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Adolescents' Prescription Stimulant Use and Adult Functional Outcomes: A National Prospective Study

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Abstract

Objective—To assess the prospective 17-year relationship between the medical and nonmedical use of prescription stimulants during adolescence (age 18) and educational attainment and substance use disorder (SUD) symptoms in adulthood (age 35).

Method—A survey was self-administered by nationally representative probability samples of U.S. high school seniors from the Monitoring the Future study; 8,362 of these individuals were followed longitudinally from adolescence (age 18, high school senior years of 1976–1996) to adulthood (age 35, 1993–2013).

Results—An estimated 8.1% reported medical use of prescription stimulants while 16.7% reported nonmedical use of prescription stimulants by age 18. Approximately 43% of adolescent medical users of prescription stimulants had also engaged in nonmedical use of prescription stimulants during adolescence. Among past-year adolescent nonmedical users of prescription stimulants, 97.3% had used at least one other substance during the past-year. Medical users of prescription stimulants without any history of nonmedical use during adolescence did not differ significantly from population controls (i.e., non-attention-deficit/hyperactivity disorder (ADHD)

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and non-stimulant medicated ADHD during adolescence) in educational attainment and SUD symptoms in adulthood. In contrast, adolescent nonmedical users of prescription stimulants (with or without medical use) had lower educational attainment and more SUD symptoms in adulthood, compared to population controls and medical users of prescription stimulants without nonmedical use during adolescence.

Conclusions—Nonmedical use of prescription stimulants is common among adolescents prescribed these medications. The findings indicate youth should be carefully monitored for nonmedical use because this behavior is associated with lower educational attainment and more SUD symptoms in adulthood.

INTRODUCTION

Despite the efficacy of stimulant medication as part of a multi-modal therapy for attention deficit hyperactivity disorder (ADHD), there are legitimate concerns associated with exposure to these medications. These concerns include increases in the nonmedical use of prescription stimulants among U.S. children and adolescents, high rates of stimulant diversion and medical misuse among prescribed users, and increases in adverse consequences related to the use of prescription stimulants.^{1–6} For instance, the estimated number of emergency department visits involving the use of ADHD prescription stimulants has steadily increased among those aged 18 and older from 13,379 visits in 2005 to 31,244 visits in 2010.⁵ To date, there are few data showing the long-term functional effects of stimulant medication taken in medical and nonmedical contexts.

Because more than one in every six U.S. adolescents has ever used prescription stimulants either medically or nonmedically,⁷ and approximately one in every four young adults develop a substance use disorder (SUD) involving alcohol or other drugs,^{8,9} an important question is the relationship between medical and nonmedical use of prescription stimulants during adolescence and subsequent SUD in adulthood. While clinical and epidemiological evidence in the U.S. suggests that early stimulant therapy does not increase the subsequent risk for SUD,^{10–16} the long-term associations between early stimulant medication therapy and subsequent SUDs have yet to be examined in large nationally representative samples in the U.S. followed prospectively from adolescence into adulthood. This is one emphasis of the present study.

A second emphasis of this study is the association between adolescent medical and nonmedical use of prescription stimulants and adulthood educational attainment. In general, illicit drug use, particularly heavy marijuana use, during adolescence and early adulthood, is associated with subsequent lower educational attainment.^{17,18} However, when it comes to nonmedical use of prescription stimulants, the outcome may be different. Past studies have identified the leading motive associated with nonmedical use of prescription stimulants among adolescents and young adults is to help study and increase concentration.^{19,20} At this point, the long-term educational attainment and health outcomes associated with medical and nonmedical use of prescription stimulants during adolescence are not well-understood.²¹

Although past studies have shown associations between nonmedical use of prescription stimulants and adverse behaviors such as sleep difficulties, headaches, substance-related

problems, missed classes, and lower grade point averages,^{19–23} these studies have primarily been conducted at single colleges and it remains unclear whether medical and nonmedical use of prescription stimulants during adolescence can predict long-term outcomes such as educational attainment and SUD symptoms in adulthood. The main objective of the present study are to examine the medical and nonmedical use of prescription stimulants in adolescence with educational attainment and SUD symptoms in adulthood using national, multi-cohort, prospective longitudinal data.

