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Medical Use, Illicit Use and Diversion of Prescription Stimulant Medication†

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Abstract

The objective of this study was to examine the prevalence and factors associated with the illicit use of prescription stimulants and to assess the relationship between the medical and illicit use of prescription stimulants among undergraduate college students. A Web survey was self-administered by a random sample of 9,161 undergraduate students attending a large public midwestern university in the spring of 2003. A total of 8.1% reported lifetime illicit use of prescription stimulants and 5.4% reported past year illicit use. The number of undergraduate students who reported illicit use of prescription stimulants exceeded the number of students who reported medical use of prescription stimulants for ADHD. The leading sources of prescription stimulants for illicit use were friends and peers. Multivariate logistic regression analyses revealed several risk factors for illicit use of prescription stimulants such as being male, White, member of a social fraternity or sorority, Jewish religious affiliation, and lower grade point average. All of these characteristics were also related to medically prescribed use of prescription stimulants. Those who initiated medically prescribed use of prescription stimulants for ADHD in elementary school were generally not at increased risk for illicit use of prescription stimulants or other drugs during college as compared to those who were never prescribed stimulant medication. The present study provides evidence that the illicit use of prescription stimulants is a problem among undergraduate college students, and certain subgroups appear to be at heightened risk.

Keywords

college students; epidemiology; prescription drug abuse; stimulant medication for ADHD; substance use

“Getting Adderall and Ritalin are probably easier than getting alcohol on this campus.”

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—Male undergraduate college student

“I snorted my friend’s Ritalin before finals last semester.”

—Female undergraduate college student

Psychostimulants commonly prescribed for the treatment of attention deficit hyperactivity disorder (ADHD) include various formulations of methylphenidate (Ritalin, Concerta), dextroamphetamine (Dexedrine), and mixed-salts amphetamine (Adderall) (Greenhill et al. 2002). Several studies have reported recent increases in the prescription rates of stimulant medications among American youth (Olfson et al. 2003; Robison et al. 2002, 1999; Safer, Zito & Fine 1996). The rise in stimulant prescriptions is probably due to several factors, including improved diagnostic practices (Goldman et al. 1998) and an increased duration of treatment (Safer, Zito & Fine 1996). Although prescription stimulants are considered medically sound and efficacious for treating symptoms of ADHD, the high abuse potential of these medications, paired with an increase in both the medical and illicit use over the past decade, has captured the attention of public health officials (Kollins, MacDonald & Rush 2001; Johnston, O’Malley & Bachman 2003a, b; Office of Applied Studies 2003, 2002a, Office of Applied Studies b).

For purposes of the present study, illicit use of prescription stimulants refers to the use of a scheduled, psychotherapeutic stimulant medication not prescribed to an individual by a doctor. Although illicit use of prescription stimulants among college students has been observed, to date it has received much less attention than other forms of substance use such as heavy drinking (e.g., O’Malley & Johnston 2002; Wechsler et al. 2002), marijuana use (e.g., Gledhill-Hoyt et al. 2000; Bell, Wechsler & Johnston 1997), and Ecstasy use (e.g., Boyd, McCabe & d’Arcy 2003; Yacoubian 2003; Strote, Lee & Wechsler 2002).

The illicit use of prescription medications has been increasing in the past decade among US college students and is second only to marijuana as the most common form of illicit drug use (Johnston, O’Malley & Bachman 2003a); thus, it may represent a significant public health problem if there are adverse consequences associated with illicit use (Johnston, O’Malley & Bachman 2003a, b; Office of Applied Studies 2003). The illicit use of many prescription medications, including stimulant medications, by college students and other young adults aged 18 to 22 is now at its highest level in several decades (Johnston, O’Malley & Bachman 2003a, b). Johnston and colleagues (2003a) found that college students reported higher rates of illicit use of methylphenidate (Ritalin) in the past year (5.7%) than their same age peers not attending college (2.5%).

Studies examining illicit use of prescription stimulants at individual colleges and universities suggest there is wide variation in the prevalence rates between schools (see Table 1). To date, annual rates of illicit use of prescription stimulants range from 3% at the lowest use school to 36% at the highest use school. However, differences in prevalence rates between schools could be partially attributed to the sampling methods and dependent measures used in these studies. Past research has identified some possible correlates for illicit use of prescription stimulants among college students (e.g. Johnston, O’Malley & Bachman 2003a; Teter et al. 2003; Babcock & Byrne 2000). For instance, Babcock and Byrne (2000) found illicit use of methylphenidate was much more prevalent among traditional-aged students (18 to 24) than among nontraditional students (25 years or older). In fact, no students older than 25 years reported illicit use. Several studies have found that college men reported higher rates of illicit use of stimulant medications than college women (e.g. Johnston, O’Malley & Bachman 2003a; Low & Gendaszek 2002). After controlling for several demographic factors, lifetime or past year illicit users of methylphenidate were significantly more likely to earn lower grade point averages and engage in higher rates of alcohol and other drug (AOD) use and other risky behaviors (Teter et al. 2003). Taken together, these past studies have identified selected correlates but additional

epidemiological research is needed to accurately assess the characteristics of those individuals most at risk for illicit use of stimulant medication based on larger samples.

