

# Substance Use Among Adolescents with Attention-Deficit/Hyperactivity Disorder: Reasons for Use, Knowledge of Risks, and Provider Messaging/Education

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**ABSTRACT:** *Objective:* Adolescents with attention-deficit/hyperactivity disorder (ADHD) are at increased risk for alcohol and marijuana use. This study's objective is to describe adolescents' ADHD-specific reasons for marijuana use, knowledge of ADHD-specific alcohol risks, and reported subspecialty provider messaging/education regarding alcohol use among adolescents with ADHD. *Methods:* Youths with ADHD aged 12 to 18 years completed a survey about alcohol and marijuana use, ADHD-specific reasons for marijuana use, knowledge of ADHD-specific alcohol risks, and reported provider messaging/education regarding alcohol use. We assessed knowledge toward substance use using descriptive statistics. We used  $\chi^2$  and *t* tests to determine whether knowledge or provider messaging/education differed by sociodemographic characteristics. *Results:* Of the 96 participants, 61.5% were male, average age was 15.7 years; 31.3% reported past-year alcohol use and 20.8% reported past-year marijuana use. The majority (65.2%) said "no/don't know" to both "Can alcohol make ADHD symptoms worse?" and "Can alcohol interfere or get in the way of the medications you take?" Older participants were more likely to correctly answer the medication question "yes." Despite most (74%) participants reporting that their provider asked about alcohol use, few youth reported that their providers gave specific messages/education that alcohol could make ADHD symptoms worse (9.4%) or interfere with ADHD medications (14.6%); older participants and past-year alcohol users were more likely to have received these alcohol-specific messages. *Conclusion:* Many youth with ADHD are unaware of the risks of alcohol use in relation to ADHD and providers are not consistently discussing these risks in the context of clinical ADHD care.

(*J Dev Behav Pediatr* 38:417–423, 2017) **Index terms:** ADHD, substance use, alcohol, marijuana, provider counseling, adolescents.

**A**ttention-deficit/hyperactivity disorder (ADHD) impacts 8% (approximately 4 million) of school-aged children<sup>1</sup> in the United States and often persists into adulthood.<sup>2</sup> Youth with ADHD initiate alcohol and other substance use earlier,<sup>3</sup> and are more vulnerable to developing substance use disorders (SUDs) once exposed.<sup>4,5</sup> Early onset SUD increases the likelihood of academic failure, suicidal behavior, and incarceration.<sup>6,7</sup> The use of alcohol, marijuana, and other illicit substances by youth with ADHD may contribute to and accelerate negative psychiatric and psychosocial consequences. Alcohol use is also associated with treatment

nonadherence in youth with chronic medical conditions.<sup>8</sup> Considering these numerous risks, substance use screening is particularly important for youth with ADHD. Screening and subsequent counseling about ADHD-specific substance use risks could help ameliorate the risk of negative outcomes in ADHD.

Stimulant medications are the first-line medication treatment recommended for ADHD, and alpha<sub>2</sub> agonist medications and atomoxetine also have U.S. Food and Drug Administration approval for treatment.<sup>9</sup> All of these medications have risks when used in combination with marijuana or alcohol. Marijuana use is associated with loss of concentration and challenges with short-term memory<sup>10</sup>; thus, it may counter the positive benefits of a medication used to treat ADHD symptoms. The combination of marijuana and stimulant medication is associated with increases in peak heart rate and subjective effects, and slower reaction times, compared with the use of either substance alone.<sup>11</sup> Alcohol may enhance the adverse/toxic effects of stimulants,<sup>12</sup> increase risk of central nervous system depression in combination with alpha<sub>2</sub> agonists, and could result in temporary liver impairment which would contraindicate the use of atomoxetine.<sup>13</sup> Given these risks, adolescents with ADHD

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should be informed about the possible dangerous outcomes of using ADHD medications in combination with alcohol, marijuana, and/or illicit drugs.

However, to our knowledge, there are no published studies describing either ADHD youths' knowledge about dangers of substance use or substance use messages/education used by their physicians. As such, we sought to describe adolescents' ADHD-specific reasons for marijuana use and knowledge of ADHD-specific alcohol risks, as well as youth-reported screening and messaging/education regarding alcohol use by their subspecialty providers.

