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Medical and Nonmedical Use of Prescription Stimulants: Results From a National Multicohort Study

Dr. Sean Esteban McCabe, Ph.D. and

Institute for Research on Women and Gender and the Substance Abuse Research Center at the University of Michigan

Dr. Brady T. West, Ph.D.

Survey Research Center, Institute for Social Research, and the Center for Statistical Consultation and Research at the University of Michigan

Abstract

Objective—To examine the lifetime prevalence of medical and nonmedical use of prescription stimulants (e.g., Adderall®, Concerta®, Ritalin®, Dexedrine®) among high school seniors in the United States and to assess substance use behaviors (i.e., cigarette smoking, binge drinking, marijuana, and other drug use) based on lifetime histories of medical and nonmedical use of prescription stimulants.

Method—Nationally representative samples of high school seniors from the Monitoring the Future study were surveyed via self-administered questionnaires. The sample consisted of 4,572 individuals (modal age 18) from 2 independent cohorts (2010 and 2011) and was 50% female, 57% White, 12% African-American, 13% Hispanic, and 18% other.

Results—The lifetime prevalence of medical use of prescription stimulants was 9.5% while lifetime nonmedical use of prescription stimulants was also 9.5%. Among those who were ever prescribed stimulants, approximately 59.3% reported medical use only, 22.9% reported medical use prior to nonmedical use, and 17.8% reported nonmedical use prior to medical use. The odds of substance use behaviors generally did not differ between medical users only and non-users. In contrast, the odds of substance use behaviors were greater among nonmedical users only and medical users who reported any history of nonmedical use relative to non-users.

Conclusions—About 1 in every 6 high school seniors in the United States has ever had some exposure to prescription stimulants either medically or nonmedically. Health professionals should carefully screen and monitor adolescents because the risk for substance abuse is directly associated with a history of nonmedical use of prescription stimulants.

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Correspondence to Sean Esteban McCabe, Ph.D., University of Michigan Institute for Research on Women and Gender, 204 S. State St., Ann Arbor, MI, 48109-1290; plus@umich.edu.

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Keywords

adolescent; attention-deficit/hyperactivity disorder (ADHD); diversion; epidemiology; stimulant

INTRODUCTION

The diagnosis of attention-deficit hyperactivity disorder (ADHD) and prescribing of stimulant medications to treat ADHD has increased substantially among adolescents in the United States over the past 2 decades.^{1–3} Although prescription stimulants are highly efficacious when used properly to treat ADHD, possible consequences of increases in prescribing rates include concomitant increases in diversion, nonmedical use of prescription stimulants and related consequences due to greater availability.^{4–7} In fact, the estimated number of emergency department (ED) visits involving the use of prescription stimulants to treat ADHD has steadily increased among those aged 18 and older from 13,379 ED visits in 2005 to 31,244 ED visits in 2010.⁶

The transition from adolescence to adulthood represents an important developmental period to examine medical use and nonmedical use of prescription stimulants because many individuals become responsible for their own medication management during this time. In addition, previous research has shown that individuals in the United States who initiated nonmedical use of prescription stimulants at 18 years of age or younger were significantly more likely to develop stimulant use disorders than those who initiated nonmedical use of prescription stimulants after 18 years of age.⁷ Notably, peers are the leading source of diversion for nonmedical use of prescription stimulants among adolescents and most nonmedical users obtain these controlled medications from friends for free.^{4,9–12}

The vast majority of adolescents treated with stimulant medications for ADHD use their medication appropriately.^{13–15} For example, at least one study of secondary public school students in the Detroit metropolitan area found that about 8 out of every 10 of adolescents prescribed stimulants in the past 12 months used their medications correctly as prescribed.¹³ In addition, a prospective study of medicated adolescents with ADHD found that 22% took too much or misused their own prescribed ADHD medication in the past 4 years.¹⁴ Two past studies of secondary public school students in the Detroit metropolitan area found that between 19% and 29% of lifetime medical users of prescription stimulants reported a lifetime history of nonmedical use of prescription stimulants while between 41% and 50% of lifetime nonmedical users of prescription stimulants reported a lifetime history of medical use of prescription stimulants.^{16–17} The findings from both of these small regional studies were consistent with other regional clinical and epidemiological studies indicating that appropriate stimulant treatment for ADHD in childhood does not appear to be associated with a greater risk of substance abuse or dependence in adolescence and young adulthood.^{18–22}