Despite the high prevalence and recent increases in illicit use, prescription stimulants remain a highly effective and safe medication for the majority of individuals with ADHD. Despite their abuse potential, the use of stimulant medications for ADHD does not appear to increase the risk for developing substance-related disorders later in life (Barkley et al. 2003) and possibly is protective against subsequent substance use disorders in those with ADHD (Wilens et al. 2003). Case reports (e.g. Barrett & Pihl 2002; Coetzee, Kaminer & Morales 2002; Garland 1998; Jaffe 1991; Goyer, Davis & Rapoport 1979) and poison center reports (Klein-Schwartz 2003; Foley, Mrvos & Krenzelo 2000) suggest that individuals have used their own prescription stimulants for reasons other than what was intended by the prescribing clinician. The relationship between medically prescribed use of stimulant medication for ADHD and subsequent illicit use of prescription stimulants among college students is relatively unexplored in epidemiological studies. One college-based study found no past year illicit use of prescription stimulants among medically prescribed methylphenidate users (Teter et al. 2003) while other studies excluded prescribed users from analyses (Low & Gendaszek 2002), did not collect information regarding medical use of prescription stimulants (Johnston, O'Malley & Johnston 2003a; University of Florida Alcohol and Drug Resource Center 2002) or did not examine the relationship between the personal use of prescribed medications and the illicit use of these medications (Babcock & Byrne 2000). One study of secondary school students found that among the prescribed users of stimulant medication for ADHD, 29% also reported illicit use of stimulant medication but no information was available regarding the temporal relationship between prescribed and illicit use (McCabe, Teter & Boyd 2004).

There are no studies that we are aware of describing the diversion of prescription stimulants among college students. A better understanding of the diversion of medically prescribed stimulants is available for elementary and secondary school students (e.g. McCabe, Teter & Boyd 2004; Farris et al. 2003; Moline & Frankenberger 2001; Poulin 2001; Musser et al. 1998). Of school children in rural Mid-western areas who had been prescribed stimulant medication, 16% were approached to sell, give or trade their stimulant medication (Musser et al. 1998). Another study of middle school and high school students in Canada found that approximately 15% who were prescribed stimulants gave them away and 7% reported selling them (Poulin 2001). Young men were significantly more likely to divert medication than young women. Approximately 14% of those responsible for dispensing medication at middle schools and high schools in Iowa reported medications had been stolen from the medication storage area at their schools (Farris et al. 2003). McCabe and colleagues (2004) examined the prevalence and factors associated with the diversion of prescribed stimulant medication for ADHD within a racially diverse sample of secondary school students. Of the students who reported prescription stimulant use, 23% were approached to sell, give or trade their prescription drugs.

Collectively, findings suggest the diversion of prescription stimulants is occurring among secondary school students. However, important differences exist between secondary students and postsecondary college students that may limit directly comparing these two age groups. For instance, differences are known between college and younger students in terms of their physical, intellectual, and emotional development as well as drug use behaviors (e.g. Hawkins, Catalano & Miller 1992; Johnston et al. 2003a, b; Schulenberg & Maggs 2002). In addition, college students are often responsible for their own medication management, which may have an impact on the diversion of stimulant medications. Therefore, research is needed to examine the diversion of prescription drugs among college students.

To date, there are no known studies that have systematically examined the illicit use, diversion, and relationships between medical and illicit use of prescription stimulants within the same undergraduate college student population. The prevalence and severity of prescription drug abuse may represent a problem in higher education until the causes of illicit use and diversion of prescription stimulants are better understood. The incomplete understanding of factors associated with prescription drug abuse represents an important shortcoming in higher education because this lack of information may lead to misguided research and prevention efforts.

METHODS

In the present study, a large random sample of undergraduate college students self-administered a Web survey that focused on drug use, including the illicit use of prescription stimulants. Open-ended questions and corresponding responses were used to examine how illicit users obtained prescription stimulants, and a content analysis was used to advance a more complex understanding of the sources for illicit use of prescription stimulants among college students. Finally, relationships between the medical and illicit use of prescription stimulants were assessed, as were other substance use behaviors associated with the medical and illicit use of prescription stimulants.

The protocol for the present study was approved by the Institutional Review Board and respondents gave informed consent online. The study was conducted during March and April of 2003, drawing on a total undergraduate population of 21,294 full-time students (10,860 women and 10,434 men). A random sample of 19,378 full-time undergraduate students was drawn from the Registrar's Office records. The entire sample was sent an email invitation describing the study and asking them to self-administer the Student Life Survey (SLS) by clicking on a link to access the Web survey and using a unique password. All participants were informed that a private research firm was contracted to set-up the Web survey as well as store and maintain data. University officials, faculty or staff were unable to access any contact information connected with the data of any respondent. The Web survey was maintained on a hosted secure Web site running under the secure sockets layer (SSL) protocol to insure that respondent data was safely transmitted between the respondent's browser and the server. Finally, all respondents were sent information making it clear that participation was voluntary, explaining the relevance of the study and that responses were kept confidential. Previous research has shown that less than 1% of nonrespondents in an identical Web survey had concerns regarding confidentiality that prevented them from completing the survey (McCabe 2004). By participating in the survey, students became eligible for a sweepstakes that included 13 cash prizes ranging from \$100 to \$1,000. The final response rate was 47%, which is consistent with national college-based alcohol and other drug studies (Wechsler et al. 2002). Study design and procedures are described in more detail elsewhere (McCabe 2002; McCabe et al. 2002).