METHODS

Study Design

The present study used national panel data from the Monitoring the Future (MTF) study.^{4,24} Based on a three-stage sampling procedure, MTF has surveyed nationally representative samples of approximately 17,000 U.S. high school seniors each year since 1975, using questionnaires administered in classrooms. Approximately 2,400 high school seniors are randomly selected for biennial follow-ups each year and surveyed biennially using mailed questionnaires through age 30; they are also followed up at age 35. This study uses data from high school seniors who were randomly assigned to complete form 1 at baseline (one of six questionnaires provided at baseline) and the single form provided to all panel respondents at age 35. Form 1 contained information regarding medical and nonmedical use of prescription stimulants. The MTF age 35 survey includes questions concerning adult SUD symptoms as well as educational attainment. The study period for respondents at age 35 was between 1993 (12th grade cohort in 1976) and 2013 (12th grade cohort in 1996).

The student response rates at baseline over the study period ranged from 77% to 86%; most all non-response was due to the given respondent being absent (less than 1% refuse to participate). Moreover, the MTF panel also oversamples drug users from the 12th grade sample to secure a population of drug users to follow into adulthood (appropriate weights are then used to best approximate population estimates in the follow-up). The overall weighted response rate for the longitudinal sample was 54%. Given potential non-response bias, we incorporate attrition weights to account for respondent characteristics associated with non-response at follow up. The baseline characteristics used to construct attrition weights included sex, race, two-parent household, parental education, average grade in school, truancy, religiosity, plans to attend college, 30-day cigarette use, two-week binge drinking, 30-day marijuana use, geographical region, and cohort year. The project design, sampling methods, and details on how the attrition weights are constructed in the MTF is described in greater detail elsewhere, including how these weights have yielded representative samples over the past 40 years.^{4,24,25}

Sample

The weighted longitudinal sample included 8,373 individuals. The demographic distribution of the sample was 53.0% female, 73.5% White, 11.9% Black, 6.4% Hispanic, and 8.1% from other racial/ethnic categories (Table 1). The modal age at baseline was 18 years.

Measures

The MTF study assesses a wide range of behaviors, attitudes, and values. For the present study, we selected specific measures for analysis, including sex (i.e., Male and Female), race/ethnicity (i.e., White, Black, Hispanic, and other race), parental education (i.e., at least one parent has a college degree or higher or neither parent has a college degree), U.S. Census geographic location (i.e., Northeast, Midwest, South and West), urbanicity based on metropolitan statistical area (i.e., large MSA, other MSA, and non-MSA), truancy (i.e., past-month missed at least one whole day of school due to skipping school versus did not skip school), average grade during high school (i.e., C+ or lower versus B- or higher), and annual alcohol, marijuana, and other drug use based on prior studies that have examined correlates associated with medical and nonmedical use of prescription stimulants.^{4,6,7,19–23}

Medical and nonmedical use of prescription stimulants at baseline (age 18) was based on two separate questions measuring lifetime medical use (i.e., “Have you ever taken amphetamines because a doctor told you to use them?”) and lifetime nonmedical use (i.e., “...have you taken amphetamines on your own—that is, without a doctor telling you to take them in your lifetime?”). Respondents were informed that amphetamines are prescribed by doctors and drug stores are not supposed to sell them without a prescription from a doctor. Respondents were provided a list of several examples of prescription amphetamines/stimulants such as Ritalin® and Dexedrine®. Respondents were informed not to include any non-prescription or over-the-counter drugs (see Appendix A for more details). Based on these two questions, a variable with four mutually exclusive categories was constructed to include the following categories for lifetime history of prescription stimulant use at baseline (age 18): (1) no medical or nonmedical use (population controls), (2) medical use only, (3) both medical and nonmedical use, and (4) nonmedical use only.

Substance use disorder (SUD) symptoms at age 35 were measured with several questions based on the DSM criteria for alcohol use disorders, cannabis use disorders, and other drug use disorders. Although these measures of SUD symptoms do not yield a clinical diagnosis, the items are largely consistent with how SUD have been measured in other large scale surveys^{26–28} and have been used in the past to reflect DSM-IV and DSM-5 alcohol, cannabis, and other drug use disorders.^{25,29,30} Respondents were asked to report SUD symptoms over the past five years related to alcohol use, cannabis use and other drug use disorders. Fifteen items were used to develop eight of the eleven DSM-5 criteria that were consistent with alcohol, cannabis, and other drug use disorders (see Appendix B for more details). The eight criteria were summed to obtain an overall number of criteria endorsed. We followed recommended practice that any use disorder (including mild, moderate, or severe) is indicated by meeting two or more of the criteria.^{8,9}

Educational attainment at age 35 was based on the highest degree the respondent earned (six-point scale ranging from “less than a high school diploma” to a “doctoral degree or equivalent”). The response scale was used to create the following two educational attainment outcomes based on standard definitions according to the U.S. Department of Education:³¹ (1) at least a two-year associate’s college degree and (2) at least a four-year bachelor’s college degree.