## METHODS

### Study Design and Sample

This was a cross-sectional study, in which we recruited from an outpatient developmental medicine subspecialty clinic affiliated with a large pediatric teaching hospital in the Northeast United States, a convenience sample of 96 English-speaking youth, aged 12 to 18 years who had been diagnosed with attention-deficit/hyperactivity disorder (ADHD) for at least 1 year. Patients who were medically or emotionally unstable on the day of the clinic visit were excluded. We obtained a certificate of confidentiality for this study and assented youth with a waiver of parental consent under the approval of our hospital's Institutional Review Board.

In total, 99 youth enrolled in this study of 137 invited (response rate 72.3%). Of these 99, 2 were excluded because of active mental health issues on the day of the visit and one subject was excluded because of missing responses for the outcome variables; thus, the final analytic sample consisted of 96 participants.

### Assessment

In the waiting room, assented youth completed a self-administered survey about: (1) alcohol and marijuana use behaviors (up to 11 items, sample, "In the past year, on how many days have you used marijuana?"), (2) ADHD-specific reasons for marijuana use (2 items asked to participants who had reported marijuana use, "When you used marijuana in the past year, how often did you use it because you thought it would make your ADHD symptoms better or help with medication side effects?" and "When you used marijuana in the past year, how often did you choose it instead of alcohol because you thought alcohol was worse for your ADHD?"), (3) knowledge of ADHD-specific alcohol risks (2 items, "Can alcohol make ADHD symptoms worse?" and "Can alcohol interfere with or get in the way of the medications you take?"; both with answer choices of "yes," "no," or "don't know" which, given cell size numbers, were dichotomized to yes vs no/do not know for this study), (4) reported provider screening and messaging/education regarding alcohol use (5 items, "In the past year, did your doctor or a member of your health care team ask you if you drink alcohol?"), and (5) sociodemographic and

health information (including gender, age, grade, race/ethnicity, and mental health). Surveys were completed on a tablet computer with a polarizing screen for privacy and an optional audio recording of the assessment. The assessment was 57 to 281 questions in length, contingent on responses to programmed skip logic.

Past-year alcohol and marijuana use were dichotomized (any vs none). Responses to questions about knowledge of risks associated with alcohol use were dichotomized as "yes" versus "no" and "don't know." To assess mental health status, we used the validated 5-question scale from the Mental Health Inventory (MHI-5) of the Short Form-36 (SF-36)<sup>14</sup>; responses were transformed to a 100-point scale for analysis consistent with published reports.<sup>15</sup> High scores indicated better mental health with values <40 considered clinically relevant.

### Analytic Approach

All analyses were performed using Statistical Analysis System 9.3. We calculated prevalence of alcohol and marijuana use behaviors and attitudes toward marijuana use among the whole sample and assessed differences in sociodemographics by substance use and knowledge using *t* tests and  $\chi^2$  analyses. We calculated the percentage of participants who reported that their health care provider had asked whether they drink alcohol and the percentage of participants who reported that their health care provider discussed specific messages about alcohol use. *T* tests and  $\chi^2$  analyses were used to assess differences in receipt of specific messages from providers by age, gender, race/ethnicity, past-year drinking status, and medication status.

## RESULTS

### Demographics and Reported Substance Use Patterns

The mean age was 15.7 years (SD = 1.7), 61.5% were male, and race/ethnicity was predominantly white (78.1%). Most participants (N = 90) achieved a mental health score above the clinically significant range, indicating overall good mental health functioning (range 24.0–100.0; score <40 indicates concern). A total of 81 participants (84.4%) were taking medication for their attention-deficit/hyperactivity disorder (ADHD) with 73 taking stimulant medication (76.0%), 15 taking alpha<sub>2</sub> agonist medications (15.6%), and 4 taking atomoxetine (4.2%).

Past-year alcohol use was reported by 31.3% of the sample, and past-year binge drinking was reported by 16.7% of past-year alcohol users. Average age at first alcohol use was 14.9 years (SD = 2.1). Past-year marijuana use was reported by 20.8% of the sample. Average age at first marijuana use was 14.7 years (SD = 1.2). Of the 20 participants who reported past-year marijuana use, the majority (85%) also reported past-year alcohol use. Respondents who reported past-year alcohol and marijuana use were older on average than nonusers (16.7

years vs 15.3 years,  $p < .0001$ ; 16.7 years vs 15.5 years,  $p = .0002$ , respectively). Gender, race, and mental health score were not associated with substance use patterns (Table 1).

