquency (p<.001), and poorer academic performance (p=.032) and mental health (p=.002) in high school. At wave 7, compared to White youth, Hispanic and multi-ethnic youth reported poorer academic performance (p<.001 and p=0.034, respectively); Asian, Black, and Hispanic youth reported

Address correspondence to: Elizabeth J. D'Amico, Ph.D., RAND Corporation 1776 Main St., Santa Monica, CA 90407, Phone: 310-393-0411, damico@rand.org.

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higher academic unpreparedness (p<.001, p=.019, and p=.001); and Asian youth and multi-ethnic youth reported poorer physical health (p=.012 and p=.018) controlling for AM use.

Conclusions—Greater AM use was associated with worse functioning in high school for all youth. After controlling for AM use, non-White youth reported worse outcomes in high school for academics and health.

Keywords

trajectories; alcohol; marijuana; adolescents; race/ethnicity

The period from middle school to high school is associated with important developmental changes that occur physically, socially and mentally (1–3). Initiation of alcohol and/or marijuana (AM) during this time period can significantly affect functioning, especially if youth initiate at a younger age. For example, AM use during this time period is associated with academic problems, poorer mental health, use of other illicit drugs in the future (including heroin and cocaine), and a higher likelihood of abuse or dependence in adulthood (4–6). Furthermore, given that the brain is still developing, adolescents can still have memory, attention, and reaction time deficits even after they stop using compared to youth who have never used AM (7, 8).

Studies in the United States examining trajectories of alcohol use during adolescence have shown a consistent pattern. Initiation typically occurs in early adolescence (roughly ages 11–15), with drinking rates increasing steadily during mid- and late adolescence before peaking in early young adulthood (9). Marijuana use trajectories follow a similar pattern, albeit with a later average age of initiation (i.e., 17). However, not all individuals follow this general pattern; thus research has focused on identifying distinct developmental trajectories of AM use. Most of these studies identify a group of persistent or high users, a declining group where use starts off heavy and gradually declines over time, an increasing group where use gradually escalates over time, and a moderate/infrequent group that uses occasionally over time (9–14). Persistent or high AM users typically have the worst outcomes (15–19). For example, youth in high marijuana use groups during high school also reported higher rates of both mental health and drug problems at age 21 (20); membership in higher alcohol use groups in 6^{th} grade was associated with greater use of other substances and violent behavior in 8^{th} grade (21); youth in the heaviest drinking trajectory group at age 18 had more problems with verbal memory and monitoring two years later (22); and youth who initiated alcohol and cigarettes concurrently early on reported worse physical health, a higher likelihood of selling drugs and the highest rates of self-reported problems compared to groups that did not initiate use in early adolescence (23).

Few studies have examined trajectories of alcohol and other drug (AOD) use among diverse ethnic and racial samples across middle school and high school (9, 11, 24). However, the face of the United States is changing. During the next 15 years, Asian American, Hispanic American, African American, and Native American populations are expected to rapidly grow in size, with each of these cultures subsequently comprising a significant proportion of the nation (17, 25). In addition, multi-racial Americans are the fastest growing population under age 18 (26). Research has shown that non-Whites often have worse health outcomes

(11, 27, 28) and more interpersonal problems and other negative outcomes from AOD use (8, 29–31) compared to Whites, even with less AOD use. To date, there are no studies that longitudinally address when these disparities may start; for example, whether we may see disparities in functioning due to AOD use begin as early as adolescence. It is imperative that we assess when disparities in functioning may begin to occur and in what domains so that clinicians and providers can better determine the best time and way to intervene.

A small body of research has assessed racial/ethnic differences in AOD use; however, studies typically focus on one substance and do not address potential disparities in outcomes. Results indicate that Whites and Hispanics are more likely than Blacks and Asians to drink alcohol (32, 33), smoke cigarettes (34–36), and use marijuana (37, 38). Four recent studies have examined racial/ethnic differences in more than one substance across adolescence into adulthood (2, 39, 40). They all used data from the National Longitudinal Study of Adolescents and Adults (Add Health) to examine use of cigarettes, alcohol, and marijuana. Although these studies examined use from adolescence to adulthood, they only had four waves of data that were spaced over a 14 year period. Setoh and colleagues (2) examined differences between Whites and Hispanics; Keyes et al. (40) compared Whites and Blacks; Chen and Jacobson (41) compared Whites, Blacks, Hispanics and Asians; and Evans-Polce et al. (39) examined differences between Whites, Hispanics and Blacks. Three studies found that White youth had higher rates of AOD use initially and increased their use more rapidly over time than non-White youth; however, racial/ethnic differences lessened as youth aged indicating that non-White youth "caught up" in their 20's and 30's. Chen and Jacobson (41) found that Hispanics had the highest rate of use for all substances at age 12, with Whites increasing the most rapidly, and peak levels of use for Blacks occurring at later ages.

