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Adolescent Alcohol Use Predicts Cannabis Use over a Three Year Follow-up Period

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Abstract

Background: Alcohol and cannabis use frequently co-occur, which can result in problems from social and academic impairment to dependence (i.e., alcohol use disorder [AUD] and/or cannabis use disorder [CUD]). The Emergency Department (ED) is an excellent site to identify adolescents with alcohol misuse, conduct a brief intervention, and refer to treatment; however, given time constraints, alcohol use may be the only substance assessed due to its common role in unintentional injury. The current study, a secondary data analysis, assessed the relationship between adolescent alcohol and cannabis use by examining the National Institute of Alcohol Abuse and Alcoholism (NIAAA) two question screen's (2QS) ability to predict future CUD at one, two, and three years post-ED visit.

Methods: At baseline, data was collected via tablet self-report surveys from medically and behaviorally stable adolescents 12–17 years old (n=1,689) treated in 16 pediatric EDs for non-life-threatening injury, illness, or mental health condition. Follow-up surveys were completed via telephone or web-based survey. Logistic regression compared CUD diagnosis odds at one, two, or three-year follow-up between levels constituting a single-level change in baseline risk categorization on the NIAAA 2QS (nondrinker versus low-risk, low- versus moderate-risk, moderate- versus high-risk). Receiver operating characteristic curve methods examined the predictive ability of the baseline NIAAA 2QS cut points for CUD at one, two, or three-year follow-up.

Results: Adolescents with low alcohol risk had significantly higher rates of CUD versus non-drinkers (OR range: 1.94–2.76, $p < .0001$). For low and moderate alcohol risk, there was no difference in CUD rates (OR range: 1.00–1.08). CUD rates were higher in adolescents with high alcohol risk versus moderate risk (OR range: 2.39–4.81, $p < .05$).

Conclusions: Even low levels of baseline alcohol use are associated with risk for a later CUD. The NIAAA 2QS is an appropriate assessment measure to gauge risk for future cannabis use.

Keywords

alcohol; cannabis; adolescents; emergency department; screening

Introduction

Based on data from the nationally representative Monitoring the Future Study, alcohol is one of the most frequently used substances by adolescents[1], and in the past few years there have been significant increases in cannabis use (vaping, daily use amongst 8th and 10th graders)[2], with rates remaining stable in 2020[1]. Early alcohol use is associated with future negative consequences including other substance use, risky sexual behaviors, and other high-risk behaviors[3], highlighting a need for early alcohol use identification. The co-occurrence of alcohol use and cannabis use is also well-documented[4,5], and alcohol use disorder (AUD) is the most common substance use comorbidity for those with cannabis use disorder (CUD)[6].

Because the pediatric emergency department (ED) is the sole source of medical care for many adolescents and the ED is recognized as a key point of intervention for substance misuse[7], the ED is an excellent site in which to identify adolescents with alcohol misuse, conduct a brief intervention, and refer to treatment as indicated. In the United States between 2010 and 2013, among patients 12–20 years old, there were 517,800 ED visits for alcohol misuse only (without any co-occurring medical or injury problem), and 139,028 alcohol and drug misuse-related ED visits[8]. Co-use appears associated with more risk, as individuals 12 years and older with CUD and AUD had higher odds of past-year ED admission and inpatient hospitalization compared to those with only CUD in an analysis of the National Surveys on Drug Use and Health[9]. This co-occurrence highlights that when adolescents are seen in the ED for an alcohol-related incident, there is a high likelihood that they are concurrently using cannabis. However, there are barriers to brief screening and interventions for substance misuse in the ED (e.g., time, staff knowledge[10]), alcohol is commonly involved in unintentional injury[11], and alcohol is the only substance for which there is a screening policy by the American College of Emergency Physicians[12]. Consequently, adolescents may be less likely to be assessed for co-use during an ED visit.

