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Screening for adolescent alcohol use in the emergency department: What does it tell us about cannabis, tobacco, and other drug use?

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Introduction

Alcohol and other drug (AOD) use is high among US adolescents and increases with age. In the United States, current use of alcohol, tobacco and marijuana is reported by 32.8%, 16% and 21.7% of high school students, respectively. In the same group, lifetime use of alcohol, tobacco and marijuana is 63.2%, 32.3% and 38.6%, respectively¹. Early initiation of alcohol has also been associated with subsequent misuse of prescription drugs^{4,5} and illicit drugs⁶. Furthermore, in recent years, the number of drug overdose deaths has exceeded fatalities from motor vehicle crashes among adults⁸.

Given the potential negative consequences of drug use during adolescence, screening for alcohol and other drugs is recommended by numerous medical^{9–12} and federal organizations^{13–15}. A pediatric emergency department (PED) visit represents a distinctive opportunity to capture high-risk adolescents missed in other settings. Nearly 1.5 million adolescents use the nation's emergency departments as their only source of care¹⁶. These

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adolescents may be more likely to report drug use, worsening health status, and mental health problems, highlighting a need for PED-based screening^{17,18}.

In light of the public health crisis of drug abuse, the PED represents a unique opportunity for identification and intervention of youth at risk for this condition. Drug use screening through interviewing or surveys as part of a comprehensive biopsychosocial screening, is recommended when delivering routine or emergency adolescent health care^{23–30}. Studies in busy PEDs have shown that brief screening is feasible and acceptable^{31–38}. The ideal screen should require minimal training and implementation time and should be sensitive enough to detect patients who have alcohol and other drug use and misuse while not over identifying those with non-hazardous use. Many alcohol and drug screening instruments exist; however, one brief instrument that can be incorporated into triage assessments and accurately detect alcohol and drug use issues would be most efficient.

A number of brief screening instruments are appropriate for use in the PED, yet no one instrument is universally utilized. A recent review of pediatric alcohol and other drug screening instruments for the emergency department found evidence supporting the use of a Diagnostic and Statistical Manual of Mental Disorders (DSM-5) 2-question instrument to screen for alcohol misuse and a Diagnostic Interview Schedule for Children (DISC) 1-question instrument to screen for cannabis misuse²⁹. Other options for brief drug use screening for adolescents include the Brief Screener for Tobacco, Alcohol and Other Drugs (BSTAD), which asks about past year alcohol, tobacco and cannabis use²⁵ or the Screening to Brief Intervention (S2BI) tool²⁷ which identifies frequency of alcohol, tobacco, marijuana and other drug use. The National Institute of Alcohol Abuse and Alcoholism (NIAAA) has recommended a brief screen which asks about a teen's drinking frequency and friends' drinking, as a potentially effective predictor of current and future alcohol misuse^{39,40}. Recent studies demonstrate the NIAAA two-question screen to be a valid approach for alcohol screening that is briefer than most other comparable screens^{41–43}. If a positive alcohol screen is positively associated with drug use, this may represent a strong screening option for the PED where short implementation time is necessary.

The purpose of the present study was to examine whether the NIAAA two-question alcohol screen is also positively associated with an adolescent's cannabis use disorder (CUD), cigarette smoking, or lifetime use of other drugs in a PED setting. A secondary aim was to determine if the association between the NIAAA two-question alcohol screen and other drug use varied by demographic characteristics.

Methods

The present study is a secondary analysis of baseline data from a prospective cohort design which examined the reliability and validity of the NIAAA two-question screen⁴¹. Sixteen PED sites from the Pediatric Emergency Care Applied Research Network (PECARN) participated in this study. Youth 12 to 17 years of age who were being treated for a non-life threatening injury, illness or mental health condition were eligible for this study if they were medically, cognitively and behaviorally stable based on the medical team's recommendation. Exclusion criteria included not being accompanied by an adult qualified to give written

permission for the youth's participation in the study; parents or teens unable to read and speak English or Spanish; or lacking a telephone or an address of residence. A detailed study methodology is described in a previously published paper⁴⁴.