These studies have significantly advanced our knowledge in this area; however, several gaps need to be addressed. First, few longitudinal studies examine trajectories for more than one substance. Given that AM are the two substances initiated and used most frequently during adolescence, it is important to examine how trajectories of AM use during this time period may differentially affect outcomes. Second, none of these studies measure AM use with *regular* assessments during *both* middle school and high school. These are important developmental time periods to measure consistently. More regular assessments allow examination across critical transitions, including from age 11 to 14 when use rates increase dramatically (42, 43), and from 14 to 17 when youth begin to gain more independence from parents and may have more opportunities to engage in risk behaviors (44, 45). Third, studies tend to focus on differences between just a few racial/ethnic groups. Longitudinal research with diverse groups of youth is needed, including multi-ethnic youth, so we can examine how use in middle school and high school may affect functioning in high school. Fourth, most studies that examine how trajectories affect outcomes tend to focus on one outcome, such as mental health or academic achievement. It is important to assess several different domains, such as academics, physical and mental health, social functioning, and behavior as findings could shed light on what domains may be most affected during this important developmental period, which could help inform prevention efforts. Most importantly, these studies do not typically address potential disparities in functioning that may occur given the same rates of use during this time period. One cross sectional study found that Latino high

school aged youth who reported drinking also reported a higher likelihood of getting into trouble with the police compared to White and Asian youth who drank alcohol (30). The current study moves the field forward significantly in this area by a) testing slope and intercept differences for AM use by race/ethnicity to determine whether differences exist in probability of use and rate of change in probability of use, b) testing whether the intercept and slope (average and change) of probability of AM use from age 11 to 16 predict outcomes across several key domains of functioning at age 17, and c) adjusting for level of AM use and comparing outcomes for White, Black, Hispanic, Asian and multi-ethnic youth to understand whether functioning in high school differs for these groups after controlling for AM use.

Method

Participants and procedures

This study focuses on two cohorts of youth who were in 6th and 7th grade (age 11–12) in 2008 and were followed until 2015 (age 17). Participants were part of an AOD use prevention program, CHOICE, conducted in 16 middle schools in the greater Los Angeles area (46). Schools were initially selected to participate across three districts to obtain a diverse sample and to have similar AM use rates at baseline. A total of 14,979 students across all 16 schools received parental consent forms; 92% of parents returned this form (n = 13,785). Approximately 71% of parents gave permission for their child to participate (n = 9,828) and 94% of consented students completed the first survey (n = 8,932). The study has a Certificate of Confidentiality; all procedures were approved by the institution's review board. Youth completed waves 1 through 5 in middle school during PE class (wave 1: fall 2008, wave 2: spring 2009, wave 3: fall 2009, wave 4: spring 2010, and wave 5: spring 2011), and follow up rates ranged from 74% to 90%, excluding new youth that could have come in at a subsequent wave. Procedures are reported more extensively elsewhere (46). As youth graduated from middle school to high school between waves 5 and 6, they transitioned from 16 middle schools to over 200 high schools nationally and internationally. The cohort was re-contacted and re-consented to complete four annual web-based surveys; we utilize the first two waves in the current study as this is what is available at this time. Wave 6 occurred between May 2013 and April 2014 when participants were in 9th–12th grades. Of the 4,366 youth who were eligible for the wave 6 survey (i.e., in 6th–7th grade at wave 1, could be located, were re-consented), 2,653 (61%) of those completed the survey. Retention from wave 6 to wave 7 was 80%. Drop out was not significantly associated with demographics or risk behaviors, such as drinking and marijuana use. The trajectory sample of 6,509 youth includes original 6th and 7th graders from wave 1, and youth that completed a survey at any other wave from waves 2–7; 77% of youth completed 4 or more survey waves. See Table 1 for descriptive statistics and Table 2 for sample information at each wave.