Sample

As illustrated in Table 2, the final sample consisted of 9,161 undergraduate students and the demographic characteristics closely resembled the characteristics of the overall student population ($N = 21,294$). The proportion of women was higher in the sample than the overall student population (56% versus 51%). The racial/ethnic and academic class year distributions between the sample and population mirrored each other. The racial/ethnic distribution of the sample was 68% White, 13% Asian, 6% African American, 4% Hispanic, and 9% other racial/ethnic category. Approximately 46% of the sample lived in a house or apartment within the university town, 44% in a university residence hall, 5% in a fraternity or sorority house, and 5% resided in some other living arrangement. Roughly three out of four undergraduate students

lived within one mile of the main campus and 98% of the sample was not married. Approximately 14% of the sample belonged to a social fraternity or sorority.

Instrument and Measures

The Student Life Survey (SLS) was developed and pilot tested in 1993 and 1999 and includes items from several national studies of alcohol and other drug use (Wechsler et al. 2000; Johnston, O'Malley & Bachman 1999; Presley, Meilman & Cashin 1996). Demographic measures in the survey included items such as gender, race/ethnicity, class year, social fraternity and sorority status, living arrangement, family income, religious affiliation, and grade point average.

Medically prescribed use of stimulant medication was measured using the following item: "Based on a doctor's prescription, on how many occasions . . . (a) in your lifetime or (b) in the past 12 months have you used the following types of drugs? Stimulant medication for ADHD (e.g., Ritalin, Dexedrine, Adderall, Concerta)." The response scale was (1) never, (2) 1–2 occasions, (3) 3–5 occasions, (4) 6–9 occasions, (5) 10–19 occasions, (6) 20–39 occasions, and (7) 40 or more occasions. If respondents indicated they were medically prescribed stimulant medication for ADHD in their lifetime, they received a follow-up question asking when they began using the stimulant medication for ADHD. The three response categories were elementary school, secondary school (middle school or high school), and college. Based on the age of initiation of stimulant medication for ADHD and whether students were medically prescribed stimulants in the past year, four mutually exclusive groups were formed to examine different patterns of medically prescribed use, which included: (1) no prescribed use, (2) elementary school initiation (elementary initiators), (3) secondary school initiation (secondary initiators), and (4) college initiation (college initiators).

Illicit use of prescription stimulant medication was assessed with the following item: "Sometimes people use prescription drugs that were meant for other people, even when their own doctor has not prescribed it for them. On how many occasions . . . (a) in your lifetime or (b) in the past 12 months have you used the following types of drugs, NOT prescribed to you? Stimulant medication (e.g., Ritalin, Dexedrine, Adderall, Concerta)." The response scale was the same as for medically prescribed use.

Diversion of prescription stimulant medication was assessed using the following item: "On how many occasions . . . (a) in your lifetime or (b) in the past 12 months have you been approached to sell, trade or give away your prescription medication? Stimulant medication for ADHD (e.g., Ritalin, Dexedrine, Adderall, Concerta)." The response scale was the same as for medically prescribed use.

Obtaining prescription stimulant medication not prescribed to an individual was assessed by asking respondents who reported illicit use of prescription stimulant medication the following statement: "Please use the text box below to explain how you obtained prescription drugs NOT prescribed to you by a doctor." Since so little information is available regarding the sources for diversion, an open-ended text box was provided to respondents.

Binge drinking was measured using the following single item question: "Over the past two weeks, on how many occasions have you had five or more drinks in a row (four or more for women)?" A drink was defined as a glass of wine, a bottle of beer or wine cooler, a shot glass of liquor or a mixed drink. The response scale was (1) none, (2) once, (3) twice, (4) 3–5 occasions, (5) 6–9 occasions, and (6) 10 or more occasions (Wechsler et al. 2000).

Monthly alcohol use was measured using the following question: "On how many occasions (if any) have you had alcohol to drink—more than just a few sips during the past 30 days?" The

response scale was: (1) no occasions, (2) 1–2 occasions, (3) 3–5 occasions, (4) 6–9 occasions, (5) 10–19 occasions, (6) 20–39 occasions, and (7) 40 or more occasions (Johnston et al. 2003a).

Annual marijuana use was assessed using the following question: “On how many occasions in the past 12 months have you used the following types of drugs? DO NOT include drugs used under a doctor’s prescription.” The response scale was the same as for monthly alcohol use.

An *annual illicit drug index* was developed by summing the total number of illicit drugs used in the past year (other than marijuana). The illicit drugs included in the index were cocaine, LSD, other psychedelics, Ecstasy, inhalants, amphetamines, crystal meth, heroin, other opiates, GHB, and Rohypnol. The response scale for each drug was the same as for monthly alcohol use.

Data Analysis

The prevalence of medically prescribed use, illicit use and diversion of prescription stimulants was determined by taking the number of students reporting each of these behaviors and dividing by the total number of respondents. Bivariate associations between medically prescribed use and several characteristics were examined using chi-square tests. Next, multiple logistic regressions were used to model student characteristics with medically prescribed use of prescription stimulants, using characteristics that were significantly associated with medically prescribed use of prescription stimulants based on bivariate results ($p < 0.05$). Adjusted odds ratios and 95% confidence intervals were reported. The same bivariate and multivariate approaches were used for illicit use of prescription stimulants.