After enrollment, an assessment battery that included the NIAAA two-question screen²⁸ and other measures of drug use and risk behavior was self-administered on a tablet computer. The NIAAA two-question alcohol screen²⁸ asks slightly different questions based on whether a teen is in middle or high school. Middle school and high school were determined by age (12–13 years middle school; 15–17 years high school) unless participants identified as 14 years which were sorted by grade level (grades 6–8 middle school; grades 9–12 high school). The past year alcohol use question is used to categorize teen risk level based on NIAAA recommendations (See Table 1). Any alcohol use among middle school participants categorizes them at moderate or high risk, while high school users can be categorized as lower, moderate or high risk based on their frequency of use. We have reported on the reliability and validity of this instrument in the PED⁴¹; others have reported on its validity in other medical settings^{42,43}.

To determine the relationship between the NIAAA two-question screen and CUD, the screen was compared to marijuana diagnoses derived from the substance abuse module of the DISC. For this study, a question about craving marijuana was added so that the CUD diagnosis would be based on DSM-5, rather than the DSM-4, criteria. The tobacco module of the DISC was also administered to assess tobacco use disorders. However, since in the practice setting tobacco use is more commonly examined lifetime tobacco use was coded yes or no. The DISC is the most widely used and studied mental health interview that has been tested in both clinical and community populations⁴⁵. DISC has high sensitivity (0.73–1.0) for psychiatric disorders, including substance use disorders⁴⁶. The Drug Use Questionnaire (DUQ) was used to assess the number of days the teen used cocaine, lysergic acid diethylamide (LSD), phencyclidine (PCP), inhalants and other drugs in a given time period. Internal consistency of the DUQ is 0.75 ($\alpha = 0.80$ when inhalants was dropped)⁴⁷.

Statistical Analysis

The Cochran-Armitage test was used to test the association between the NIAAA two-question screen categories (non-drinker, lower risk, moderate risk, and high risk) and CUD diagnosis, lifetime tobacco use, and lifetime other drug use. A logistic regression was used to test for the association of sex and age group with CUD diagnosis, lifetime tobacco use and lifetime drug use. A receiver-operating characteristic curve (ROC) analysis was used to investigate possible cut points on the NIAAA two-question screen score for detecting a CUD diagnosis (as well as lifetime tobacco and lifetime other drug use). We defined the optimal cut point as the point at which the sum of sensitivity and specificity was maximized. Test characteristics were calculated at each potential cut-point and the area under the curve (AUC) was used to provide an assessment of the overall accuracy of the screen in predicting CUD, lifetime tobacco use and other drug use. Additional analyses were conducted by sex, race, and ethnicity for the combined sample of middle and high school students.

An a priori power analysis was conducted using sensitivity for alcohol use problems as the basis for our sample size requirements. We assumed a target sensitivity of 90%. For the 95% confidence interval for sensitivity to be within $\pm 2.5\%$, approximately 5000 participants were projected as the required sample size.

For analyses involving the DISC and cigarette/drug use surveys, multiple imputation was used to handle responses that participants chose not to answer. We generated five imputations by fully conditional specification⁴⁸. Standard methods for pooling test statistics, confidence intervals and p-values were applied in all analyses involving imputed data. All analyses were performed using SAS Version 9.4 (SAS Institute, Cary, NC).

Results

The demographics of the sample with respect to a CUD diagnosis, lifetime tobacco use, and lifetime drug use, are presented in Table 2. Of the 4,834 participants who completed the baseline survey, 97.5%, 99% and 96% of participants completed enough questions to obtain CUD diagnoses, lifetime tobacco use, and lifetime other drug use, respectively. Older teens were more likely to have a CUD (9.3% vs. 1.7%, $p < 0.01$), report lifetime tobacco (20.2% vs. 6.3%, $p < 0.01$), and lifetime drug use (13.3% vs. 10.8%, $p = 0.01$) than younger teens. Females were more likely to report lifetime use of tobacco (16.7% vs 12.6%, $p < 0.01$) than males.