Alcohol use itself, not rising to the level of a disorder, may also be associated with the co-occurrence of cannabis use and CUDs. An alcohol screening study, using the NIAAA two question screen (NIAAA 2QS[13]), conducted in 16 US Pediatric Emergency Care Applied Research Network (PECARN) pediatric EDs found that 25% of adolescent PED patients reported past year alcohol use[14] and that the NIAAA 2QS identified both current AUD[13] and future AUD[15]. Cross-sectional data[16] also found that any self-reported alcohol use in the past year was significantly associated with a CUD and the association was stronger for high school students than middle school students. This association was also found across gender, ethnicity and race[16]. The purpose of the present study was to determine whether this common co-occurrence of alcohol and cannabis use in adolescence[17] held longitudinally such that alcohol use could predict future cannabis use. In order to test this question, we

examined whether self-reported alcohol use on the NIAAA 2QS at an initial ED visit would predict CUDs at one, two and three years after the PED visit.

Methods

This study presents secondary analyses from a parent study that examined the predictive validity of the NIAAA 2QS across 16 PEDs nationwide[13]. Eligible participants were medically and behaviorally stable adolescents 12–17 years old treated in one of the 16 participating PEDs for a non-life-threatening injury, illness, or mental health condition. Exclusion criteria included: those not accompanied by an adult qualified to give written consent for the adolescent's participation in the study, parents or adolescents unable to read and speak English or Spanish, or those lacking a telephone or an address of residence. Institutional Review Board approval was obtained at all sites prior to study enrollment. Study staff approached eligible adolescents and their parent(s); to enroll, they provided written assent and written parental permission, respectively. Participants were enrolled from May 2013 to June 2015, and the last follow-ups were completed in March 2018.

Adolescents enrolled in the study completed a web-based baseline assessment consisting of the NIAAA 2QS, measures of other substance use, and other risk behavior measures. Assessments occurred on a tablet computer in adolescents' hospital room; parents were told information would be kept confidential. Details about methodology were previously reported[14]. The other instrument related to the analyses reported here was the CUD module of the Diagnostic Interview Schedule for Children (DISC[18]), a structured interview used to determine a range of DSM-5 psychiatric disorders. The DISC has been shown to have high sensitivity (0.73–1.00 for psychiatric disorders such as substance use disorder[18]).

At baseline, there were 4,834 participants who completed the alcohol screen during the PED visit, of which 4,714 completed the cannabis use DISC questions. A subsample of these participants was randomly selected for long-term follow-up; 2,147 adolescents were randomized to receive the assessment battery again at one- and two-year follow-up. At the two-year follow-up, participants were given the option of taking part in a three- year follow-up. All follow-ups were completed via telephone or web-based survey, based on patient preference. Of these, 1,689 adolescents completed the DISC cannabis questions for at least one follow-up timepoint. Baseline demographics for the sub-sample in the current study (n = 1,689) are similar to those previously described when reporting on main outcomes[14,15]. Nearly half of the sample identified as White, 24% identified as Black and just over one quarter identified as Hispanic. Participants received a $10 gift card for the baseline survey and a $25 gift card for each follow-up survey. Of the 2,147 selected, 1,511 (70%) were successfully contacted at 1-year follow-up and completed the DISC questions related to cannabis use. At 2- and 3-year follow-up, the numbers completing cannabis follow-up assessments were 1,485 (69%) and 1,286 (60%), respectively. In total, 1,689 (79%) participants completed the DISC cannabis questions for at least one of the follow-up times.

Statistical Analysis

First, we used logistic regression models (Wald test) to compare the odds of a DISC diagnosis of CUD at 1-, 2-, or 3-year follow-up between levels constituting a single-level change in baseline risk categorization outlined in the NIAAA 2QS manual (nondrinker versus low-risk, low- versus moderate-risk, and moderate- versus high-risk). Next, we used receiver operating characteristic (ROC) curve methods to examine the predictive ability at various cut points of the baseline alcohol screen for CUD at 1-, 2-, or 3-year follow-up. We calculated sensitivity and specificity to estimate the probability that the alcohol screen appropriately categorized participants with a DISC diagnosis of CUD and the probability that the alcohol screen appropriately categorized participants who did not have a DISC diagnosis of CUD. We defined the optimal cut point as the point with the highest sum of sensitivity and specificity. We calculated test characteristics at each potential cut point, and used the area under the curve (AUC) to provide an assessment of the overall predictive ability of the screen. We performed these analyses for each of the follow-up time points separately.