In addition, a content analysis was performed on open-ended responses to the following question: “Please use the text box below to explain how you obtained prescription drugs NOT prescribed to you by a doctor.” After reading all of the open-ended textual responses ($n = 458$) provided by students who reported illicit use of prescription stimulants in the past year, the first author constructed distinct categories (with defining attributes) based on the text. After creating the categories, he proceeded to code the students’ responses and place the responses within the previously determined and mutually exclusive categories. After completing the initial coding, all of the textual responses were given to the second and third authors with instructions to independently code them using the previously determined categories constructed by the first author. Inter-coder agreement was determined by randomly selecting 100 of the open-ended responses and comparing the three raters’ coding of these responses and was calculated after all three coders completed their coding of the textual data. Inter-coder agreement was defined as the number of responses agreed upon by three raters divided by the total number of responses assessed. An inter-rater agreement of 95% was obtained for the three raters using the random sample of 100 open-ended responses.

RESULTS

Medically Prescribed Use of Prescription Stimulants

Approximately 3% ($n = 287$) of undergraduate students reported medical use of prescription stimulants for ADHD in their lifetime and 2% ($n = 184$) reported medically prescribed use in the past year. As illustrated in Table 3, after controlling for several student characteristics, the factors that were significantly associated with the medically prescribed use of stimulant medication for ADHD in the past year were being White, a member of a social fraternity or sorority, annual family income more than \$250,000, Jewish religious affiliation, and low cumulative grade point average.

Illicit Use of Prescription Stimulants

Approximately 8.1% of the undergraduate student sample reported the illicit use of prescription stimulants in their lifetime ($n = 744$) and 5.4% in the past year ($n = 458$). Approximately 48% of students who reported illicit use of prescription stimulants in the past year used on one to two occasions, 34% used on three to nine occasions, and 18% used on 10 or more occasions.

As illustrated in Table 4, after controlling for several student characteristics, the factors that were significantly associated with the illicit use of stimulant medication for ADHD in the past year were being male, White, upper-class (non-freshmen), member of a social fraternity or sorority, resident of a fraternity or sorority house, resident of an off-campus house or apartment, Jewish religious affiliation, no religious affiliation, lower cumulative grade point average, and initiation of exposure to stimulant medication for ADHD during secondary school or in college. In particular, undergraduate men and White students were significantly more likely to report illicit use of prescription stimulants than women and Asian- and African-American undergraduate students, respectively. Students residing in a fraternity house, sorority house, off-campus house or off-campus apartment were significantly more likely than students living in residence halls to report illicit use of prescription stimulants. Students who considered their primary religious affiliation as Jewish or who had no religious affiliation were significantly more likely than students who considered their primary affiliation as Catholic to report illicit use of prescription stimulants. Students with lower cumulative grade point averages were significantly more likely than students who earned a 3.5 or above to report illicit use of prescription stimulants. Finally, students who initiated medically prescribed use of stimulant medication for ADHD in secondary school or college were three to seven times more likely than students who were never prescribed stimulant medication for ADHD to report illicit use of prescription stimulants. However, students who initiated medically prescribed use of stimulants for ADHD in elementary school were not more likely than students who were never prescribed stimulant medication for ADHD to report illicit use of prescription stimulants.

Diversion of Prescription Stimulants

Of the undergraduate students who were medically prescribed stimulant medication for ADHD in the past year, approximately 54% had been approached to divert their medication (e.g., sell, trade or give away) in the past year. There were no significant associations between being approached to divert stimulant medication and gender, race, class year, family income, and religious affiliation.

Sources for Illicit Use of Prescription Stimulants

Following the content analysis of the open-ended responses provided by students who reported illicit use of prescription stimulants, we became most interested in the sources of these drugs that were described by undergraduate students. Of the 458 students who reported illicit use of prescription stimulants in the past year, the leading source for obtaining the prescription stimulants were friends and peers ($n = 310$). One hundred and thirty-one students did not specify a source or indicated they did not know their source. Fourteen students identified a family member (e.g., sibling, parent, and other family members) as their source for obtaining prescription stimulants. There were a few sources (less than 1%) cited by students that included: abroad, drug dealer, and self. Notably, there were *no* undergraduate students who indicated obtaining prescription stimulants via the Internet. Finally, students often obtained the prescription stimulant medication from a friend or peer who had been medically prescribed stimulants. Likely responses coded within the leading category of friend/peer included such statements as:

- A friend has a prescription and sells the pills to me.” (White male, senior)
- “I was given them by a friend at a party.” (White female, freshmen)

- “My friends need these drugs for ADD/ADHD and they give them out to myself and other friends.” (Hispanic female, senior)
- “From friends with prescriptions, or from those who have bought large quantities from people with prescriptions.” (White male, junior)
- “Purchased from friends who may or may not have the prescription for them. Adderall and Ritalin are especially easy to get, because they are so widely prescribed.” (White male, sophomore)
- “Getting Adderall and Ritalin are probably easier than getting alcohol on this campus. I could find 500 pills in 20 minutes.” (White male, senior)
- “A friend who was prescribed to this drug gave me a pill.” (White male, sophomore)
- “My friend has ADD and so has a prescription.” (White male, freshman)
- “A friend has a prescription for Ritalin.” (White female, sophomore)