Despite the findings from these small regional studies, there remains a lack of research assessing the relationships between lifetime history of medical and nonmedical use of prescription stimulants and other drug use in national samples of adolescents.^{23,24} Such information is especially important for health professionals given the recent increases in prescribing and nonmedical use of stimulant medications to treat ADHD in the United States.^{1–7} Therefore, the objectives of the present study are to 1) assess the lifetime prevalence of medical and nonmedical use of prescription stimulants in a national sample of high school seniors in the United States; and 2) assess the associations between lifetime histories of medical and nonmedical use of prescription stimulants and other substance use behaviors (defined as cigarette smoking, binge drinking, marijuana, and other drug use).

METHOD

Study Design

The Monitoring the Future (MTF) study annually surveys a cross-sectional, nationally representative sample of high school seniors in approximately 127 public and private schools in the coterminous U.S., using self-administered paper-and-pencil questionnaires in classrooms. The samples analyzed in this study consisted of high school seniors from two independent cohorts (senior years 2010 and 2011), and the MTF study used a multistage sampling procedure in each year. In stage 1, geographic areas (or primary sampling units) are selected; in stage 2, schools within primary sampling units are selected (with probability proportionate to school size); and in stage 3, students within schools are selected. Corrective weighting was used in the analyses presented in this study to account for the unequal probabilities of selection that occurred at any stage of sampling.

The student response rates for high school seniors ranged from 83% to 85% in 2010 and 2011. Because so many questions are included in the MTF study, much of the questionnaire content is divided into six different questionnaire forms which are randomly distributed. This approach results in six virtually identical subsamples. The measures most relevant for this study were asked on Form 1, so this study focuses on the cross-sectional subsamples receiving Form 1 within each year cohort. Additional details about the MTF design and methods are available elsewhere.⁴ Institutional Review Board approval was granted for this study by the University of Michigan Institutional Review Board Health Sciences.

Sample

The sample for this study included 4,572 individuals who completed questionnaires during the spring of their senior year in 2010 and 2011. The sample represented a target population that was 50% female, 57% White, 12% African-American, 13% Hispanic, and 18% other/not reported/missing. The modal age of the individuals in the sample was 18 years of age.

Measures

The MTF study assesses a wide range of behaviors, attitudes, and values. For the present study, we selected specific measures for analysis, including demographic characteristics and standard measures of substance use behaviors such as cigarette use, binge drinking, and marijuana and other drug use.

Medical use of prescription stimulants was assessed by asking respondents the following question: "Have you ever taken amphetamines because a doctor told you to use them?" Respondents were informed that amphetamines are sometimes prescribed by doctors for people who have ADHD and drug stores are not supposed to sell them without a prescription from a doctor. The following medications were listed as examples of amphetamines: Adderall®, Concerta®, Ritalin®, and Dexedrine®. Respondents were informed not to include any nonprescription or over-the-counter drugs. The response options included: 1) No; 2) Yes, but I had already tried them on my own; and 3) Yes, and it was the first time I took any.

Nonmedical use of prescription stimulants was assessed by asking respondents the following question: "On how many occasions (if any) have you taken amphetamines on your own—that is, without a doctor telling you to take them in your lifetime?" The response scale ranged from 1) no occasions to 7) 40 or more occasions.

Cigarette use was measured by asking respondents how frequently they smoked cigarettes during the past 30 days. The response scale ranged from 1) not at all to 7) 2 or more packs

per day. *Binge drinking* was measured with a single item focused on the frequency of having 5 or more drinks in a row during the past 2 weeks. The response scale ranged from 1) none to 6) 10 or more times. *Marijuana and other illicit drug use* included LSD, other psychedelics, crack cocaine, other cocaine, and heroin, and *nonmedical use of other prescription medications* included prescription opioids (e.g., Vicodin[®] OxyContin[®]), prescription sedatives (e.g., Ambien[®], Lunesta[®]), and prescription tranquilizers (e.g., Xanax[®], Valium[®]). These drug use behaviors were each measured by asking respondents on how many occasions (if any) they used [specified drug] in their lifetime. The response scale for these items ranged from 1) no occasions to 7) 40 or more occasions.