Results

CUD rates increased throughout the follow-up period from 6% at one-year follow-up to 7.6% at two- year follow-up and 10.3% at three-year follow-up. In Table 1, we present odds ratios for CUD diagnosis at one-, two-, and three- year follow-up as a function of baseline alcohol risk category derived from the alcohol screen.

Rates of CUD were significantly higher in those with low alcohol risk compared to non-drinkers. Similarly, CUD rates were higher in those with high alcohol risk compared to those with moderate risk. There was no difference in CUDs between those with low and moderate alcohol risk.

In Figure 1, we display the predictive ability of the NIAAA 2QS alcohol screen with reference to CUD diagnoses as ROC curves. Defining the point with the highest sum of sensitivity and specificity as optimal, we used “lower risk” and above as a cutoff for all 3 years. At this dichotomy, sensitivity is 69% (95% CI: 59%–78%) at 1 year, 67% (95% CI: 59%–76%) at 2 years, and 53% (95% CI: 44%–61%) at 3 years, with corresponding specificity of 81% (95% CI: 79%–83%) at 1 year, 82% (95% CI: 80%–84%) at 2 years, and 83% (95% CI: 80%–85%) at 3 years. Overall, the predictive ability was similar at 1-year and 2-year (AUC = 0.757 for both), but lower at 3 years (AUC 0.687).

Discussion

Taken together, these findings support the notion of the strong relationship between alcohol and cannabis use across adolescent development. The findings with respect to levels of drinking and use of cannabis across adolescence are interesting. Low risk for alcohol use was related to cannabis use over the three-year follow-up period, particularly at one and two years. Thus, someone who is low risk for an AUD is not necessarily at low risk for a CUD. Along those lines, it is notable that we found no difference in the odds of CUD diagnosis between individuals categorized at baseline as low- or moderate-risk for alcohol problems.

That is, a change in baseline NIAAA 2QS risk category from low to moderate does not predict a significant difference in odds of a CUD diagnosis from baseline to three years later. Taken together with the sensitivity and specificity findings discussed below, any alcohol use in the past year increases the odds for meeting criteria for a CUD diagnosis one to three years later among adolescents receiving pediatric ED services. This investigation extends the cross-sectional finding that any drinking in the past year is associated with increased odds of a CUD at baseline[16] to one, two, and three-year follow-up time periods.

The current study also demonstrates that the NIAAA 2QS has reasonable sensitivity and specificity with respect to predicting CUD. The predictive power is highest at one- to two-year follow-up and diminishes at the 3-year follow-up. The best combined sensitivity and specificity was achieved using the “lower risk” category of the NIAAA 2QS and above as a cutoff for prediction of a DSM-5 CUD diagnosis. This finding suggests that even when adolescents report low alcohol use, it is equally important to ask about cannabis use[19]. It is also notable that the sensitivity of the NIAAA 2QS for CUD in this study was superior to that of a prior study that used a specific question intended for use in screening for cannabis use, “In the past year, how often have you used cannabis: 0 to 1 time, ≥2 times?”[19]. Sensitivity for that question was 60.9%, 52.3% and 34.1% at one, two and three years, respectively[19]. Thus, it may be that a combination of a specific cannabis use question with an alcohol use question would be better able to predict subsequent cannabis use than either a cannabis or alcohol use question alone.

This study had some important limitations. First, this is a secondary analysis of a parent study not designed to answer this specific research question. Second, follow-up rates ranged from 70% in year one to 60% in year three. It is possible that those lost to follow-up may have had different rates of CUD than those included in this sample. Third, this large sample is derived from urban academic EDs and may not be representative of all youth nationwide. Fourth, although these data were collected at a time when few states had yet legalized recreational cannabis use, geographic location could substantially affect cannabis use rates between states that have and have not legalized recreational cannabis use. Lastly, to ensure patient confidentiality, screening was self-administered for this study. This is not necessarily a limitation, but findings may have differed had the screening been administered by a clinician.