### Attention-Deficit/Hyperactivity Disorder-Specific Reasons for Marijuana Use

Most (61%) participants reporting past-year marijuana use endorsed that they “thought it would make [their] ADHD symptoms better or help with medication side effects.” Over half (56%) of the participants endorsed choosing marijuana “instead of alcohol because [they] thought alcohol was worse for [their] ADHD” (Fig. 1).

### Knowledge of Attention-Deficit/Hyperactivity Disorder-Specific Alcohol Risks

Most (62.5%) participants answered incorrectly (no/ do not know) when asked whether alcohol could make ADHD symptoms worse. Bivariate analyses found that age, gender, race/ethnicity, past-year alcohol use, and medication use were not significantly different between those who correctly identified that alcohol could make ADHD symptoms worse and those who answered incorrectly. The majority (62.5%) also incorrectly answered when asked whether alcohol could interfere with their medications. Older participants were more likely to correctly identify that alcohol interferes with their medications (16.3 years vs 15.4 years,  $p = .015$ ). Gender, race/ethnicity, past-year drinking status, and medication status were not significantly different across reported knowledge for this question (Table 2).

### Reported Provider Screening and Messaging/ Education Regarding Alcohol Use

Seventy-one participants (74%) reported that in the past year, their doctor or health care provider asked whether they drank alcohol. There was no statistically significant difference in likelihood of being asked about

past alcohol use for past-year drinkers versus non-drinkers (73.3% vs 74.2%,  $p$  value = .925). Only a minority of the participants reported that their health care provider discussed each of the following 4 specific messages about alcohol use: “alcohol use is not healthy” (27.1%), “alcohol use could make ADHD symptoms worse” (9.4%), “alcohol could interfere or get in the way of my medications” (14.6%), and “I should not drink at all or I should stop or cut down my drinking” (5.2%). Sixty-seven participants (69.8%) reported that they did not receive any of these 4 specific messages about alcohol use, whereas 15 (15.6%) participants reported receiving just one message, 5 participants (5.2%) reported receiving 2 messages, 7 (7.3%) reported receiving 3 messages, and 2 (2.1%) reported receiving all 4 of the messages. Bivariate analyses found that youth who were older and drank alcohol in the past year were more likely to report receiving each specific message about alcohol use (Table 3).