Statistical Analysis

The estimated prevalence rates for medical and nonmedical use of prescription stimulants—across population subgroups defined by gender, race/ethnicity, and substance use behaviors—were computed using cross-tabulations incorporating the MTF sampling weights. The MTF survey stated that amphetamines are sometimes called a non-prescription illicit stimulant (i.e., “crystal methamphetamine”), which represented a potential limitation in the present study based on the differences in characteristics between individuals who report crystal methamphetamine use and nonmedical use of prescription stimulants.^{25–27} Fortunately, the MTF survey also contains additional questions that ask individuals about specific amphetamines they have used to help identify those who have used crystal methamphetamine versus prescription stimulants. Using these additional questions, four individuals were identified out of 4,572 individuals from the 2010 and 2011 cohorts who only used “crystal methamphetamine,” and we removed these 4 individuals from all analyses, thereby helping to eliminate use of nonprescription stimulants from our sample. Rao-Scott Chi-square tests of homogeneity²⁸ and design-based logistic regression analyses, or logistic regression analyses incorporating the complex sample design features of the MTF (including the sampling weights) and the effects of these features on variance estimates,^{29,30} were conducted to determine whether medical and nonmedical use history of prescription stimulants was significantly associated with substance use behaviors (i.e., cigarette use, binge drinking, marijuana use, other illicit drug use, and nonmedical use of prescription opioids, sedatives or tranquilizers). The following 5 mutually exclusive groups were compared in the analyses: 1) no lifetime medical or nonmedical use of prescription stimulants, 2) lifetime medical use only, 3) lifetime medical use prior to nonmedical use, 4) lifetime nonmedical use prior to medical use, and 5) lifetime nonmedical use only. Estimated (linearized) variances of weighted estimates were multiplied by an average MTF design effect factor prior to the construction of confidence intervals,³⁰ and weighted Pearson chi-square statistics were divided by this same design effect factor²⁸ per the recommendation of Johnston and colleagues.⁴ All statistical analyses were performed using commands for the analysis of complex sample survey data in the Stata 12.1 software.

RESULTS

Prevalence of Medical and Nonmedical Use of Prescription Stimulants

Approximately 15.5% of high school seniors in the United States had some lifetime exposure to prescription stimulants either medically or nonmedically. The estimated prevalence of lifetime medical use of prescription stimulants among high school seniors was 9.5% while the lifetime nonmedical use of prescription stimulants was also 9.5%. Overall, 84.6% reported no lifetime medical or nonmedical use of prescription stimulants, 5.6% medical use only, 2.2% medical use prior to nonmedical use, 1.7% nonmedical use prior to medical use, and 5.9% nonmedical use only. Among those who were ever prescribed stimulants in their lifetime (n=405), approximately 59.3% reported medical use only, 22.9% reported medical use prior to nonmedical use, and 17.8% reported nonmedical use prior to

medical use. Among those who ever used prescription stimulants nonmedically in their lifetime ($n=405$), approximately 22.7% reported medical use prior to nonmedical use, 15.7% reported nonmedical use prior to medical use, and 61.6% reported nonmedical use only.

There were no gender differences in the prevalence of lifetime medical and nonmedical use of prescription stimulants. As illustrated in Table 1, there were notable racial/ethnic differences with respect to the lifetime history of medical and nonmedical use of prescription stimulants. White students had higher rates of both medical and nonmedical use compared to Hispanics and African-Americans, and correspondingly lower rates of non-use. For example, the estimated lifetime prevalence of any medical use of prescription stimulants was 11.0% among White students, 5.2% among Hispanics, and 6.0% among African-Americans ($p < 0.001$). Similarly, the lifetime prevalence of nonmedical use of prescription stimulants was 11.2% among White students, 5.6% among Hispanics, and 2.9% among African-Americans ($p < 0.001$).