Statistical Analysis

All analyses were conducted using STATA 13.1 (Stata Corp, College Station, Texas) and were weighted to adjust for the unequal probabilities of selection. The analyses included both descriptive statistics and logistic regression to examine SUD symptoms at age 35 as a function of medical and nonmedical use of prescription stimulants at age 18. Descriptive analyses provided the prevalence of two or more SUD symptoms based on eight DSM-5 criteria for alcohol, cannabis, and other drug use disorders. Logistic regression analyses provided adjusted odds ratios (AOR) and 95% confidence intervals for two or more SUD symptoms at age 35 as a function of medical and nonmedical use of prescription stimulants at age 18. Logistic regression analyses controlled for respondent's sex, race/ethnicity, high school academic performance, truancy, parental education, U.S. Census geographic location, urbanicity based on metropolitan statistical area, annual alcohol use, annual cannabis use, annual other drug use, and baseline cohort year. The relative risk ratios were also provided using a modified poisson regression approach.^{32,33}

RESULTS

Prevalence of medical and nonmedical of prescription stimulants

An estimated 21.3% of U.S. high school seniors reported lifetime medical or nonmedical use of prescription stimulants by age 18 (1976–1996): approximately 4.6% of individuals reported lifetime medical use of prescription stimulants only (with no history of nonmedical use), while 3.5% reported both medical and nonmedical use of prescription stimulants, and 13.2% reported nonmedical use of prescription stimulants only (with no history of medical use) (Table 1). Among individuals who reported any medical use of prescription stimulants by age 18, over 42.9% reported a history of nonmedical use of prescription stimulants by age 18. Among individuals who reported any past-year nonmedical use of prescription stimulants by age 18, approximately 97.3% also used at least one other substance during the past-year preceding the baseline assessment.

Predicting adult SUD symptoms

Among the four subgroups, a notable progression was observed with the two subgroups of individuals with any history of nonmedical use of prescriptions stimulants during adolescence reporting the highest rates of SUD symptoms (in terms of AUD, CUD, ODUD, and any SUDs) at 35 (Table 2, 1993–2013). In addition, 95.3% of these individuals did not engage in past-year nonmedical use of prescription stimulants in the year preceding the age 35 assessment.

Those who reported medical use only of prescription stimulants by age 18 did not differ from population controls (i.e., non-ADHD and non-stimulant medicated ADHD during adolescence) in the adjusted odds ratios of SUD symptoms at age 35 (by logistic regression analyses including controls; Table 3). In addition, these individuals did not differ from population controls in the odds ratios of past-year nonmedical use of prescription stimulants at age 35 (data not shown). In contrast, those who reported nonmedical use only of prescription stimulants as well as those who reported medical and nonmedical use by age 18 had significantly higher likelihood of AUDs (nonmedical use only subgroup), CUDs,

ODUDs, and any SUDs at age 35, relative to population controls (Table 3). Finally, these nonmedical users of prescription stimulants by age 18 (with or without medical use) had higher likelihood of symptoms of AUDs, CUDs, ODUDs, and any SUDs at age 35 relative to respondents who reported medical use of prescription stimulants (without nonmedical use) at age 18 (data not shown).

Predicting adult educational attainment

Adolescent medical users of prescription stimulants (without nonmedical use) by age 18 did not differ from population controls in the odds ratios of obtaining an associate's or bachelor's college degree at age 35 when adjusting for other variates (Table 4). In contrast, adolescent nonmedical users of prescription stimulants (with or without medical use) had significantly *lower* odds than population controls of obtaining an associate's (nonmedical use only subgroup) or bachelor's degree. When logistic regression analyses were conducted separately for those with and without SUDs (data not shown); the odds ratios associated with lower educational attainment among nonmedical users (with and without medical use) relative to population controls remained significant for those with and without SUDs. Additional logistic regression analyses revealed adolescent nonmedical users of prescription stimulants (with and without medical use) had *lower* odds ratios compared to adolescent medical users of prescription stimulants (without nonmedical use) of obtaining an associate's or bachelor's degree by age 35 (data not shown). Finally, we also conducted additional logistic regression analyses separately for females and males and significance results were similar to the overall sample for educational attainment and SUDs (data not shown).