Medical and Illicit Use of Prescription Stimulants and Substance Use

A greater percentage of illicit users of prescription stimulants in the past year reported binge drinking in the past two weeks when compared to nonusers (88% versus 49%; $\chi^2 = 265.1$, $df = 1$, $p < 0.001$), marijuana use in the past year (93% versus 34%; $\chi^2 = 622.6$, $df = 1$, $p < 0.001$), cocaine use in the past year (33% versus 2%; $\chi^2 = 1180.2$, $df = 1$, $p < 0.001$), Ecstasy use in the past year (27% versus 2%; $\chi^2 = 825.3$, $df = 1$, $p < 0.001$), and use of hallucinogens in the past year (34% versus 3%; $\chi^2 = 919.1$, $df = 1$, $p < 0.001$). As illustrated in Table 5, those who initiated medically prescribed stimulants in secondary school or college reported higher rates of alcohol and other drugs (AOD) use than nonusers, while those who initiated medically prescribed stimulants in elementary school generally did not report higher rates of AOD use than nonusers. In particular, medically prescribed users who initiated stimulant medication for ADHD in elementary school reported similar rates as students who were never prescribed stimulants in terms of binge drinking, monthly alcohol use, and illicit drug use other than marijuana. Elementary initiators reported higher rates of annual marijuana and cocaine use, but the differences between nonusers did not reach statistical significance.

DISCUSSION

In an effort to better understand the factors associated with either currently having or having had a prescription for a stimulant medication, student characteristics were examined. White males and fraternity and sorority members were more likely to have been prescribed stimulants than Asians, African Americans, females or nonmembers. In addition, students with lower grade point averages and higher family incomes were also more likely to have been prescribed stimulants, as were Jewish students and students without a religious affiliation. Not surprisingly, many of the characteristics associated with prescribed stimulant use were similar to characteristics related to illicit prescription stimulant use. These included being White, male, lower grade point averages, Jewish, and a fraternity or sorority member. These striking similarities are most likely due—at least in part—to increased availability among students with similar demographic characteristics. Nonetheless, the relationships between those factors associated with both prescribed and illicit prescription stimulant use remains an area that will benefit from future inquiry. Several of the factors associated with medically prescribed use of stimulant medication in the present study have also been shown to be related to the one-year prevalence of stimulant treatment in children five to 14 years old (Cox et al. 2003). In particular, Cox and colleagues (2003) showed that stimulant prescription use was positively associated with male gender, living in higher income communities, and living in communities with a greater percentage of White persons.

While persons with childhood onset ADHD are at increased risk of developing substance-related disorders later in life as compared to those without ADHD (Biederman et al. 1995), there is no evidence that proper medication management with stimulants for young children with ADHD increases the risk for subsequent substance use (Barkley et al. 2003). Furthermore, a recent meta-analysis demonstrated that treatment with stimulant medications during childhood results in a decreased risk for subsequent substance use disorder (SUD) as compared to untreated ADHD individuals (Wilens et al. 2003). While the current study did not assess length of exposure to stimulant medications or ADHD diagnosis, it does provide an interesting complement to the available literature. We found that those who initiated medically prescribed use of stimulants for ADHD in elementary school generally did not have an increased risk of illicit prescription stimulant use or other substance use as compared to nonusers, while those who initiated medically prescribed use in secondary school or later showed increased risk for all substance use behaviors. To our knowledge, previous studies documenting the impact of stimulant pharmacotherapy on substance use behaviors have not examined the relationship between medically prescribed use and illicit use of prescription stimulants within the same sample. In the current study, it appeared that the earlier stimulant medication was prescribed (e.g., elementary age versus secondary school or college age), the less likely the child was to abuse substances in college, including both illicit use of prescription stimulants as well as other drugs of abuse. These findings support early detection and proper medication management, as pharmacotherapy may reduce substance abuse behaviors later in life by decreasing core symptoms of ADHD, such as impulsivity, and by promoting adaptive behaviors (Biederman et al. 1999). It is clear that these prescription patterns need further investigation; overall, there remains insufficient research regarding the possible relationship between the age of initiation of medically prescribed stimulant medication for ADHD and subsequent illicit use of prescription stimulants and other substance use among college students.

There is growing evidence that adolescent illicit users of prescription medications are heavily involved in other drug use (e.g. McCabe, Teter & Boyd 2004; McCabe et al. 2004; Teter et al. 2003; Office of Applied Studies 2002a). The present study found that undergraduate students who reported illicit use of prescription stimulants were much more likely to use other drugs such as marijuana and cocaine, which is consistent with recent findings among secondary school students (McCabe, Teter & Boyd 2004; McCabe et al. 2004), college students (Teter et al. 2003), and young adults (Office of Applied Studies 2002a). The higher rates of substance use among illicit prescription stimulant users suggests that this type of drug use behavior is part of a pattern of polydrug use and likely represents part of a larger cluster of multiple problem behaviors (e.g., Biglan et al. 2004; Jessor, Donovan & Costa 1991).

The present study provided compelling evidence that the main source of prescription stimulants for illicit use among undergraduate students were their friends and peers. Of those illicit users who specified a source, 92% indicated that they obtained prescription stimulants from friend and peer sources. There was little evidence that prescription stimulants were being obtained via the Internet but there was strong evidence that prescription stimulants were being diverted from students with medical prescriptions to other students based on self-reports from illicit users. In addition, more than half of undergraduate students who were medically prescribed stimulants for ADHD were approached to give away, trade or sell their stimulant medication in the past year. The rate of college students with prescriptions for stimulant medication or ADHD who were approached to divert their stimulant medication was higher than previous studies within younger student populations (e.g., McCabe et al. 2004; Poulin 2001; Musser et al. 1998).