Despite these limitations, this study demonstrates that a simple alcohol screen may provide some valuable information on future risk of a CUD diagnosis for youth seen in EDs. Future research might study the combined specificity and sensitivity of alcohol and cannabis screening to determine future risk for both problematic alcohol and cannabis use. Also, a study evaluating the factors that make adolescents presenting to the ED potentially at greater risk for co-use than the general population would be of interest and could inform prevention and early intervention efforts.

Conflicts of Interest and Source of Funding:

Funding sources:

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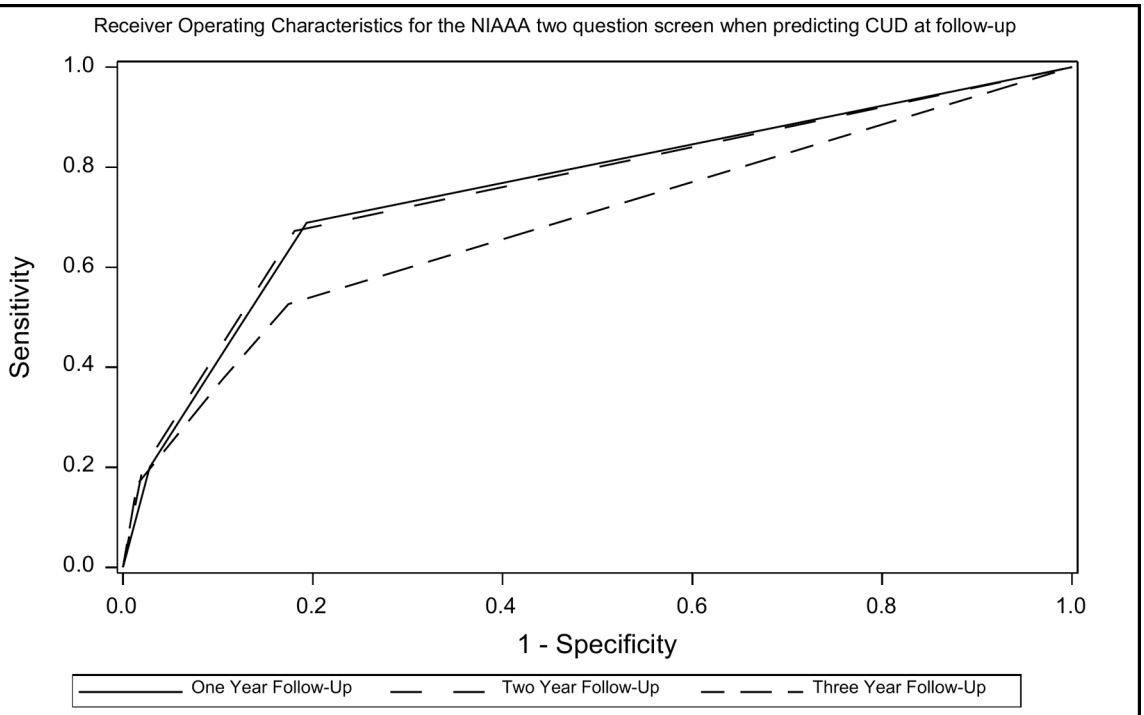