Table 3 presents whether a participant received a DSM-5 diagnosis of a CUD on the DISC (or used cigarettes or other drugs in their lifetime) by categories of the NIAAA two-question screen. NIAAA two-question screen risk category was significantly associated with CUD diagnosis as well as lifetime tobacco use, with a generally increasing trend from non-drinker to high risk. The same was true of most of the other drugs, with the exception of PCP and crystal methamphetamine.

Among middle school students, a DSM-5 diagnosis of CUD (Figure 1), lifetime tobacco use (Figure 2) or lifetime drug use (Figure 3) was predicted by any self-reported alcohol use in the past year, which indicates a classification of moderate risk on the NIAAA two-question screen. Among high school students, the accompanying tables to Figures 1, 2, and 3 indicate that a DSM-5 diagnosis of CUD, lifetime tobacco use, and lifetime drug use was predicted optimally by any drinking days in the past year. Any drinking days for high school students indicates a classification of lower risk on the NIAAA two-question screen. However, the lower risk classification for high school students is functionally equivalent to the moderate risk classification in middle school, i.e. any drinking days in the past year.

For both males and females, to detect a CUD, the optimal cutoff was classification of moderate risk or higher for middle school students and lower risk or higher for high school students on the NIAAA two-question screen. The same held true regardless of race (White, Black, Asian, American Indian/Alaskan Native, Native Hawaiian or other Pacific Islander, or more than one race) and ethnicity, either Hispanic/Latino or non-Hispanic/Latino. Since there is no low risk category for middle school students, this finding functionally translates to increased risk for a CUD for any adolescent reporting drinking at all in the past year.

Although experimentation with alcohol is normative developmentally, this finding suggests nonetheless that alcohol use during adolescence may be associated with and predictive of other potential problems, including CUDs.

For both males and females, lifetime tobacco use and lifetime drug use were most strongly associated with the classification of moderate risk for middle school students and lower risk for high school students on the NIAAA two-question screen. The same held true for race (White, Black, Asian, American Indian/Alaskan Native, Native Hawaiian or other Pacific Islander, or more than one race) and ethnicity, either Hispanic/Latino or non-Hispanic/Latino, with one exception. For Asian participants, lifetime drug use was predicted best by classification as moderate risk on the NIAAA two-question screen for high school students, and high risk for middle school students. Like the finding with CUD, these results suggest that any drinking in the past year is related to not only higher risk for significant marijuana use but also tobacco and other drug use. Interestingly, for Asian participants, drinking more substantially (more than 6 days per year for middle school students, and more than 12 days per year for high school students) was necessary to increase the odds of tobacco and other drug use.

Discussion

This study found, in a large sample of adolescent patients seen in a PED, endorsement of any drinking in the past year was positively associated with a CUD, lifetime cigarette smoking, and lifetime use of other drugs. This association was found for both males and females, adolescents of Hispanic and non-Hispanic ethnicity, and White, Black, Asian, American Indian/Alaskan Native, Native Hawaiian or other Pacific Islander, or adolescents of more than one race, with one exception.

For Asian participants, lifetime drug use was more strongly related to a classification as moderate risk, rather than lower risk, on the NIAAA two-question screen for high school students and high risk for middle school students. It is unclear why this finding, which implies a protective factor, is specific to Asians. Further, among Asians, it is unclear why it was specific to drug use and not a CUD or tobacco use. Although these findings could be a reflection of genetic⁴⁹, familial, and/or cultural factors, these results are based on only 8 youth endorsing lifetime drug use so these findings need to be replicated before any further speculation is warranted. It is also important to note that endorsement of any drinking in the past year, which translates to an NIAAA two question screen lower risk classification for high school students and moderate risk classification in middle school students, is still associated with other drug use.