Medical and Nonmedical Use of Prescription Stimulants and Other Substance Use

Bivariate analyses were used initially to examine the associations among lifetime medical and nonmedical use of prescription stimulants and other substance use behaviors (see Table 2). Rao-Scott Chi-square tests revealed significant associations between each substance use behavior (i.e., cigarette use, binge drinking, marijuana use, other illicit drug use, and nonmedical use of prescription opioids, sedatives or tranquilizers) and lifetime history of prescription stimulant use ($p < 0.001$). The prevalence of substance use behaviors was highest among individuals who reported any history of nonmedical use of prescription stimulants, including those who reported (a) medical use prior to nonmedical use, (b) nonmedical use prior to medical use, and (c) nonmedical use only. For example, the majority of individuals with a history of any nonmedical use of prescription stimulants also reported nonmedical use of other prescription medications (i.e., opioids, sedatives, or tranquilizers) in their lifetime as compared to about 10% of individuals who reported only lifetime medical use of prescription stimulants or no lifetime history of medical use or nonmedical use of prescription stimulants ($p < 0.001$).

Logistic regression analyses reinforced the bivariate findings; the odds of reporting substance use behaviors were considerably higher among individuals who reported any history of lifetime nonmedical use of prescription stimulants after adjusting for relevant covariates, including race/ethnicity, cohort year, school geographical region, and metropolitan statistical area status of the school (see Table 3). In contrast, individuals who reported only lifetime medical use of prescription stimulants had similar odds of substance use behaviors compared to individuals who reported no lifetime medical or nonmedical use of prescription stimulants. Finally, most of the odds of substance use behaviors for individuals who reported medical use prior to nonmedical use were significantly greater than for those who reported no lifetime medical or nonmedical use, but considerably lower than those who reported only lifetime nonmedical use or those who reported nonmedical use prior to medical use.

Finally, we conducted additional exploratory analyses and examined whether the odds of the substance use behaviors shown in Table 3 were significantly associated with several characteristics of past-year nonmedical use of prescription stimulants, including frequency of nonmedical use (experimental use on 1 or 2 occasions vs. more frequent use on 3 or more occasions), motives of nonmedical use (academic performance motives vs. recreational motives), diversion sources (e.g., friend, relative, own, other), and diversion modes (e.g., free, stolen, bought, other). We found that the odds of substance use behaviors were not significantly related to frequency or motives of past-year nonmedical use of prescription stimulants. However, the odds of all substance use behaviors with the exception of binge

drinking were significantly higher among past-year nonmedical users who obtained prescription stimulants from their friends and those who bought prescription stimulants ($p < 0.05$).

DISCUSSION

This is the first national study to assess the lifetime prevalence of medical and nonmedical use of prescription stimulants and the relationships with substance use behaviors in the United States. The results indicate that nearly one in every six high school seniors in the United States had some lifetime exposure to prescription stimulants either medically or nonmedically in 2010 and 2011. The lifetime prevalence rates of nonmedical use of prescription stimulants in the present study were higher than estimates from other national studies of adolescents and young adults in the United States.^{5,31} For example, the National Survey on Drug Use and Health (NSDUH) found that approximately 7.7% of individuals 18 to 20 years of age reported nonmedical use of prescription stimulants at least once in their lifetime in 2010 and 2011.⁵ In addition, while the 2002–2004 National Comorbidity Survey–Adolescent Supplement found that approximately 3% of adolescents reported past-year medical use of prescription stimulants,³² more recent analyses have indicated a sharp increase in past-year medical use of prescription stimulants among adolescents.³ The differences in prevalence rates found between the present study and other national studies could be partially attributed to a wide array of factors that varied between the studies, including but not limited to differences in time frames for measures, years of data collection, changes in prescribing practices, modes of data collection, questionnaire wording, the survey administration settings, the target populations, the response rates, and the consent process.

Interestingly, we found that the proportions of high school seniors in the United States who report medical and nonmedical use of prescription stimulants were very similar in the present study, which differs from previous studies of younger adolescents and older college-age young adults.^{12,16,17,33,34} In fact, the ratio of nonmedical users of prescription stimulants to medical users of prescription stimulants ranged from 0.4 to 0.7 among younger secondary school students^{16,17} while the ratio of nonmedical users to medical users of prescription stimulants ranged from 1.7 to 2.5 among older college students.^{12,33,34} Previous studies have found that less than 17% of secondary school students prescribed stimulant medications have diverted (i.e., sold, gave away, loaned, traded) their medications despite frequent requests from peers to divert their medications.^{35,36} Although these findings suggest that a minority of adolescent patients prescribed stimulant medications serve as diversion sources for their friends, stimulant medications should be closely monitored and appropriately stored to reduce diversion and nonmedical use. Prescribers should warn adolescent patients that they may be approached to divert their stimulant medications and a plan should be developed with patients if requests to divert occur.