Implications for Future Practice and Research

There are several potential risks to the illicit user who obtains prescription stimulants from non-physician sources. In these cases, illicit users who obtain stimulants from their peers do not benefit from a thorough clinical assessment and they do not receive important medical information that accompanies a prescription for stimulants. The illicit user is likely to be unaware of the stimulant's potential for interaction with other drugs or alternatively, the drug's documented contraindications and precautions. For example, the death of a 19-year old male was directly attributed to methylphenidate taken in combination with alcohol. The patient developed hyperpyrexia and tachycardia as well as cardiac lesions—signs and symptoms consistent with amphetamine toxicity (Massello & Carpenter 1999). Also, there is literature to suggest that a significant proportion of those using stimulant medications nonmedically develop problem use and dependence behaviors (Simoni-Wastila & Strickler 2004; Zacny et al. 2003). In addition, students who are medically prescribed stimulants and divert their medication are at risk of being noncompliant with their therapeutic drug regimen, which has been prescribed for a medical condition. This may result in an exacerbation of symptoms or in an apparent treatment failure.

The higher rates of illicit use and diversion among college students could be largely attributed to college students being more likely than younger student populations to be responsible for their own medication management and less likely to have medication administration and control strategies (e.g., school and parental) over prescription stimulant medication (e.g., Farris et al. 2003). The lack of medication administration and control strategies at institutions of higher education and the high rates of diversion found in the present study suggest that novel pharmaceutical delivery systems that are less prone to abuse (e.g., Concerta) or nonstimulant alternative medications for ADHD (e.g., atomoxetine, bupropion) may be particularly useful for reducing the illicit use and diversion of prescription stimulants among college students. Furthermore, in young adults attending college who are diagnosed with ADHD complicated by a substance use disorder, bupropion may be an appropriate first-line option for the treatment of ADHD (Wilens et al. 2001).

Based on the findings of the present study, future research would benefit from examining the long-term usage patterns of prescription stimulant medications among undergraduate students beyond college and into young adulthood. Past research has shown that heavy drinking and other substance use, except for cigarette smoking, tends to decline as college students assume post-college responsibilities (Bachman et al. 2002, 1997; Schulenberg & Maggs 2002; Schulenberg et al. 2001). However, it remains unknown whether these post-college patterns of decline in substance use hold true for the illicit use of prescription drugs with high abuse potential, such as stimulant medication. Future research should examine possible adverse consequences resulting from the illicit use of prescription stimulants. In particular, research using well-defined diagnostic survey items is needed to explore the relationship between the illicit use of prescription stimulants and the subsequent development of abuse and dependence. Finally, there is recent evidence of an increase in illicit use of other prescription drugs (such as opiate analgesics and benzodiazepines) among young adults and college students that should be the focus of additional research (Johnston, O'Malley & Bachman 2003a, b; Zacny et al. 2003).

Limitations

The present study contained some limitations that should be noted while considering the findings. First, generalizability of the present study could be limited because it took place at a single university and the sample was predominantly White and relatively affluent. Second, nonresponse bias may have impacted the results of the present study given the response rate. The concerns regarding nonresponse bias were lessened because demographic characteristics

of the sample closely resembled the characteristics of the overall student population. In addition, the rates of drug use in the present study were similar to national results of college students (Johnston, O'Malley & Bachman 2003a; Mohler-Kuo, Lee & Wechsler 2003). Third, we did not collect information regarding the quantity of illicit stimulant medication that students were using on each occasion, context of use or route of administration—factors that have been previously shown to influence the medical use and abuse of methylphenidate (Volkow & Swanson 2003). Future research examining the motives, route of administration, and context of illicit use could help to further clarify the extent to which students are abusing stimulant medications. Finally, the current study relied on self-report data, and respondents in this study may have had trouble recalling the answers to questions about prescription medications they were prescribed, used illicitly or diverted when they were younger. While previous research has shown the self-report questions used in the present study to be valid and reliable (e.g., Harrison & Hughes 1997; Johnston & O'Malley 1985; O'Malley, Bachman & Johnston 1983), additional research is needed to examine the reliability of survey questions used to assess the licit and illicit use of prescription stimulant medications.

Despite these limitations, the present findings suggested a strong relationship between certain prescription patterns of stimulant medication for ADHD and the likelihood for subsequent illicit use of prescription stimulants and other substance use. These findings demonstrate the importance of assessing the age of initiation of prescription stimulants when examining the relationship between medically prescribed use of stimulant medication for ADHD and substance use. Additional prospective research is needed to assess whether there is an increased risk for substance use among individuals who are initially treated for ADHD with stimulant medications in secondary school or college as compared to earlier initiation of stimulant treatment in elementary school.

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TABLE 1
Prevalence of Illicit Use of Prescription Stimulants Among College Students Based on Survey Research

Author(s)	Methodology and Population	Sample	Stimulant	Illicit Prevalence	Risk Factors
Babcock & Byrne 2000	Cross-sectional, mailed paper survey of all enrolled undergraduate students) (n=1401 at the Massachusetts College of Liberal Arts	N = 283	Methylphenidate (Ritalin)	Lifetime = 16.6%	Traditional-aged (under 25 years old)
Johnston, O'Malley & Bachman 2003a	Longitudinal, mailed paper survey of a national sample of college students one to four years past high school enrolled full-time in two- or four-year colleges or universities	N = 1260	Methylphenidate (Ritalin)	Past year = 5.7%	Male
Low & Gendaszek 2002	Cross-sectional, in-class paper survey of convenience sample of undergraduate students primarily from psychology classes at a small U.S. college	N = 150	Methylphenidate Adderall	Past year = 35.5%	Male, high sensation seeking
Teter et al. 2003	Cross-sectional, Web survey of a random sample of 3500 undergraduate students at the University of Michigan	N = 2250	Methylphenidate (Ritalin)	Lifetime = 5.1% Past year = 2.5%	High family income, low GPA, Jewish religious affiliation, higher rates of risky behaviors
University of Florida Alcohol & Drug Resource Center 2002	Cross-sectional, in-class paper survey of randomly selected classrooms at the University of Florida	N = 1332	Methylphenidate (Ritalin)	Lifetime = 5.9% Past year = 2.9% Past month = 1.5%	NA