Measures

Demographics at wave 1—Students were asked about their age, race/ethnicity, and gender. Students were classified into one of five racial/ethnic groups: non-Hispanic White (reference group), non-Hispanic Black, Hispanic, Asian or Pacific Islander, and multi-ethnic (indicated more than race)/Other (Native American, Native Hawaiian).

Alcohol and marijuana use at waves 1–7—Alcohol and marijuana use were assessed using well-established measures with adolescents (47, 48). For past month use, we asked: "During the past month, how many days did you [drink at least one full drink of alcohol] [use marijuana]?" Responses ranged from 1="0 days" to 8="20–30 days" and were dichotomized (1="any use" versus 0="no use") due to infrequent responses at high levels of use.

Academic performance and unpreparedness at wave 7—Academic performance was based on three items: self-reported grades in past year (48) (1=*mostly F's* to 8=*mostly A's*), highest level of school they plan to finish (49) (1=*I may not finish high school* to 6=*I plan to go to graduate school or professional school*), and how much they agree with the statement "Getting good grades is important to you" (1=*strongly disagree* to 5=*strongly agree*). Items were standardized (mean=0; standard deviation=1) to account for a difference in item scales and summed (α=0.57), with higher scores indicating stronger academic performance. Academic unpreparedness (50) had 4 items that evaluated how often the respondent went to class without homework done, without paper and pencil, without books, and how often they went to class late (0=*never* to 3=*often*). Items were summed with higher scores indicating more unpreparedness (α=0.75).

Physical health at wave 7—A *physical ailments* scale (51) had 4 items from the Physical Health Questionnaire-15 on how bothered the respondent had been in the previous 4 weeks by stomach pain, headaches, feeling tired or having low energy and trouble sleeping. Original responses were dichotomized such that 0=*not at all bothered* and 1=*bothered a little or a lot.* Responses were summed with higher scores indicating more symptoms (α=0.69). *Physical health* (52) included 3 items: general health (0=*excellent* to 4=*poor*), physically able to do activities that one enjoys (0=*with no trouble* to 4=*not able to do*), and could participate in sports/activities similar to their peers (0=*with no trouble* to 4=*not able to do*). Items were reverse scored and summed with higher scores indicating better health (α=0.69).

Mental health at wave 7—General mental health status was assessed using the MHI-5 (53), a subscale of the SF-36; α=.75 (14). Five items reflecting mood in the past 30 days were rated on a 6-point scale (1=*none of the time* to 6=*all of the time*) and reflected domains primarily related to anxiety and depression (e.g., "How much of the time have you been a very nervous or anxious person?," "How much of the time have you felt downhearted or blue?") Items were summed and then, following scoring instructions, items were linearly transformed to a 0 to 100 scale such that higher scores indicate better mental health.

Social functioning at wave 7—Respondents rated seven items from the PROMIS Peer Relationships Short Form item bank (22) on a 5-point scale (0=*never* to 4=*always*). Raw scores ranged from 0 to 32. Following PROMIS scoring instructions, we transformed raw scores to a t-score (α=.92) with higher scores indicating better social functioning. Sample items include: "I was able to count on my friends", "I felt accepted by other kids my age", and "Other kids wanted to talk to me."

Delinquency at wave 7—Eight items (32) rated on a 6-point scale (1=*not at all* to 6=*20 or more times*) and summed (α=.80) assessed how often the respondent engaged in various problem behaviors (e.g., school misbehavior, fighting, stealing) in the past year. In adolescent populations this measure is associated with AM use and mental health. (54–56)

Statistical Analysis

We used latent growth modeling to examine AM use over time, employing a structural equation modeling framework, using Mplus v6.11 (57) as this approach allows us to treat change as both an outcome (as in conventional growth models) and a predictor. The intercept represents the predicted value of the outcome when the predictor is equal to zero. This was set at 2.75 years because waves were not evenly spaced. There were 5.5 total years between waves 1 and 7 (wave 1 = 0 years, wave 2 = .5 years, wave 3 = 1 year, wave 4 = 1.5 years, wave 5 = 2.5 years, wave 6 = 4.5 years, and wave 7 = 5.5 years); the intercept therefore represents the average use; thus we refer to the intercept as the average in later sections. The slope represents the change in the probability of use as the individual ages. We used the weighted least squares with mean and variance adjusted estimator (WLSMV). This estimator (as implemented in Mplus) can provide consistent and unbiased estimates in the presence of missing data under some general assumptions, (58) hence we are able to use information for all individuals, regardless of the number of surveys they completed. Because of convergence problems caused by dissimilar variances, the MHI-5 score was divided by 10. Structural equation models are tested for fit to data using the chi-square test, however, this test can be overpowered, suggesting statistically significant misfit when discrepancies are negligible; hence, we use two additional measures of fit: the comparative fit index (59) (CFI) and the root mean square error of approximation (RMSEA) (60, 61). Values of RMSEA less than 0.05 indicate good fit, as do CFI values greater than 0.95.