One important contribution of this study was the racial/ethnic differences found with respect to medical and nonmedical use of prescription stimulants. The results of this study indicated that White students were significantly more likely than their peers to report medical and nonmedical use of prescription stimulants, which is consistent with several regional and national studies conducted in the United States among adolescents and young adults.^{16,31,33,26,27,37,38} Similarly, White adolescents and adults in the United States are more likely than Black adolescents and adults to be diagnosed with ADHD and treated with stimulant medications for ADHD.^{3,16,39–41} In the present study, racial/ethnic differences found in the nonmedical use of prescription stimulants may be influenced by the racial/ethnic differences in medical availability, especially given that peers serve as the leading source of diversion for nonmedical use of prescription stimulants among adolescents.^{4,9,11,12}

The findings of the present study also support previous work indicating that the nonmedical use of prescription stimulants is highly associated with the use and co-ingestion of other drugs.^{6,42–44} For example, nearly two-thirds of ED visits involving prescription stimulants involved co-ingestion of one or more other drugs such as alcohol, marijuana, and anti-anxiety and opioid medications.⁶ In addition, we found that the odds of substance use behaviors were significantly higher among past-year nonmedical users who obtained prescription stimulants from their friends or bought their prescription stimulants, but did not differ based on frequency of nonmedical use (experimental use on 1 or 2 occasions vs. more frequent use on 3 or more occasions) or motives of nonmedical use (academic performance motives vs. recreational motives). These findings were consistent with previous work among college students.^{11,43} Notably, our findings provide new insights about the increased risk associated with buying prescription stimulants for nonmedical use. While several cross-sectional studies have found strong associations among nonmedical use of prescription stimulants, substance use disorders and other psychiatric disorders,^{45–47} additional longitudinal research is needed to examine the etiology associated with nonmedical use of prescription stimulants.

This study has noteworthy strengths, including the analysis of self-administered survey data collected from large national samples of high school seniors in the United States. Further, this study represents the first attempt to assess both the medical and nonmedical use of prescription stimulants nationally among adolescents. Despite these strengths, there were also some limitations that should be considered. First, since the present study consists of secondary analyses, the survey items in the MTF limited the variables that could be examined in some cases. For example, the MTF survey did not contain information regarding the amount of stimulant, type of stimulant (e.g., immediate release vs. extended release), or caffeine usage. In addition, the MTF study relies on single questions to assess the medical and nonmedical use of prescription stimulants and does not contain additional items to probe further or to clarify understanding of the intended meaning of these questions. Similarly, there is a lack of other sources of information regarding diagnosis and stimulant exposure (e.g., prescription records, parent interviews). Second, the results cannot be generalized to all adolescents because this sample only included high school seniors and did not include individuals who had dropped out of school or were not present in school on the day of survey administration. Third, the data are subject to the potential bias introduced when assessing sensitive behaviors via self-report surveys administered in a school setting.⁴⁸ Fourth, the racial/ethnic subgroup “Other” was comprised of several different types of individuals including those who endorsed multiple races, Asian, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, not reported, and missing. Based on the relatively high rate of lifetime medical and nonmedical exposure to prescription stimulants within this subgroup (16.5%), additional research is needed to understand possible heterogeneity in prescription stimulant use and abuse within this subgroup. Finally, the cross-sectional nature of the study presented some limitations; longitudinal studies are needed to elucidate the reasons underlying the patterns of medical and nonmedical use of prescription stimulants.