TABLE 2
Demographic Characteristics of Population, Sample and Illicit Stimulant Users, 2003

	Undergraduate Population (N = 21,294) %	Undergraduate Sample (N = 9,161) %	Past Year Illicit Stimulant Users (N = 458) %
Gender			
Women	50.6	56.2	51.3
Men	49.4	43.8	48.7
Race/ethnicity			
White	64.0	68.0	78.2
African-American	8.2	6.3	1.5
Asian	13.9	12.6	7.9
Hispanic	4.6	4.2	5.9
Other	9.3	8.9	6.6
Class year *			
Freshmen	15.8	15.9	13.5
Sophomore	23.8	24.4	25.3
Junior	25.8	26.3	30.1
Senior	34.4	33.0	30.8
Other **	0.3	0.4	0.2

* Class year status is based on academic credit hours.

** Noncandidate degree status.

TABLE 3
Adjusted Odds Ratios (OR) for Medically Prescribed Use of Stimulant Medication, 2003

	N = 8,362	Lifetime		Past Year	
		Odds Ratios	95% CI	Odds Ratios	95% CI
Gender					
Male	3,596	1.00	reference	1.00	reference
Female	4,766	0.67 ^{***}	0.52–0.86	0.86	0.63–1.16
Race					
White	5,749	1.00	reference	1.00	reference
African American	513	0.30 ^{**}	0.13–0.71	0.33 [*]	0.11–0.97
Hispanic	356	1.19	0.71–1.98	1.09	0.57–2.09
Asian	1,026	0.38 ^{**}	0.22–0.66	0.38 [*]	0.18–0.79
Other	718	0.97	0.63–1.47	1.15	0.80–1.90
Class year					
Freshmen	1,319	1.00	reference	1.00	reference
Sophomore	2,022	0.84	0.57–1.23	0.71	0.43–1.16
Junior	2,219	1.10	0.80–1.50	1.13	0.76–1.67
Senior	2,769	1.04	0.64–1.69	1.02	0.56–1.85
Other	33	1.12	0.15–8.54	****	****
Living arrangement					
Residence hall	3,741	1.00	reference	1.00	reference
Fraternity/sorority	403	1.08	0.62–1.91	1.09	0.56–2.10
House/apartment	3,926	1.21	0.85–1.71	0.99	0.64–1.54
Outside city and other	292	1.06	0.49–2.29	0.56	0.17–1.89
Fraternity/sorority status					
Non-member	7,248	1.00	reference	1.00	reference
Member	1,114	1.77 ^{***}	1.26–2.49	1.93 ^{***}	1.29–2.89
Annual family income					
Less than \$50,000	1,028	1.00	reference	1.00	reference
\$50,000 – \$99,999	2,009	0.58 [*]	0.35–0.95	0.56	0.27–1.14
\$100,000 – \$149,999	1,674	0.87	0.54–1.41	1.35	0.71–2.54
\$150,000 – \$249,999	1,058	1.12	0.68–1.85	1.67	0.87–3.22
More than \$250,000	763	1.56	0.95–2.56	2.24 [*]	1.17–4.32
Don't know or refused	1,830	1.32	0.85–2.08	1.48	0.80–2.77
Religious affiliation					
Catholic	2,234	1.00	reference	1.00	reference
Jewish	764	2.45 ^{***}	1.67–3.60	2.84 ^{***}	1.80–4.47
Presbyterian	343	1.23	0.63–2.38	1.34	0.62–2.93
Episcopal	159	1.92	0.92–3.99	1.83	0.75–4.45
Protestant	727	1.02	0.59–1.74	0.88	0.44–1.78
Christian reformed	148	0.55	0.13–2.27	****	****
Baptist	236	1.19	0.45–3.13	1.05	0.30–3.65
Interdenominational	530	0.73	0.35–1.55	0.75	0.29–1.93
Muslim	134	0.36	0.05–2.62	****	****
None	1,984	1.68 ^{**}	1.19–2.37	1.50	0.96–2.32
Other	945	1.27	0.79–2.04	1.28	0.71–2.30
Refused	158	0.70	0.22–2.29	0.38	0.05–2.83
Cumulative GPA					
3.5 or higher	2,837	1.00	reference	1.00	reference
3.0 to 3.4	3,199	1.79 ^{**}	1.27–2.51	2.34 ^{***}	1.49–3.69
2.5 to 2.9	1,567	3.28 ^{***}	2.28–4.72	4.24 ^{***}	2.61–6.88
Below 2.5	759	4.10 ^{***}	2.68–6.27	6.83 ^{***}	3.99–11.69

Note: Sample sizes are based on lifetime model.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