There is a strong need for PED-based screening as adolescent PED patients report high levels of drug use and mental health problems^{17,18}. Further, high school dropouts, who commonly use the PED for healthcare²⁰ and cannot be reached in schools, are more likely to report alcohol and drug misuse relative to their school-attending peers¹⁹. While there is a need, a PED screen must be brief, easy to administer and require minimal staff training. Adolescents may also be more willing to admit to alcohol use rather than marijuana, tobacco, or other drug use. Being identified as being at moderate or high risk for alcohol use

on the NIAAA two-question screen may provide an opening for a PED staff person to probe further about tobacco and other drug use

There are several limitations to this study. First, the sample is not representative of the general population because it is limited to adolescents being treated in a PED. Similarly, patients who did not speak English or Spanish, did not have a parent present or lacked a telephone/address were excluded from the study. Third, the friend's alcohol use question was not used to determine individual risk assessment. This variable may have provided valuable information about a teen's risk level. Fourth, the measures were collected by self-report so we do not know how the screen will perform if the questions were asked directly of teens by a health care provider. Lastly, given the strong correlation between tobacco and marijuana use, it is possible that a screen for cigarette smoking might be equally useful in predicting drug use as the NIAAA two-question screen.

Despite these limitations, study findings suggest that a simple question about alcohol use in the past year can provide valuable clues about tobacco, marijuana, and other drug use. More research is necessary to better understand the use of the NIAAA two-question screen in the PED including how to increase its sensitivity, e.g. if combined with another brief screen.