DISCUSSION

The present investigation was the first national longitudinal study to examine the relationships between medical and nonmedical use of prescription stimulants during adolescence (1976–1996) and SUD symptoms and educational attainment during adulthood (1993–2013). We found that more than one in every six high school seniors reported lifetime nonmedical use of prescription stimulants. While these baseline results are based on data that were collected several years ago, long-term trends indicate the lifetime medical use of prescription stimulants has increased while the nonmedical use of prescription stimulant has decreased over the past four decades.^{4,34} Notably, an estimated 43% of adolescents who were prescribed stimulants had also engaged in nonmedical use of prescription stimulants by age 18 consistent with recent estimates.⁴

Previous prospective clinical and epidemiological studies indicate that early stimulant medication therapy is not associated with substance-related problems during adolescence and young adulthood.^{10–16} The findings of the present study provide valuable new epidemiological information by showing that medical use of prescription stimulants (without any history of nonmedical use) by age 18 was 1) *not associated* with lower educational attainment or an increased risk of nonmedical use of prescription stimulants or SUD symptoms in adulthood (age 35), relative to population controls (i.e., non-ADHD and non-stimulant medicated ADHD youth), 2) *was associated* with higher educational attainment

and decreased risk of SUD symptoms in adulthood (age 35), relative to their peers with a history of nonmedical use of prescription stimulants (with and without medical use) during adolescence. The findings indicating that those adolescents taking prescription stimulants appropriately had similar educational and SUD outcomes to population controls are particularly notable given the extent literature indicating that ADHD results in lower educational attainment^{35–37} and higher rates of SUD.^{38,39}

Nonmedical use of prescription stimulants was common among adolescents who reported medical use of prescription stimulants by age 18 consistent with other epidemiological findings of adolescent and young adult populations (lifetime range 40% – 43%).^{7,22} The high rate of nonmedical use of prescription stimulants among prescribed users is likely a result of several factors. First, past research indicates that the majority of adolescents who report a lifetime history of both medical and nonmedical use of prescription stimulants initiated medical use before nonmedical use of prescription stimulants.⁷ The transition from adolescence to adulthood represents a key developmental period because some youth prescribed stimulant medication for ADHD will experience a reduction in ADHD symptoms during this transition and may stop taking their medication and have excess leftover medication for diversion and nonmedical use.^{34,40} Second, many older adolescents become responsible for their own stimulant medication management for the first time and several studies have shown peer-to-peer diversion and stimulant misuse is highly prevalent during late adolescence and young adulthood.^{7,19,22,34} Finally, many adolescents who misuse prescribed stimulants may have comorbid disorders (e.g., conduct disorder), family or environmental stressors, or other risk factors that put them at increased risk for stimulant misuse and subsequent SUD, independent of the actual stimulant misuse.^{6,41}

The present study provides new evidence to our knowledge about nonmedical use of prescription stimulants. We found that adolescents who reported any history of nonmedical use of prescription stimulants (with or without a history of medical use) had significantly lower odds of obtaining a 4-year college degree and significantly greater odds of developing SUD symptoms in adulthood. Notably, we found the significant association between nonmedical use of prescription stimulants and lower educational attainment was present for both those with and without SUDs. While previous work has found that nonmedical use of prescription stimulants is associated with an increased risk of short-term consequences such as substance-related problems and academic difficulties during adolescence and young adulthood,^{19,20,22} this investigation represents the first national study to examine long-term adult functional outcomes. Future prospective research is needed to examine whether the lower educational attainment associated with nonmedical use of prescription stimulants signals a subgroup of adolescents at high risk for SUD and/or academic underachievement.