We first examined race/ethnicity as a predictor of the slope and average (dummy coded, with White as the reference, compared to categories of Asian, Black, Hispanic, multi-ethnic/other; average represented as the intercept); we controlled for age, gender and whether the individual attended an intervention school. We estimated separate models for alcohol and marijuana. We next examined a sequelae of change model (62). This is a feature possible within a structural equation modeling framework in which the random effect of the rate of change can function not just as an outcome (as it is conventionally modeled) but also as a predictor of downstream outcomes; thus we tested whether the slope and intercept for AM were associated with outcomes measured at wave 7. Finally, we examined race/ethnic differences in outcomes after controlling for use by estimating a single model with slope and intercept of both AM, and estimating the direct effect from race/ethnicity to each outcome.

Results

Predictors of slope and intercept of use

The first models we estimated included the latent growth to examine race/ethnic differences in the slope and intercept for alcohol and marijuana using two separate models. The intercept represents average probability of use, and slope represents change in probability of use over time, both modeled as a logistic function. Overall fit was good; for marijuana, chi-

square=109, df=63, RMSEA=0.011, CFI=0.982; for alcohol chi-square=161, df=63, RMSEA=0.016 and CFI=0.971. Fit statistics indicate that the logistic-linear model of change in probability of use was a good description of the data (Table 3).

We found statistically significant effects for race/ethnicity predicting the average probability of use (intercept) and the change in the probability of use (slope) (Table 3). The averages of Asian teens were lower than White teens for both alcohol and marijuana, meaning that they used significantly less AM than Whites. Similarly, Black and multi-ethnic groups had lower averages than Whites for alcohol use, but these groups did not differ significantly on marijuana averages. For slopes, Hispanic youth had less steep slopes than did Whites for both AM, indicating that their rate of increase in the probability of use was less than that of White youth.

Effects of use on wave 7 outcomes

We next fit models where the intercepts and slopes of AM predicted outcomes measured at wave 7[1]. To avoid collinearity problems, we again fit separate models for alcohol and marijuana. Model fit was again very good indicating that the linear logistic model fit the data; for marijuana, chi-square=146; df=99, RMSEA=0.009, CFI=0.995; for alcohol, chi-square=215, df=101, RMSEA=0.013, CFI=0.989. A higher average (intercept) of alcohol use was associated with greater academic unpreparedness and delinquency scores (Table 4). For marijuana, a higher average was associated with greater academic unpreparedness, lower academic performance, poorer mental health and greater delinquency. The slopes for AM were also predictive of delinquency (with positive slopes associated with greater delinquency), and for alcohol with social functioning (with a positive slope associated with higher social functioning scores).

Race/ethnic differences for wave 7 outcomes controlling for use

Finally, we fit a model with AM use, and examined direct effects from race/ethnicity to the outcomes, controlling for both the average (intercept) and slope (rate of increase) of probability of use. The final model provided a good fit: chi-square=417, df=238, CFI=0.991, RMSEA=0.011. Table 5 shows results of this model, with the direct effects from race/ethnicity to outcomes, controlling for use. Hispanic and multi-ethnic youth reported lower academic performance than White youth, and Asian, Black, and Hispanic youth reported significantly higher academic unpreparedness than White youth. Asian youth and multi-ethnic youth also reported significantly poorer physical health than White youth. There were no statistically significant differences for delinquency, mental health, physical ailments or social functioning.

Discussion

The current study moves the field forward in the area of trajectory research by examining how AM use among a diverse sample of youth across this developmental period affects functioning for a variety of domains, including physical and mental health, academics, social

[1]Results were largely the same whether using all waves 1–7 or using wave 7 prospectively.

functioning, and behavior. In addition, we assessed whether there were racial/ethnic differences in functioning for White, Black, Hispanic, Asian and multi-ethnic youth after controlling for level of AM use.