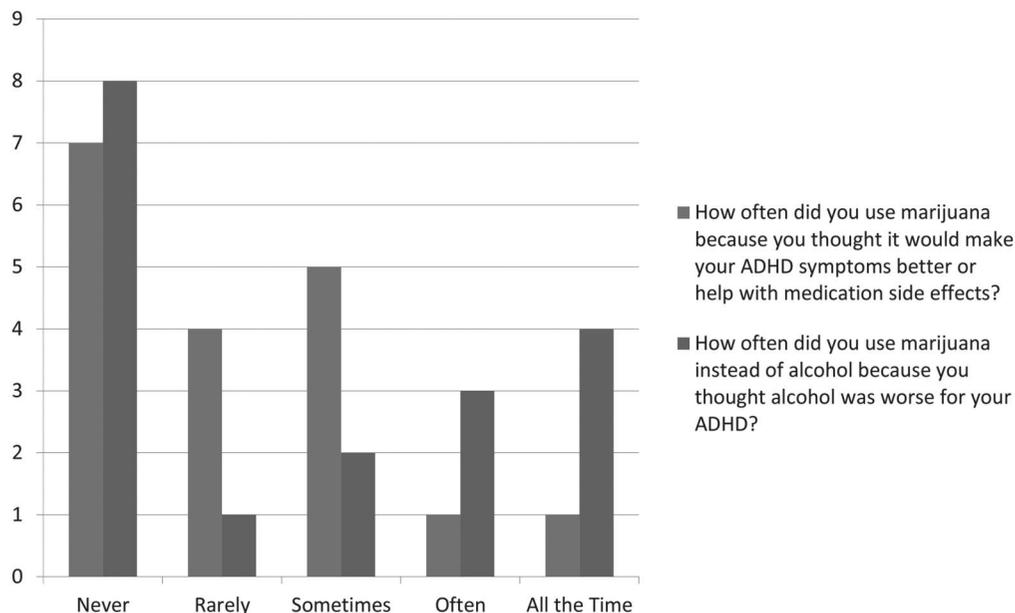
## DISCUSSION

This study reported on attention-deficit/hyperactivity disorder (ADHD)-specific reasons for marijuana use, knowledge of ADHD-specific alcohol risks, and reported provider screening and messaging/education regarding alcohol use among adolescents with ADHD. Past-year marijuana use was reported by 20.8% of the sample and many of these participants reportedly chose marijuana because they thought it would help with their ADHD symptoms or medication side effects, suggesting an under-appreciation of the risks of marijuana use. We found that most (62.5%) of the adolescents with ADHD in this study lacked knowledge about how alcohol can negatively impact ADHD symptoms and medication treatment. Despite most (74%) participants reporting that their provider asked about alcohol use in the past year, few participants received specific messages/education that alcohol could make ADHD symptoms worse

**Table 1.** Sample Sociodemographic Characteristics by Substance Use Status

Sociodemographic Characteristic	Total Sample (N = 96)	Past-Year Alcohol Use			Past-Year Marijuana Use		
		Any (N = 30)	None (N = 66)	$p^a$	Any (N = 20)	None (N = 76)	$p^a$
Age in years, mean (SD)	15.7 (1.7)	16.7 (1.2)	15.3 (1.7)	<.001 <sup>b</sup>	16.7 (1.0)	15.5 (1.8)	<.001 <sup>b</sup>
Gender <sup>c</sup>				.799			.715
Male	59 (61.5)	19 (63.3)	40 (60.6)		13 (65.0)	46 (60.5)	
Female	37 (38.5)	11 (36.7)	26 (39.4)		7 (35.0)	30 (39.5)	
Race/ethnicity <sup>c</sup>				.405			.064
White, non-Hispanic	75 (78.1)	25 (83.3)	50 (75.8)		19 (95.0)	56 (73.7)	
Other	21 (21.9)	5 (16.7)	16 (24.2)		1 (5.0)	20 (26.3)	
Mental health score <sup>c</sup> , Mean (SD)	67.4 (18.6)	64 (16.1)	69 (19.6)	.229 <sup>b</sup>	62.6 (17.9)	68.7 (18.7)	.196 <sup>b</sup>
Past-year binge drinking, N (%)	5 (5.2)	5 (16.7)	0	—	—	—	—
Age in years at use onset, mean (SD)	—	14.9 (2.1) (N = 35) <sup>d</sup>	—	—	14.7 (1.2) (N = 21) <sup>d</sup>	—	—

Shaded cells indicate that the  $p$  value is statistically significant ( $<.05$ ). <sup>a</sup> $p$ -value for  $\chi^2$  test, unless otherwise indicated. <sup>b</sup>Two-sample  $t$  test. <sup>c</sup>Data are presented as number  $n$  (column percent). <sup>d</sup>Some subjects who did not report past year alcohol/marijuana use did report an age at use onset given that they had a history of prior substance use.



**Figure 1.** Attention-deficit/hyperactivity disorder (ADHD)-specific reasons for marijuana use among past-year marijuana users. Figure shows the frequency distribution for participants' response about reasons for choosing marijuana, among past-year marijuana users who responded to these questions (N = 18). Of these past-year marijuana users, 61% (N = 11) reported ever using marijuana because they thought it would make their ADHD symptoms better or help with medication side effects, and 56% (N = 10) reported ever using marijuana instead of alcohol because they thought alcohol was worse for their ADHD.

(9.4%) or interfere with ADHD medications (14.6%). These findings highlight the need to educate youth with ADHD about their unique substance use risks. Incorporating education about ADHD-specific substance use risks into clinical ADHD care may fill a currently missing gap in care.

Despite current scientific research highlighting the unique risks of substance use among ADHD youth,<sup>8</sup> our study is the first to show that most adolescents with

ADHD may be unaware of these specific risks, as most participants were unaware of the negative impact alcohol use can have on ADHD symptoms and medications. Moreover, we identified that many participants endorsing marijuana use reported doing so because they thought it would make their ADHD symptoms better or help with medication side effects; this is very concerning given that adolescent marijuana use can result in impairments in executive functioning, a source of the

**Table 2.** Knowledge of Attention-Deficit/Hyperactivity Disorder (ADHD)-Specific Alcohol Use Risks by Sociodemographic Characteristics