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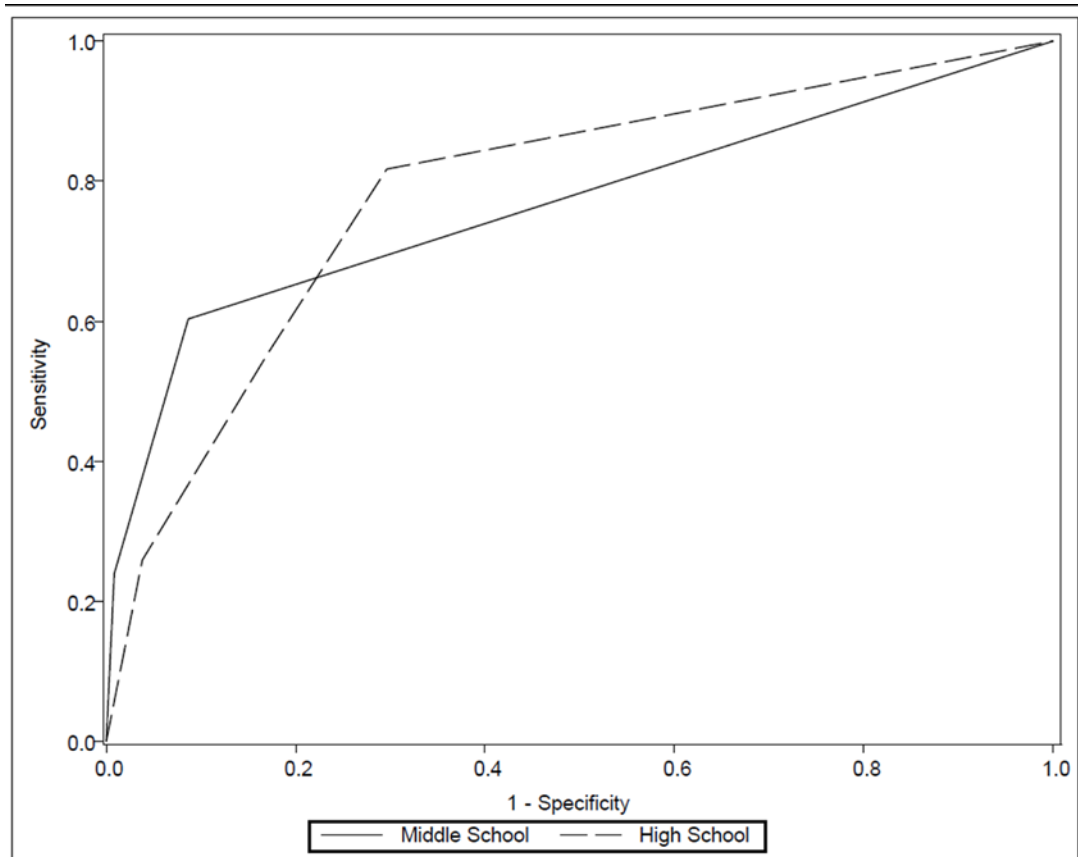
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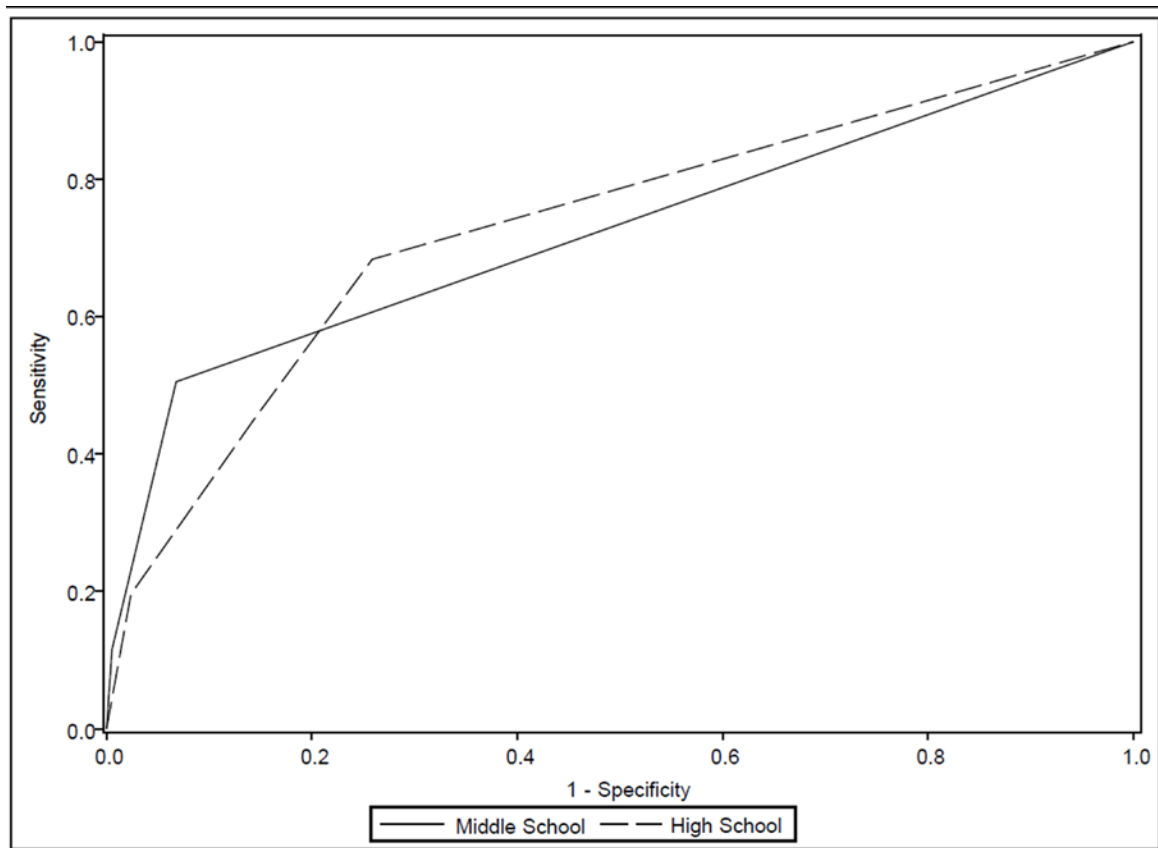
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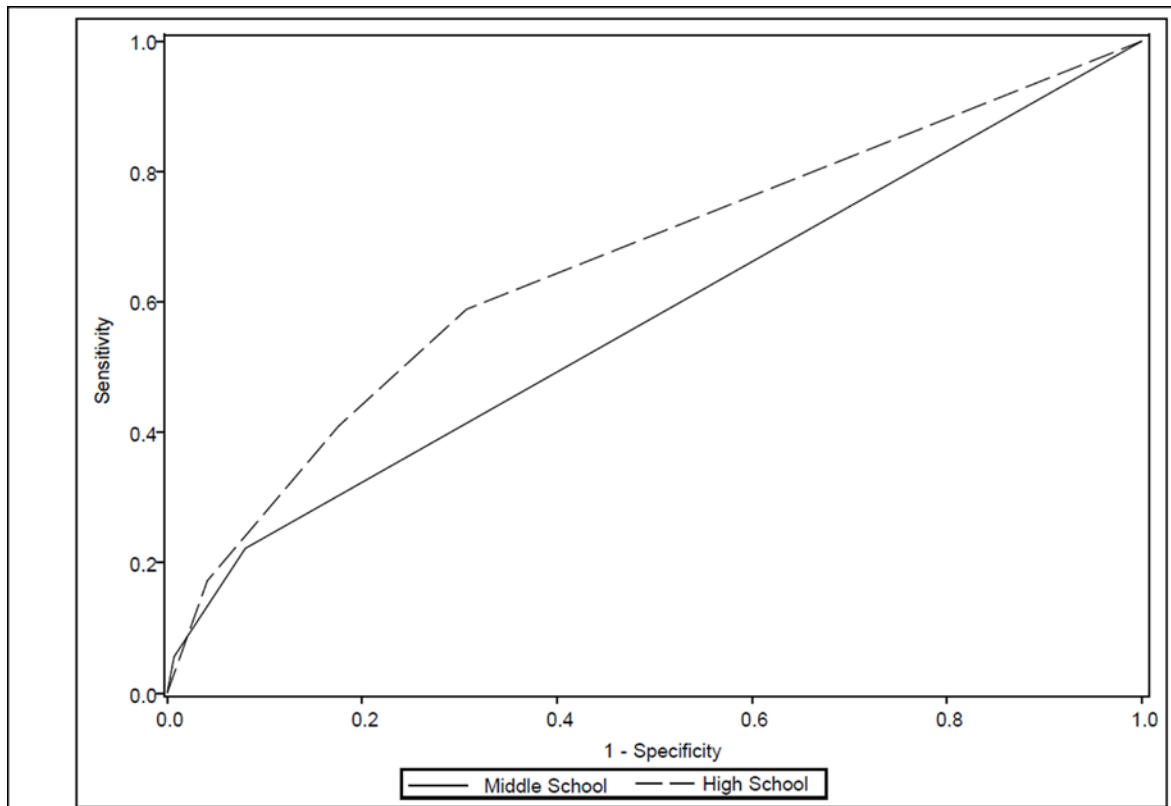
DSM-5 CUD		Test characteristic (% (95% CI))		AUC
Age Group	Predict positive outcome if NIAAA risk category is \geq	Sensitivity	Specificity	
Middle school	Non-drinker	100.0 (100.0, 100.0)	0.0 (0.0, 0.0)	0.766
Middle school	Moderate risk	60.3 (42.5, 78.1)	91.3 (90.0, 92.6)	
Middle school	High risk	23.9 (8.4, 39.5)	99.2 (98.7, 99.6)	
High school	Non-drinker	100.0 (100.0, 100.0)	0.0 (0.0, 0.0)	0.784
High school	Lower risk	81.7 (77.0, 86.5)	70.4 (68.6, 72.1)	
High school	Moderate risk	55.5 (49.5, 61.5)	82.9 (81.5, 84.3)	
High school	High risk	25.9 (20.6, 31.2)	96.2 (95.5, 96.9)	