Similar to previous work in this area (38, 63), Asian youth reported less alcohol and marijuana use than White youth, and Black and multi-ethnic youth reported less alcohol than White youth. Furthermore, the rate of increase in the probability of drinking and marijuana use for Whites during adolescence was greater than the rate of increase in the probability for Hispanics, which corresponds with recent research on the Add Health data set (2, 39, 40). Thus, White youth continue to be at higher risk for substance use during middle school and high school.

Marijuana and alcohol use both affected functioning in high school; however, marijuana use was associated with poorer functioning across more domains. Specifically, youth who had a higher probability of marijuana use also reported lower academic functioning, were less prepared for school, engaged in more delinquent behavior and had poorer mental health. In addition, delinquent behavior in high school was more likely among youth who showed a greater increase in their probability of marijuana use from middle school to high school. These findings are important because teen marijuana use is rising across the United States (64). In addition, many youth tend to think that alcohol use has more consequences than marijuana use and therefore view marijuana use as "safer" than drinking (65), which may be due, in part, to changing views of marijuana use that have occurred due to changing marijuana policies (66). Prevention efforts must begin to address these changing views by educating youth about marijuana's effects and how although marijuana may help with certain ailments, larger clinical trials with more varied groups of patients are needed (40). In addition, youth need to understand the potential harms of this drug such as its potential effect on their developing brain and how it can affect performance in both adolescence and adulthood (67).

Similar to marijuana use, delinquent behavior and academic unpreparedness in high school were more likely among youth who showed a greater increase in their probability of alcohol use from middle school to high school. These youth also reported higher social functioning in high school. Of note, some items on the social functioning measure focused on acceptance (other people may age want to be with me; want to talk with me) and popularity (I am good at making friends; other people want to be my friend). Alcohol use is often driven by social motives (68), and youth who view themselves as more popular tend to report heavier drinking (69). This is in contrast to youth who report use of other drugs, such as prescription drug use; these youth view themselves as less popular and therefore report lower social functioning (56). Thus, it may be that during this time period drinking is associated with being more social, and feeling more accepted and popular. Tucker and colleagues suggest that more work is needed in this area to gain a clearer understanding of why adolescents with a larger number of school-based friendship ties are more likely to drink (69).

When we examined functioning in high school by race/ethnicity while controlling for level of AM use, we found differences in academic functioning and physical health. Specifically,

Asian youth and multi-ethnic youth reported more problems with physical health than White youth when using at the same level; Asian, Black and Hispanic youth reported being less prepared academically, and Hispanic and multi-ethnic youth reported lower academic performance compared to White youth. The difference that showed up most frequently was in regards to academic performance, which is developmentally applicable given that most youth are still in school and this may be one of the first domains to show problems due to AM use. However, Asian and multi-ethnic youth also reported poorer physical health even when controlling for level of AM use, which is something that has been shown in adult populations. Thus, it is crucial to address AM use early on for non-White youth, especially in light of findings, perhaps by increasing protective factors such as parental support (70), enhancing culture (71), or improving resistance skills (72).

The current study is limited by the nature of the survey data being self-report; however, AM data from these youth have matched AM self-reported data from national surveys (46, 67). We had larger samples of White, Asian, Hispanic and youth of mixed ethnicity compared to Black youth, yet we still found statistically significant differences for Black youth compared to White youth. Finally, we were unable to recontact many youth as they transitioned from middle school to high school; however, youth that completed the survey at wave 6 in high school did not differ demographically or on their AM use compared to those who did not complete the survey. In addition, we retained most of the sample once in high school, from wave 6 to wave 7, which occurred one year later.

In sum, findings suggest that during adolescence, non-White youth who report similar likelihood of AM use as White youth also report worse outcomes across several domains. One explanation for our findings is that similar levels of AM use affect diverse groups differently, and may be more problematic for non-white groups of youth. Thus, intervention programs that target AM use during this developmental period among those at-risk for negative outcomes might be one viable approach to ameliorating disparities in functioning. However, there are other preexisting factors that we did not include in the current study that could have potentially contributed to either AM use or lower functioning during this time period, such as discrimination, parental involvement, or neighborhood quality. In addition, although we did not find differences on demographics or AM use between those youth who dropped out of the study and those who continued to complete surveys, they could have differed on characteristics that we were unable to measure. Future work must continue to survey diverse groups of youth longitudinally and measure a variety of factors so that we can obtain a clearer understanding of how functioning may be affected by AM use during adolescence and emerging young adulthood and whether disparities in functioning may differ across different developmental milestones.