**** Sample size of particular cell was too small to produce reliable odds ratio.

TABLE 4
Adjusted Odds Ratios (OR) for Illicit Use of Stimulant Medication, 2003

	N = 8,307	Lifetime		Past Year	
		Odds Ratios	95% CI	Odds Ratios	95% CI
Gender					
Male	3,568	1.00	reference	1.00	reference
Female	4,739	0.83*	0.70–0.99	0.77*	0.63–0.95
Race					
White	5,712	1.00	reference	1.00	reference
African American	508	0.41**	0.23–0.75	0.35**	0.16–0.77
Hispanic	353	0.92	0.62–1.37	1.16	0.75–1.79
Asian	1,018	0.57**	0.41–0.78	0.67*	0.46–0.98
Other	716	0.63**	0.44–0.88	0.69	0.46–1.03
Class year					
Freshmen	1,315	1.00	reference	1.00	reference
Sophomore	2,006	1.42**	1.10–1.82	1.90***	1.40–2.58
Junior	2,204	1.28*	1.03–1.58	1.59**	1.23–2.08
Senior	2,749	1.56*	1.09–2.22	2.27***	1.48–3.45
Other	33	1.89	0.55–6.45	1.33	0.18–9.99
Living arrangement					
Residence hall	3,720	1.00	reference	1.00	reference
Fraternity/sorority	401	1.75**	1.17–2.60	1.68*	1.08–2.61
House/apartment	3,895	2.63***	2.04–3.37	2.48***	1.84–3.35
Outside city and other	291	1.98**	1.19–3.32	0.92	0.39–2.16
Fraternity/sorority status					
Non-member	7,209	1.00	reference	1.00	reference
Member	1,098	2.29***	1.81–2.91	2.80***	2.14–3.66
Annual family income					
Less than \$50,000	1,021	1.00	reference	1.00	reference
\$50,000 – \$99,999	1,998	0.85	0.63–1.16	1.02	0.70–1.49
\$100,000 – \$149,999	1,668	0.91	0.67–1.25	0.94	0.64–1.40
\$150,000 – \$249,999	1,047	0.91	0.65–1.28	0.98	0.64–1.49
More than \$250,000	756	1.24	0.88–1.74	1.36	0.90–2.05
Don't know or refused	1,817	0.69*	0.50–0.96	0.67	0.45–1.01
Religious affiliation					
Catholic	2,224	1.00	reference	1.00	reference
Jewish	756	2.02***	1.54–2.66	1.98***	1.45–2.72
Presbyterian	342	0.74	0.44–1.24	0.62	0.33–1.20
Episcopal	158	1.01	0.53–1.90	0.91	0.43–1.95
Protestant	722	0.86	0.59–1.25	0.79	0.50–1.24
Christian reformed	146	1.64	0.89–3.01	1.00	0.42–2.33
Baptist	236	0.40	0.15–1.13	0.60	0.21–1.70
Interdenominational	528	0.74	0.46–1.20	0.52	0.26–1.01
Muslim	134	0.43	0.13–1.40	0.41	0.10–1.70
None	1,971	1.69***	1.34–2.14	1.45**	1.10–1.92
Other	940	1.47*	1.08–2.00	1.23	0.84–1.79
Refused	150	1.59	0.83–3.05	1.58	0.74–3.37
Cumulative GPA					
3.5 or higher	2,824	1.00	reference	1.00	reference
3.0 to 3.4	3,175	1.39**	1.13–1.71	1.62***	1.25–2.10
2.5 to 2.9	1,553	1.63***	1.28–2.09	1.90***	1.40–2.57
Below 2.5	755	1.75**	1.29–2.38	1.96**	1.35–2.86
Initiated prescribed use					
Never prescribed	8,048	1.00	reference	1.00	reference
Elementary initiation	65	1.11	0.48–2.72	1.72	0.72–4.11
Secondary initiation	99	4.25***	2.68–6.73	3.14***	1.82–5.42
College initiation	95	7.72***	4.98–11.97	7.51***	4.75–11.89

Note: Sample sizes are based on lifetime model.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

TABLE 5
Prevalence and Adjusted Odds Ratios (OR) of Substance Use as a Function of Age of Initiation of Prescription Stimulant Medication

Age of Initiation of Prescription Stimulant Medication	Two-Week Binge Drinking		Monthly Alcohol Use		Annual Marijuana Use		Annual Cocaine Use		Annual Illicit Drug Index	
	%	OR	%	OR	%	OR	%	OR	%	OR
Stimulant medication No prescribed use (n = 8199)	50.9	1.00	74.3	1.00	36.3	1.00	3.2	1.00	14.3	1.00
Elementary initiation (n = 65)	50.0	0.69	78.1	1.01	50.8	1.49	9.2	2.42	18.5	1.20
Secondary initiation (n = 105)	70.2	1.68*	90.4	2.59**	60.0	1.98**	19.2	4.40****	41.9	3.54****
College initiation (n = 97)	68.0	1.07	94.8	3.60**	78.9	4.30****	22.1	4.46****	51.5	4.41****

Note: Odds ratios (OR) are adjusted for all other predictors in the model and the reference group for each model was students who did not report nonmedical use of stimulants in the past year. All of the models also included gender, race, class year, living arrangement, fraternity/sorority membership, family income, religious affiliation, and grade point average. The odds ratios for these variables were not shown.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.

Illicit drug index consists of summing annual use of cocaine, LSD, other psychedelics, Ecstasy, inhalants, amphetamines, crystal meth, heroin, other opiates, GHB, and Rohypnol.