Group	Category	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	AUC
One Year Follow-Up	≥ Non-drinker	1.000 (1.00, 1.00)	0.000 (0.00, 0.00)	0.060 (0.05, 0.07)	0.000 (0.00, 1.00)	0.757
	≥ Lower risk	0.689 (0.59, 0.78)	0.806 (0.79, 0.83)	0.184 (0.14, 0.23)	0.976 (0.97, 0.98)	
	≥ Moderate risk	0.478 (0.37, 0.58)	0.878 (0.86, 0.90)	0.199 (0.15, 0.25)	0.964 (0.95, 0.97)	
	≥ High risk	0.200 (0.12, 0.28)	0.972 (0.96, 0.98)	0.310 (0.19, 0.43)	0.950 (0.94, 0.96)	
	> High risk	0.000 (0.00, 0.00)	1.000 (1.00, 1.00)	0.000 (0.00, 1.00)	0.940 (0.93, 0.95)	
Two Year Follow-Up	≥ Non-drinker	1.000 (1.00, 1.00)	0.000 (0.00, 0.00)	0.076 (0.06, 0.09)	0.000 (0.00, 1.00)	0.757
	≥ Lower risk	0.673 (0.59, 0.76)	0.819 (0.80, 0.84)	0.235 (0.19, 0.28)	0.968 (0.96, 0.98)	
	≥ Moderate risk	0.460 (0.37, 0.55)	0.891 (0.87, 0.91)	0.257 (0.20, 0.32)	0.952 (0.94, 0.96)	
	≥ High risk	0.195 (0.12, 0.27)	0.980 (0.97, 0.99)	0.440 (0.30, 0.58)	0.937 (0.92, 0.95)	
	> High risk	0.000 (0.00, 0.00)	1.000 (1.00, 1.00)	0.000 (0.00, 1.00)	0.924 (0.91, 0.94)	
Three Year Follow-Up	≥ Non-drinker	1.000 (1.00, 1.00)	0.000 (0.00, 0.00)	0.103 (0.09, 0.12)	0.000 (0.00, 1.00)	0.687
	≥ Lower risk	0.526 (0.44, 0.61)	0.826 (0.80, 0.85)	0.258 (0.21, 0.31)	0.938 (0.92, 0.95)	
	≥ Moderate risk	0.376 (0.29, 0.46)	0.895 (0.88, 0.91)	0.292 (0.22, 0.36)	0.926 (0.91, 0.94)	
	≥ High risk	0.165 (0.10, 0.23)	0.985 (0.98, 0.99)	0.564 (0.41, 0.72)	0.911 (0.90, 0.93)	
	> High risk	0.000 (0.00, 0.00)	1.000 (1.00, 1.00)	0.000 (0.00, 1.00)	0.897 (0.88, 0.91)	

Figure 1:

CUD = cannabis use disorder; PPV = positive predictive value; NPV = negative predictive value; AUC = area under the curve

Table 1.

Distribution of Cannabis Use Disorder (CUD) at Baseline and Follow-up categorized by NIAAA Two-Question Screen (2QS) Baseline Risk Assessment

	CUD baseline			CUD 1 year			CUD 2 year			CUD 3 year		
Baseline NIAAA Risk	**Yes**	**OR (95% CI)**	***p***	**Yes**	**OR (95% CI)**	***p***	**Yes**	**OR (95% CI)**	***p***	**Yes**	**OR (95% CI)**	***p***
Non-drinker	16/1307 (1.2%)	--	--	28/1174 (2.4%)	--	--	37/1161 (3.2%)	--	--	63/1015 (6.2%)	--	--
Lower risk	21/139 (15.1%)	3.79 (2.70, 5.32)	<.0001	19/121 (15.7%)	2.76 (2.03, 3.76)	<.0001	24/122 (19.7%)	2.73 (2.07, 3.60)	<.0001	20/100 (20.0%)	1.94 (1.47, 2.56)	<.0001
Moderate risk	20/180 (11.1%)	0.70 (0.36, 1.35)	.2918	25/158 (15.8%)	1.01 (0.53, 1.93)	.9782	30/152 (19.7%)	1.00 (0.55, 1.83)	.9893	28/132 (21.2%)	1.08 (0.57, 2.05)	.8214
High risk	21/63 (33.3%)	4.00 (1.99, 8.06)	.0001	18/58 (31.0%)	2.39 (1.19, 4.83)	.0147	22/50 (44.0%)	3.20 (1.61, 6.35)	.0009	22/39 (56.4%)	4.81 (2.25, 10.26)	<.0001

Notes. OR=odds ratio; NIAAA=National Institute of Alcohol Abuse and Alcoholism.

The displayed *p*-values are based on a logistic regression model comparing the odds of CUD diagnosis between those of a given NIAAA risk assessment to those with the next lowest risk assessment.