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Table 1

Descriptive information

	N/Mean	%/SD	Minimum	Maximum
Demographics				
Age	17.31	0.67	14.00	18.00
Race				
White	502	20.14		
African American	57	2.29		
Hispanic	1,146	45.97		
Asian	512	20.54		
Multiracial/Other	276	11.06		
Male	1,142	45.81		
Mother's Highest Level of Education				
<High School	337	14.60		
High School	407	17.63		
Some College	313	13.56		
College	1,252	54.22		
Outcomes				
Academic Performance	0.00	2.17	−12.72	2.49
Academic Unpreparedness	7.56	2.69	0	12
Delinquency	13.79	4.88	1	66
Physical Ailments	1.91	1.41	0	4
Physical Health	12.95	2.06	0	12
Mental Health (MHI-5)	65.84	20.32	0	100
Social Functioning	43.39	7.56	17.68	64.44
Substance Use - Past Month			Skewness	
Alcohol Use				
Wave 1	200	3.45	10.69	
Wave 2	288	5.20	7.48	
Wave 3	236	4.56	8.73	
Wave 4	354	7.22	5.70	
Wave 5	357	9.18	5.12	
Wave 6	433	17.07	3.25	
Wave 7	696	28.03	1.99	
Marijuana Use				
Wave 1	41	0.71	22.16	
Wave 2	153	2.76	10.99	
Wave 3	129	2.49	9.33	
Wave 4	229	4.67	7.29	
Wave 5	239	6.15	5.95	
Wave 6	299	11.79	3.88	
Wave 7	416	16.73	2.78	

Notes: For academic performance each individual item was standardized (mean=0, SD=1), which results in possible negative scores. Social function scores of 0 to 35 were converted to z-scores per the scoring instructions for the PROMIS. Skewness: a skewness of 0 indicates a symmetric distribution. Positive skewness values such as we see here indicate a positively skewed distribution.

Table 2a

Sample size at each wave

Wave	N
1	5,826
2	5,566
3	5,196
4	4,946
5	3,903
6	2,539
7	2,493

Note: Response rates cannot be computed from the N at each wave alone, as youth could come in and out of the study (e.g., complete waves 1, 3, 5, and 7, but not waves 2, 4, and 6) and still be retained in the sample. Response rates from waves 1–5 when youth were in middle school ranged from 74%–90%, excluding new youth that could have come in at a subsequent wave. Sixty-one percent of youth (N = 2,653 of the 4,366 youth who were eligible for the wave 6 survey) completed the survey at wave 6. They were eligible for the wave 6 survey if they were in 6^{th}–7^{th} grade at wave 1, could be located, and were re-consented. Retention from wave 6 to wave 7 was 80%.

Table 2b

Wave completion rate

Waves completed	Frequency	Percent of youth
1 wave	471	7.24
2 waves	419	6.44
3 waves	626	9.62
4 or more waves	4,993	76.7

Note: Youth had to complete two or more waves to be included in trajectory analyses.

Table 3

Parameter estimates predicting alcohol and marijuana intercept and slope

		Alcohol		Marijuana	
		Intercept	**Slope**	**Intercept**	**Slope**
Race/Ethnicity	White (reference category)				
	Asian	−0.62 (−0.74, −0.49) <0.001	0.01 (−0.04, 0.06) 0.748	−0.57 (−0.71, −0.43) <0.001	−0.01 (−0.07, 0.06) 0.852
	Black	−0.35 (−0.55, −0.14) 0.001	−0.07 (−0.16, 0.03) 0.164	−0.08 (−0.31, 0.15) 0.51	0.00 (−0.12, 0.13) 0.987
	Hispanic	−0.06 (−0.15, 0.02) 0.132	−0.13 (−0.17, −0.10) <0.001	0.02 (−0.08, 0.11) 0.711	−0.12 (−0.16, −0.08) <0.001
	Multi-ethnic	−0.17 (−0.29, −0.04) 0.008	−0.01 (−0.06, 0.04) 0.7	−0.09 (−0.23, 0.06) 0.235	0.00 (−0.06, 0.07) 0.982
	Other	−0.33 (−2.67, 2.01) 0.78	−0.1 (−2.06, 1.86) 0.919	−0.25 (−7.22, 6.73) 0.945	−0.04 (−3.96, 3.88) 0.984
Age		0.17 (0.12, 0.21) 0.000	−0.01 (−0.02, 0.01) 0.588	0.15 (0.10, 0.21) 0.000	−0.04 (−0.06, −0.02) 0.001
Male		−0.15 (−0.21, −0.09) 0.000	−0.01 (−0.04, 0.02) 0.435	0.05 (−0.02, 0.12) 0.136	0.01 (−0.02, 0.05) 0.376

Note: Table shows estimate (95% CIs), p-value.