Covariates	Can Alcohol Make ADHD Symptoms Worse?			Can Alcohol Interfere with Medications You Take?		
	Yes (n = 36)	No/Don't Know (n = 60)	<i>p</i> <sup>a</sup>	Yes (n = 36)	No/Don't Know (n = 60)	<i>p</i> <sup>a</sup>
Age in year, mean (SD)	16.0 (1.3)	15.6 (1.9)	.206 <sup>b</sup>	16.3 (1.4)	15.4 (1.81)	.015 <sup>b</sup>
Gender <sup>c</sup>			.213			.417
Male	25 (69.4)	34 (56.7)		24 (66.7)	35 (58.3)	
Female	11 (30.6)	26 (43.3)		12 (33.3)	25 (41.7)	
Race/ethnicity <sup>c</sup>			.339			.566
White, non-Hispanic	30 (83.3)	45 (75.0)		27 (75.0)	48 (80.0)	
Other	6 (16.7)	15 (25.0)		9 (25.0)	12 (20.0)	
Past-year alcohol use <sup>c</sup>			.909			.909
Any	11 (30.6)	19 (31.7)		11 (30.6)	19 (31.7)	
None	25 (69.4)	41 (68.3)		25 (69.4)	41 (68.3)	
ADHD medication use <sup>c</sup>			.156			.717
Any	33 (91.7)	48 (80.0)		31 (86.1)	50 (83.3)	
None	3 (8.3)	12 (20.0)		5 (13.9)	10 (16.7)	

Shaded cells indicate that the *p*-value is statistically significant (<0.05). <sup>a</sup>*p* value for  $\chi^2$  test, unless otherwise indicated. <sup>b</sup>Two-sample *t* test. <sup>c</sup>Data are presented as number n (column percent). ADHD, attention deficit hyperactivity disorder.

**Table 3.** Health Care Provider Screening and Messaging/Education About Alcohol Use by Sociodemographic Characteristics

Reported Messages Received	Alcohol Use Is Not Healthy			Alcohol Use Could Make ADHD Symptoms Worse		
	Yes (n = 26)	No (n = 70)	<i>p</i> <sup>a</sup>	Yes (n = 9)	No (n = 87)	<i>p</i> <sup>a</sup>
Age in years, Mean (SD)	16.5 (0.99)	15.4 (1.82)	<.001 <sup>b</sup>	17.0 (0.87)	15.6 (1.7)	<.001 <sup>b</sup>
Gender <sup>c</sup>			.340			.736
Male	18 (69.2)	41 (58.6)		6 (66.7)	53 (60.9)	
Female	8 (30.8)	29 (41.4)		3 (33.3)	34 (39.1)	
Race/ethnicity <sup>c</sup>			.703			.095
White, non-Hispanic	21 (80.8)	54 (77.1)		9 (100.0)	66 (75.9)	
Other	5 (19.2)	16 (22.8)		0 (0.0)	21 (24.1)	
Past-year alcohol use <sup>c</sup>			<.001			.002
Any	16 (61.5)	14 (20.0)		7 (77.8)	23 (26.4)	
None	10 (38.5)	56 (80.0)		2 (22.2)	64 (73.5)	
ADHD medication use <sup>c</sup>			.502			.567
Any	23 (88.5)	58 (82.8)		7 (77.8)	74 (85.0)	
None	3 (11.5)	12 (17.1)		2 (22.2)	13 (14.9)	

Reported Messages Received	Alcohol Could Interfere with or Get in the Way of My Medications			I Should Not Drink at All or I Should Stop or Cut Down My Drinking		
	Yes (n = 14)	No (n = 82)	<i>p</i> <sup>a</sup>	Yes (n = 5)	No (N = 91)	<i>p</i> <sup>a</sup>
Age in years, Mean (SD)	16.8 (0.80)	15.6 (1.75)	<.001 <sup>b</sup>	16.6 (0.55)	15.7 (1.73)	.015 <sup>b</sup>
Gender <sup>c</sup>			.720			.382
Male	8 (57.1)	51 (62.2)		4 (80.0)	55 (60.4)	
Female	6 (42.8)	31 (37.8)		1 (20.0)	36 (39.5)	
Race/ethnicity <sup>c</sup>			.457			.314
White, non-Hispanic	12 (85.7)	63 (76.8)		3 (60.0)	72 (79.1)	
Other	2 (14.3)	19 (23.1)		2 (40.0)	19 (20.9)	
Past-year alcohol use <sup>c</sup>			<.001			<.001
Any	10 (71.4)	20 (24.4)		5 (100.0)	25 (27.5)	
None	4 (28.6)	62 (75.6)		0 (0.0)	66 (72.5)	
ADHD medication use <sup>c</sup>			.881			.782
Any	12 (85.7)	69 (84.1)		4 (80.0)	77 (84.6)	
None	2 (14.3)	13 (15.8)		1 (20.0)	14 (15.4)	