The present study focused on SUD symptoms in adulthood (age 35) including alcohol, cannabis and other drugs (which included stimulant use disorder). This wide range of substances was used to assess SUD symptoms to account for the over 95% of adolescent nonmedical users of prescription stimulants who engaged in polysubstance use in the past-year. Recent findings indicate that approximately two-thirds of polysubstance use among past-year adolescent nonmedical users of prescription stimulants involves simultaneous co-ingestion of prescription stimulants, alcohol and/or other substances.⁴² In addition, we found

that individuals who reported any lifetime nonmedical use of prescription stimulants by age 18 were more likely to report two or more AUD symptoms than other SUD symptoms (which included cannabis and stimulant use disorder symptoms) in adulthood. Finally, we found that over 95% of adolescents who reported any history of nonmedical use of prescription stimulants at age 18 did not report past-year nonmedical use of prescription stimulants at age 35. However, over 40% of adolescents who reported any nonmedical use of prescription stimulants during adolescence (age 18) experienced two or more SUD symptoms in adulthood (age 35). At least one prior clinical study found that the majority of those adolescents and young adults who were prescribed stimulants and used them nonmedically (or diverted them) also had SUD.⁴¹

The present study had all of the strengths and limitations of large-scale longitudinal research using self-administered surveys. First, while the present study could not establish formal DSM-based diagnoses given the study methods, the prevalence of SUD symptoms for population controls in the MTF study closely resembles other recent national estimates.^{8,9,43} The present study did not include three of eleven DSM-5 SUD criteria and future research is needed to examine the sensitivity and specificity of the SUD symptoms examined in the present study. The present study also did not contain detailed information regarding type of nonmedical use (e.g., escalating dose, recreational motive, co-ingestion with other drugs, non-oral route of administration) or amount/type of prescription stimulant (e.g., immediate release vs. extended release) for medical use. Further, the present study did not include some variables related to substance use at baseline and SUD symptoms at follow-up (e.g., anxiety, conduct or mood disorder diagnosis) and the current results should be viewed as preliminary until a more comprehensive analysis controlling for these disorders is conducted. Second, we acknowledge the potential for self-reporting bias and that there are two important segments that tend to report higher rates of substance use missing from the data collected at baseline: students absent from class at the time of data collection and students who dropped out of school.^{4,24,34} Third, the term “Amphetamines” used in the MTF survey is not the broadest pharmacological term and is encompassed within the “psychostimulant” category. However, specific stimulant examples were provided in the MTF survey and included methylphenidate, dextroamphetamine, and medication brand names (e.g., Ritalin® and Dexedrine®) over the entire study (see Appendix A and supplemental Tables A, B, and C for more details). Additionally, the prevalence estimates of medical and nonmedical use of prescription stimulants in the present study were comparable to U.S. regional and national studies.^{2,6} Finally, as is typically the case in similar longitudinal studies, attrition was relatively high and differential with respect to drug use, indicating that drug users are less likely to remain in longitudinal samples.^{4,36} Despite attrition in the panel data, the current study applied weights to help correct for differential attrition. We also examined several alternative weighting approaches (e.g., multiple imputation) for assessing potential nonresponse bias which produced identical results.⁴⁴ Additionally, the follow-up response rate in the present 17-year longitudinal study (54%) compares favorably to some of the other long-term studies following ADHD and non-ADHD youth samples into adulthood.^{45,46} Nevertheless, our findings likely reflect conservative estimates of the relationships between adolescents’ prescription stimulant use and adult functional outcomes.

For clinicians, the findings provide valuable new information that nonmedical use of prescription stimulants is fairly common (43%) among adolescent medical users of prescription stimulants. The overall lifetime prevalence of nonmedical use of prescription stimulants was 16.7% by age 18 (baseline cohorts 1976–1996). Furthermore, nonmedical use of prescription stimulants within or outside of stimulant medication therapy during adolescence results in deleterious SUD symptoms and lower academic outcomes almost two decades later (1993–2013). Adolescents who only use prescription stimulants medically do not differ from population controls in educational attainment or SUD symptoms in adulthood. Indeed, medical only users have higher educational attainment and decreased risk of SUD symptoms in adulthood, relative to their peers with a history of nonmedical use of prescription stimulants (with or without medical use) during adolescence. The findings indicate that prescribers of stimulant medications and other health professionals should carefully monitor children and adolescents for any nonmedical use because this behavior appears to be a key signal for lower educational attainment and could be a useful screening item for identifying SUDs. If nonmedical use is detected, the findings support the need to assess a wide range of substance use disorders (including alcohol and cannabis) rather than assess only stimulant use disorders when assessing for the risk for SUDs based on the high rates of polysubstance use associated with nonmedical use of prescription stimulants (over 95%).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Clinical Guidance