Table 4

Parameter estimates of alcohol and marijuana use predicting outcomes at wave 7

	Academic Performance		Academic Unpreparedness		Delinquency (No DUI)		MHI5		Physical Ailments		Physical Health		Social Functioning	
	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope	Intercept	Slope
Alcohol	−0.17 (−0.25, 0.09) 0.346	0.8 (−0.27, 1.87) 0.14	0.65 (0.44, 0.85) <0.001	0.8 (−0.40, 1.99) 0.191	2.49 (2.29, 2.70) <0.001	5.78 (4.40, 7.16) <0.001	−0.13 (−0.31, 0.04) 0.143	0.96 (−0.08, 2.00) 0.069	−0.02 (−0.09, 0.04) 0.455	0.2 (−0.19, 0.58) 0.312	−0.14 (−0.31, 0.02) 0.092	0.96 (−0.06, 1.98) 0.064	−0.02 (−0.63, 0.58) 0.956	8.64 (4.64, 12.63) <0.001
Marijuana	−0.2 (−0.38, −0.02) 0.032	−0.78 (−1.76, 0.32) 0.173	0.7 (0.51, 0.95) <0.001	0.03 (−1.15, 1.21) 0.962	2.47 (2.25, 2.68) <0.001	6.74 (5.03, 8.45) <0.001	−0.29 (−0.47, −0.11) 0.002	0.42 (−0.57, 1.40) 0.406	0.03 (−0.04, 0.10) 0.425	0.07 (−0.32, 0.46) 0.737	−0.09 (−0.28, 0.09) 0.323	0.54 (−0.46, 1.53) 0.29	−0.3 (−0.99, 0.40) 0.401	1.93 (−1.88, 5.74) 0.321

Note: Table shows estimate (95% CIs), p-value.

Table 5

Parameter estimates for race/ethnicity controlling for alcohol and marijuana use

	Academic Performance	Academic Unpreparedness	Delinquency	MHI5	Physical Ailments	Physical Health	Social Functioning
White (reference category)							
Asian	0.06 (−0.28, 0.40) 0.72	0.8 (0.42, 1.19) <0.001	0.55 (−0.05, 1.15) 0.073	−0.3 (−0.51, 0.07) 0.081	−0.18 (−0.18, 0.03) 0.146	−0.36 (−0.64, −0.08) 0.012	−0.92 (−2.22, 0.34) 0.154
Black	−0.42 (−1.24, 0.40) 0.313	1 (0.16, 1.85) 0.019	−0.57 (−2.34, 1.21) 0.531	0.41 (−0.24, 1.06) 0.215	0.01 (−0.27, 0.29) 0.931	0.03 (−0.56, 0.75) 0.926	1.31 (−1.57, 4.25) 0.369
Hispanic	−0.61 (−0.93, −0.28) <0.001	0.56 (0.22, 0.90) 0.001	0.19 (−0.30, 0.69) 0.445	0.3 (−0.01, 0.55) 0.062	−0.06 (−0.16, 0.04) 0.215	−0.24 (−0.50, 0.03) 0.084	0.51 (−0.71, 1.76) 0.413
Multi-ethnic	−0.42 (−0.80, −0.03) 0.034	0.23 (−0.20, 0.67) 0.294	−0.55 (−1.27, 0.18) 0.139	−0.35 (−0.68, 0.01) 0.063	−0.1 (−0.21, 0.01) 0.077	−0.38 (−0.69, −0.07) 0.018	−1.12 (−2.49, 0.23) 0.104
Other	−0.08 (−5.75, 5.58) 0.977	0.49 (−6.49, 7.46) 0.892	−0.51 (−13.10, 12.07) 0.936	0.26 (−2.71, 3.24) 0.863	0.21 (−1.01, 1.43) 0.733	0.2 (−1.08, 1.49) 0.757	3.81 (−13.25, 21.05) 0.66

Note: Table shows estimate (95% CIs), p-value.