Figure 1: ROC analyses predicting DSM-5 diagnosis of CUD using the NIAAA two-question screen risk categories by middle school and high school youth



Ever smoked a cigarette		Test characteristic (% (95% CI))		AUC
Age Group	Predict positive outcome if NIAAA risk category is >=	Sensitivity	Specificity	
Middle school	Non-drinker	100.0 (100.0, 100.0)	0.0 (0.0, 0.0)	0.72
Middle school	Moderate risk	50.5 (41.4, 59.6)	93.2 (92.0, 94.4)	
Middle school	High risk	11.6 (5.7, 17.4)	99.5 (99.1, 99.8)	
High school	Non-drinker	100.0 (100.0, 100.0)	0.0 (0.0, 0.0)	0.73
High school	Lower risk	68.3 (64.6, 72.1)	74.1 (72.4, 75.9)	
High school	Moderate risk	45.2 (41.2, 49.2)	85.5 (84.1, 87.0)	
High school	High risk	19.6 (16.4, 22.8)	97.6 (97.0, 98.2)	

Figure 2:
ROC analyses predicting lifetime cigarette use according to NIAAA two-question screen risk categories by middle school and high school youth



Any drug use (whole life)		Test characteristic (% (95% CI))		AUC
Age Group	Predict positive outcome if NIAAA risk category is >=	Sensitivity	Specificity	
Middle school	Non-drinker	100.0 (100.0, 100.0)	0.0 (0.0, 0.0)	0.572
Middle school	Moderate risk	22.2 (16.4, 28.0)	92.0 (90.7, 93.3)	
Middle school	High risk	5.6 (2.4, 8.8)	99.3 (98.9, 99.7)	
High school	Non-drinker	100.0 (100.0, 100.0)	0.0 (0.0, 0.0)	0.659
High school	Lower risk	58.9 (54.0, 63.8)	69.3 (67.5, 71.1)	
High school	Moderate risk	40.9 (36.1, 45.8)	82.4 (81.0, 83.9)	
High school	High risk	17.2 (13.5, 20.9)	95.9 (95.1, 96.6)	

Note: Any drug use; does not include cannabis use or tobacco use.

Figure 3: ROC analyses predicting any lifetime drug use according to NIAAA two-question screen risk categories by middle school and high school youth

Table 1:

NIAAA two-question screen questions

High School:

1. In the past year, on how many days have you had more than a few sips of beer, wine or any drink containing alcohol?
2. If your friends drink, how many drinks do they usually drink on an occasion?

Middle School:

1. Do you have any friends who drank beer, wine or any drink containing alcohol in the past year?
 2. How about you-in the past year, on how many days have you had more than a few sips of beer, wine or any drink containing alcohol?
-

Age	1-5 days	6-11 days	12-23 days	24-51 days	52+days
12-15 years	Moderate	High			
16 years	Lower	Moderate	High		
17 years	Lower	Moderate		High	

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Table 2:

Demographics by CUD Diagnosis, Lifetime Tobacco Use and Other Drug Use Categories