- About one in every six U.S. high school seniors reported lifetime nonmedical use of prescription stimulants for ADHD. Especially noteworthy is that nonmedical use of prescription stimulants is highly prevalent (43%) among adolescent medical users of prescription stimulants.
- Nonmedical use of prescription stimulants (within or outside of stimulant medication therapy) during adolescence is associated with higher risk of SUD symptoms and lower educational attainment almost two decades later at age 35, controlling for adolescent sociodemographic, other drug use, and behavioral controls.
- In contrast, adolescents who use prescription stimulant therapy appropriately have risks of adult SUD symptoms and educational attainment in adulthood similar to those of population controls.
- Prescribers of stimulant medications and other health care professionals should carefully monitor children and adolescents for nonmedical use of prescription stimulants, as the implications of this behavior include lower educational attainment in adulthood and a wide range of SUDs.

Table 1

Descriptive statistics for the longitudinal sample at baseline (age 18 years)

Baseline Characteristics at Age 18	^a Study Sample (Weighted N = 8,362)
Sex	%
Male	47.0
Female	53.0
Race/Ethnicity	
White	73.5
Black	11.9
Hispanic	6.4
Other race	8.1
Parental Education	
Neither parent has a college degree	59.9
At least one parent has a college degree or higher	40.1
Geographical Region	
Northeast	21.3
Midwest	27.3
South	33.9
West	17.5
Urbanicity	
Large metropolitan statistical area	23.4
Other metropolitan statistical area	46.4
Non-metropolitan statistical area	30.2
12th Grade Cohort Year	
1976–1980	23.1
1981–1985	24.3
1986–1990	25.0
1991–1996	27.7
Medical and Nonmedical Use of Prescription Stimulants at Age 18	
No lifetime medical or nonmedical use	78.7
Lifetime medical use only	4.6
Lifetime medical and nonmedical use	3.5
Lifetime nonmedical use only	13.1

^aWeighted samples and estimates with attrition weights are provided.

Prevalence of substance use disorder symptoms at age 35 as a function of medical and nonmedical use of prescription stimulants at age 18

Table 2

Medical and Nonmedical Use of Prescription Stimulants at Age 18	Alcohol Use Disorder (AUD) Symptoms at Age 35 Two or More AUD Symptoms %	Cannabis Use Disorder (CUD) Symptoms at Age 35 Two or More CUD Symptoms %	Other Drug Use Disorder (ODUD) Symptoms at Age 35 Two or More ODUD Symptoms %	Any Substance Use Disorder (SUD) Symptoms at Age 35 Two or More SUD Symptoms %
No medical or nonmedical use	23.9%	4.5%	2.4%	25.1%
Medical use only	31.8%	6.3%	4.3%	33.9%
Medical and nonmedical use	34.1%	13.8%	8.7%	41.9%
Nonmedical use only	40.0%	11.9%	10.9%	45.7%
	^a N = 7712	^a N = 7856	^a N = 7438	^a N = 7224

^a Attrition weights applied and sample sizes vary due to missing data on the dependent measures (i.e., AUD, CUD, ODUD, and SUD symptoms at age 35)

Table 3

Adjusted odds and relative risk ratios of substance use disorder symptoms at age 35 as a function of medical and nonmedical use of prescription stimulants at age 18

Medical and Nonmedical Use of Prescription Stimulants at Age 18	Alcohol Use Disorder (AUD) Symptoms at Age 35 Two or More AUD Symptoms ^a AOR (95% CI)	Cannabis Use Disorder (CUD) Symptoms at Age 35 Two or More CUD Symptoms ^a AOR (95% CI)	Other Drug Use Disorder (ODUD) Symptoms at Age 35 Two or More ODUD Symptoms ^a AOR (95% CI)	Any Substance Use Disorder (SUD) Symptoms at Age 35 Two or More SUD Symptoms ^a AOR (95% CI)
No medical or nonmedical use	Reference	Reference	Reference	Reference
Medical use only	1.25 (.858, 1.82)	1.12 (.597, 2.11)	1.71 (.712, 4.14)	1.29 (.880, 1.91)
Medical and nonmedical use	1.32 (.908, 1.92)	2.39 (1.47, 3.90) ***	2.51 (1.43, 4.40) ***	1.73 (1.19, 2.51) **
Nonmedical use only	1.66 (1.34, 2.04) ***	2.03 (1.44, 2.85) ***	3.35 (2.21, 5.08) ***	1.96 (1.58, 2.43) ***
	<i>b</i> N = 7712	<i>b</i> N = 7856	<i>b</i> N = 7438	<i>b</i> N = 7224