Shaded cells indicate that the *p* value is statistically significant (<0.05). <sup>a</sup>*p* value for  $\chi^2$  test, unless otherwise indicated. <sup>b</sup>Two-sample *t* test. <sup>c</sup>Data are presented as number n (column percent). ADHD, attention deficit hyperactivity disorder.

symptomatology in ADHD,<sup>16</sup> and cognitive skills later in adulthood.<sup>17,18</sup> Although older participants were more likely to know that alcohol can interfere with medications, they were not more likely to know that alcohol can make ADHD symptoms worse. The finding that gender, race/ethnicity, past-year drinking status, and medication status were not significantly different across knowledge of ADHD-specific alcohol risks indicates that although there may not be large disparities in knowledge within this sample, all groups were similarly unaware of important risks.

Our study showed that although both older age and reported past-year drinking for participants were associated with increased likelihood of receiving specific

information about alcohol harms/risks, the vast majority of participants did not receive specific messaging/education about the risk of alcohol making ADHD symptoms worse or interfering with medications. These findings highlight a missed educational opportunity. The mean age of participants who reported receiving specific messages/education from providers (16.5–17.0 years, depending on the message) was noticeably higher than the mean age of onset of alcohol use in the sample, which was 14.9 years. This discrepancy suggests that providers may be underestimating the prevalence of alcohol use among their younger patients with ADHD and highlights the need to educate youth with ADHD about specific alcohol risks at a younger age, ideally before

initiation of alcohol use. We also found that nearly 70% of youth did not receive any specific messages about alcohol use and only 15% reported receiving 2 or more messages from their providers. Although further research is needed to identify which messages are the most salient for youth and most likely to motivate behavior change, it is reasonable to speculate that providing tailored, specific messaging around alcohol use harms (i.e., alcohol use could make ADHD symptoms worse, alcohol could interfere with medications, etc.) may increase youths' knowledge about the tangible, ADHD-specific risks of substance use, and in turn motivate youth with ADHD to abstain or reduce their consumption. Additionally, future work can identify which, if any, specific provider messages about marijuana use are given to youth with ADHD. Identifying and validating ways to improve knowledge and awareness about substance use risk within clinical ADHD care is an important area for further research to prevent the negative outcomes of substance use and substance use disorders among individuals with ADHD.

The findings of this study must be interpreted in the context of a few limitations. Our sample size was relatively small and homogeneous with all participants recruited from one developmental subspecialty clinic. Our findings may not be generalizable to adolescents that receive care from their primary care physician, or to those from other geographic areas. Furthermore, we may have been underpowered to detect some differences in the outcomes by demographics. It is possible that participants in this study may represent a different type of patient with ADHD, given that they are already receiving subspecialty ADHD care, and knowledge about ADHD-specific substance use risks may differ in other populations. Participants did not provide information about current level of ADHD symptoms, thus we are unable to determine whether substance use varied by the level of ADHD symptoms reported. We did not collect information about comorbid conditions and most participants indicated overall good mental health functioning according to their scores of the MHI-5. It is possible that either the participants in this study had fewer comorbid mental health difficulties than expected for youth with ADHD or that self-report of mental health with a short screen did not adequately capture existing mental health problems. Rates of both alcohol and marijuana use were lower than those reported in the Multimodal Treatment of ADHD (MTA) study in which 47.0% reported past lifetime alcohol and 32.1% reported past lifetime marijuana use during the 8-year follow-up period.<sup>19</sup> Differences in age (participants in MTA were slightly older than youth in our sample) or in recall time (past-year for this study vs lifetime for MTA) may partially account for this discrepancy. Another limitation is that we ascertained health care provider screening practices and ADHD-specific messaging/education from the adolescent youth, rather than directly from observing clinical encounters or asking health care providers

themselves and it is possible that more information was delivered by providers than retained by participants. Nonetheless, the messages that the youths recall are likely to have the greatest impact on their behavior.

In conclusion, the results of this study suggest that incorporation of ADHD-specific substance use information in clinical practice could help to address gaps in knowledge about the risks of substance use for youth with ADHD.

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