There are several notable clinical implications based on the findings of the present study. The present study indicated that the majority of high school seniors in the United States who were ever prescribed stimulants in their lifetime did not report a history of nonmedical use of prescription stimulants. Furthermore, we found that individuals who reported medical use of prescription stimulants only were not at increased risk for substance use compared to non-users. These findings, along with results from several earlier studies, should provide some reassurance to clinicians that prescription stimulants can be safely prescribed to children and does not appear to be associated with a greater risk of substance abuse.^{13–22}

The present study found that approximately 1 in every 10 high school seniors reported nonmedical use of prescription stimulants at least once in their lifetime, and prescribers need to be aware of the important role peer diversion plays among adolescents. In addition, we identified 2 subgroups of adolescents who initiated nonmedical use before and after medical use of prescription stimulants who had significantly greater odds of substance use relative to their peers who reported no lifetime history of medical or nonmedical use of prescription stimulants. In fact, these 2 subgroups of adolescents are of great clinical importance and deserve more research to understand the potential reasons (e.g., undertreatment) underlying the initiation of nonmedical use of prescription stimulants given the health risks associated with this behavior in early adolescence.⁸ Indeed, prescribers should screen patients for any comorbid psychiatric disorders and symptoms including nonmedical use of prescription stimulants when prescribing stimulant medications to treat ADHD.⁴⁹ Individuals with a legitimate need for prescription stimulants to treat ADHD who have a history of substance abuse including nonmedical use of prescription stimulants should not be denied stimulants medications, but these medications should be carefully prescribed and monitored. Health professionals are encouraged to consult the most recent American Academy of Child and Adolescents Psychiatry practice parameters for the assessment and treatment of children and adolescents with ADHD and the use of psychotropic medication in children and adolescents.^{49,50}

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Prevalence Estimates of Lifetime Medical and Nonmedical Use of Prescription Stimulants Among High School Seniors in the United States by Race/
Ethnicity, 2010–2011

Table 1

Lifetime medical and nonmedical use	White (n = 2,552) % (95% CI) ^b	Black (n = 569) % (95% CI) ^b	Hispanic (n = 596) % (95% CI) ^b	Other ^a (n = 853) % (95% CI) ^b	Racial differences <i>p-value</i> ^c
No medical or nonmedical use	81.6 (79.4–83.7)	93.3 (90.3–96.3)	91.8 (88.7–95.0)	83.6 (80.1–87.2)	< 0.001
Medical use only	7.1 (5.7–8.5)	3.7 (1.5–6.0)	2.6 (0.8–4.5)	4.3 (2.3–6.3)	< 0.01
Medical use prior to nonmedical use	2.4 (1.5–3.2)	0.4 (0.0–1.1)	1.5 (0.2–2.9)	3.2 (1.5–4.9)	NS
Nonmedical use prior to medical use	1.4 (0.8–2.1)	1.5 (0.0–2.9)	1.1 (0.0–2.2)	3.0 (1.4–4.7)	NS
Nonmedical use only	7.5 (6.1–8.9)	1.1 (0.0–2.3)	3.0 (1.0–4.8)	5.9 (3.6–8.1)	< 0.001

Note:

^aThe subgroup “Other” is comprised of multiple races, Asian, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, not reported, and missing data.

^bEstimates are weighted using the Monitoring the Future (MTF) study weights. 95% CI computed using linearized estimates of the standard errors for the weighted estimates, and the adjustment method of West and McCabe (2012), with an average MTF design effect of 2.0.³⁰

^cUncorrected Pearson chi-square statistics adjusted using a generalized design effect of 2.0.²⁸

Table 2

Prevalence Estimates of Substance Use Behaviors as a Function of Lifetime Medical and Nonmedical Use of Prescription Stimulants Among High School Seniors in the United States, 2010–2011

History of lifetime medical and nonmedical use of prescription stimulants	Any cigarette smoking in the past 30 days % (95% CI) ^a	Any binge drinking in the past 2 weeks % (95% CI) ^a	Any marijuana use in lifetime % (95% CI) ^a	Any other illicit drug use other than marijuana in lifetime % (95% CI) ^a	Any nonmedical use of other prescription medications in lifetime % (95% CI) ^a
No medical or nonmedical use	15.8 (14.2–17.5)	14.9 (13.2–16.5)	7.5 (6.3–8.7)	6.3 (5.2–7.5)	9.8 (8.5–11.2)
Medical use only	20.7 (13.6–27.9)	17.4 (10.7–24.2)	12.1 (6.3–17.8)	12.3 (6.5–18.2)	10.2 (4.8–15.6)
Medical use prior to nonmedical use	55.2 (41.0–69.4)	39.4 (25.4–53.4)	30.6 (17.8–43.4)	38.4 (24.0–52.8)	58.7 (44.5–72.9)
Nonmedical use prior to medical use	44.6 (28.5–60.7)	53.4 (36.4–70.3)	51.3 (35.1–67.5)	54.7 (38.1–71.3)	73.5 (58.5–88.5)
Nonmedical use only	56.4 (47.8–64.9)	46.0 (37.5–54.5)	36.5 (28.3–44.7)	55.6 (47.0–64.2)	58.9 (50.3–67.4)
<i>Rao-Scott p-value^b</i>	< 0.001***	< 0.001***	< 0.001***	< 0.001***	< 0.001***