	DSM-5 CUD		Ever smoked a cigarette		Any other drug use (lifetime)	
	Positive	Negative	Yes	No	Yes	No
Age (years, mean \pm SD)	15.8 \pm 1.2	14.4 \pm 1.6	15.4 \pm 1.4	14.3 \pm 1.6	14.7 \pm 1.7	14.5 \pm 1.7
Age group						
Middle school	32 (1.7%)	1833 (98.3%)	118 (6.3%)	1747 (93.7%)	201 (10.8%)	1664 (89.2%)
High school	276 (9.3%)	2693 (90.7%)	600 (20.2%)	2369 (79.8%)	395 (13.3%)	2574 (86.7%)
Sex						
Male	148 (6.8%)	2029 (93.2%)	274 (12.6%)	1903 (87.4%)	272 (12.5%)	1905 (87.5%)
Female	160 (6.0%)	2497 (94.0%)	443 (16.7%)	2214 (83.3%)	324 (12.2%)	2333 (87.8%)
Race						
American Indian/Alaska Native	9 (8.2%)	103 (91.8%)	19 (17.2%)	93 (82.8%)	12 (10.5%)	100 (89.5%)
Asian	4 (5.5%)	69 (94.5%)	7 (9.3%)	66 (90.7%)	8 (11.5%)	65 (88.5%)
Black	106 (7.0%)	1418 (93.0%)	185 (12.1%)	1339 (87.9%)	206 (13.5%)	1318 (86.5%)
Native Hawaiian or other Pacific Islander	5 (9.8%)	48 (90.2%)	8 (15.0%)	45 (85.0%)	9 (17.8%)	44 (82.2%)
White	149 (5.7%)	2481 (94.3%)	408 (15.5%)	2222 (84.5%)	291 (11.1%)	2339 (88.9%)
More than one race	34 (7.8%)	408 (92.2%)	91 (20.6%)	351 (79.4%)	69 (15.6%)	373 (84.4%)
Ethnicity						
Hispanic or Latino	89 (6.9%)	1212 (93.1%)	198 (15.2%)	1103 (84.8%)	184 (14.1%)	1117 (85.9%)
Not Hispanic or Latino	218 (6.2%)	3315 (93.8%)	520 (14.7%)	3013 (85.3%)	412 (11.7%)	3121 (88.3%)

Note: DSM-5= Diagnostic and Statistical Manual of Mental Disorders; CUD = Cannabis Use Disorder; any drug use does not include cannabis use or tobacco use.

Table 3:

CUD Diagnosis, Lifetime Tobacco Use, and Other Drug Use Trends by NIAAA Risk Category

	Overall	NIAAA risk category				P-value
		Non-drinker	Lower risk	Moderate risk	High risk	
N	4834	3633	409	595	197	
DSM-5 CUD	307 (6.4%)	63 (1.7%)	72 (17.7%)	93 (15.7%)	79 (40.1%)	<0.001
Ever smoked a cigarette	718 (14.8%)	248 (6.8%)	139 (33.9%)	200 (33.5%)	131 (66.6%)	<0.001
DUQ: Has ever used cocaine	255 (5.3%)	178 (4.9%)	18 (4.4%)	43 (7.2%)	16 (8.3%)	0.007
DUQ: Has ever used crystal meth	66 (1.4%)	47 (1.3%)	5 (1.2%)	12 (2.0%)	2 (1.0%)	0.48
DUQ: Has ever used LSD	79 (1.6%)	34 (0.9%)	11 (2.6%)	19 (3.3%)	15 (7.6%)	<0.001
DUQ: Has ever used PCP	41 (0.8%)	29 (0.8%)	2 (0.6%)	9 (1.5%)	1 (0.5%)	0.38
DUQ: Has ever used K2	165 (3.4%)	53 (1.4%)	27 (6.7%)	46 (7.8%)	39 (19.6%)	<0.001
DUQ: Has ever used inhalants	96 (2.0%)	44 (1.2%)	9 (2.2%)	28 (4.8%)	15 (7.6%)	<0.001
DUQ: Has ever used opiates	49 (1.0%)	25 (0.7%)	4 (1.0%)	10 (1.7%)	10 (5.1%)	<0.001
DUQ: Has ever used prescription medications	193 (4.0%)	64 (1.8%)	42 (10.2%)	38 (6.5%)	48 (24.6%)	<0.001
DUQ: Has ever used other drugs	55 (1.1%)	9 (0.3%)	13 (3.3%)	17 (2.8%)	16 (7.9%)	<0.001
Any drug use (whole life)	596 (12.3%)	319 (8.8%)	71 (17.3%)	127 (21.3%)	79 (40.2%)	<0.001

Note: Displayed p-values are from the Cochran-Armitage test for trend pooled over the imputed data; CUD = Cannabis Use Disorder; any drug use does not include cannabis use or tobacco use; DUQ=Drug Use Questionnaire; K2=synthetic cannabinoids; PCP=phencyclidine; LSD=lysergic acid diethylamide.