Medical and Nonmedical Use of Prescription Stimulants at Age 18	^a RR (95% CI)	^a RR (95% CI)	^a RR (95% CI)	^a RR (95% CI)
No medical or nonmedical use	Reference	Reference	Reference	Reference
Medical use only	1.15 (.907, 1.48)	1.11 (.627, 1.99)	1.67 (.731, 3.83)	1.18 (.928, 1.50)
Medical and nonmedical use	1.20 (.951, 1.53)	2.16 (1.42, 3.28) ***	2.37 (1.41, 3.99) ***	1.40 (1.14, 1.73) ***
Nonmedical use only	1.37 (1.20, 1.56) ***	1.87 (1.38, 2.54) ***	3.07 (2.08, 4.52) ***	1.49 (1.31, 1.68) ***
	<i>b</i> N = 7712	<i>b</i> N = 7856	<i>b</i> N = 7438	<i>b</i> N = 7224

* $p < .05$,

** $p < .01$,

*** $p < .001$;

AOR = adjusted odds ratio; RR = relative risk ratio (adjusted)

^a All analyses control for race, sex, truancy, average grade during high school, parental education, geographical region, metropolitan statistical area, cohort year at baseline, annual alcohol use at baseline, annual cannabis use at baseline, and annual other drug use at baseline.

^b Attrition weights applied and sample sizes vary due to missing data on the dependent measures.

Prevalence and adjusted odds of educational attainment at age 35 as a function of medical and nonmedical use of prescription stimulants at age 18

Table 4

Medical and Nonmedical Use of Prescription Stimulants at Age 18		Obtained Associate's Degree or Higher at Age 35		Obtained Bachelor's Degree or Higher at Age 35	
		%	<i>a</i> AOR (95% CI)	%	<i>a</i> AOR (95% CI)
No medical or nonmedical use		60.6%	Reference	46.8%	Reference
Medical use only		55.1%	.874 (.624, 1.22)	39.5%	.791 (.554, 1.13)
Medical and nonmedical use		43.0%	.672 (.446, 1.01)	22.7%	.474 (.307, .731)***
Nonmedical use only		48.1%	.749 (.604, .928)**	32.3%	.684 (.552, .847)***
		<i>b</i> <i>n</i> = 7813	<i>b</i> <i>n</i> = 7813	<i>b</i> <i>n</i> = 7813	<i>b</i> <i>n</i> = 7813

Medical and Nonmedical Use of Prescription Stimulants at Age 18		Obtained Associate's Degree or Higher at Age 35		Obtained Bachelor's Degree or Higher at Age 35	
		%	<i>a</i> RR (95% CI)	%	<i>a</i> RR (95% CI)
No medical or nonmedical use		60.6%	Reference	46.8%	Reference
Medical use only		55.1%	.968 (.857, 1.09)	39.5%	.910 (.765, 1.08)
Medical and nonmedical use		43.0%	.845 (.704, 1.01)	22.7%	.661 (.510, .856)**
Nonmedical use only		48.1%	.901 (.829, .980)*	32.3%	.831 (.745, .927)***
		<i>b</i> <i>n</i> = 7813	<i>b</i> <i>n</i> = 7813	<i>b</i> <i>n</i> = 7813	<i>b</i> <i>n</i> = 7813

* $p < .05$,

** $p < .01$,

*** $p < .001$;

AOR = adjusted odds ratio; RR = relative risk ratio (adjusted)

^a All analyses control for race, sex, truancy, average grade during high school, parental education, geographical region, metropolitan statistical area, cohort year at baseline, annual alcohol use at baseline, annual cannabis use at baseline, and annual other drug use at baseline.

^b Attrition weights applied and sample sizes vary due to missing data on the dependent measures.