Note: Binge drinking in the past 2 weeks was defined as consuming 5 or more drinks in a row at least once in the past 2 weeks. Any illicit drug use other than marijuana included LSD, other psychedelics, crack cocaine, other cocaine, or heroin. Any nonmedical use of other prescription medications included opioids, sedatives, or tranquilizers.

^a Estimates are weighted using the Monitoring the Future (MTF) study weights, and standard errors for parameter estimates are design-adjusted using the method of West and McCabe (2012).³⁰

^b Rao-Scott Chi-square tests of homogeneity adjusted using a generalized design effect of 2.0 were conducted to determine whether history of medical and nonmedical use of prescription stimulants was significantly associated with each substance use behavior, and all tests were significant (*** $p < 0.001$).²⁸

Table 3

Estimated Relationships of Medical and Nonmedical Use of Prescription Stimulants With the Odds of Substance Use Behaviors, Based on Logistic Regression Analyses for High School Seniors in the United States, 2010–2011

History of lifetime medical and nonmedical use	Any cigarette smoking in the past 30 days	Any binge drinking in the past 2 weeks	Any marijuana use in lifetime	Any illicit drug use other than marijuana in lifetime	Any nonmedical use of other prescription medications in lifetime
	AOR (95% CI) ^a	AOR (95% CI) ^a	AOR (95% CI) ^a	AOR (95% CI) ^a	AOR (95% CI) ^a
No medical or nonmedical use					
Medical use only	Reference ^b 1.3 (0.8–2.1)	Reference ^b 1.1 (0.7–1.8)	Reference ^b 1.7 (0.9–3.0)	Reference ^b 2.1 (1.2–3.8) [*]	Reference ^b 1.0 (0.5–1.8)
Medical use prior to nonmedical use	6.3 (3.5–11.3) ^{***}	3.6 (2.0–6.5) ^{***}	5.4 (2.7–10.6) ^{***}	8.6 (4.5–16.3) ^{***}	12.0 (6.5–22.3) ^{***}
Nonmedical use prior to medical use	4.2 (2.2–8.3) ^{***}	6.6 (3.2–13.4) ^{***}	13.3 (6.8–25.9) ^{***}	17.7 (8.7–35.8) ^{***}	25.2 (11.7–54.1) ^{***}
Nonmedical use only	6.5 (4.5–9.6) ^{***}	4.5 (3.1–6.6) ^{***}	6.6 (4.4–9.8) ^{***}	17.6 (11.7–26.7) ^{***}	11.8 (7.9–17.5) ^{***}
Sample size, N ^c	4,439	4,378	4,499	4,241	4,345

Note: Binge drinking in the past 2 weeks was defined as consuming 5 or more drinks in a row. Any illicit drug use other than marijuana included LSD, other psychedelics, crack cocaine, other cocaine, or heroin. Any nonmedical use of other prescription medications included opioids, sedatives, or tranquilizers. AOR = adjusted odds ratio.

^a Multivariable logistic regression analyses adjusted for race/ethnicity, cohort year, school geographical region, and standard metropolitan statistical area (SMSA). Estimates are weighted using the Monitoring the Future (MTF) study weights, and standard errors for parameter estimates are design-adjusted using the method of West and McCabe (2012).³⁰

^b The reference group is no medical or nonmedical use.

^c Sample sizes for the regression models ranged from 4,241 (any illicit drug use) to 4,499 (any marijuana use) due to missing data.

^{*} $p < 0.05$.

^{***} $p < 0.001$.