Non-medical use of prescription stimulants among US college students: prevalence and correlates from a national survey

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ABSTRACT

Aims To examine the prevalence rates and correlates of non-medical use of prescription stimulants (Ritalin, Dexedrine or Adderall) among US college students in terms of student and college characteristics.

Design A self-administered mail survey.

Setting One hundred and nineteen nationally representative 4-year colleges in the United States.

Participants A representative sample of 10 904 randomly selected college students in 2001.

Measurements Self-reports of non-medical use of prescription stimulants and other substance use behaviors.

Findings The life-time prevalence of non-medical prescription stimulant use was 6.9%, past year prevalence was 4.1% and past month prevalence was 2.1%. Past year rates of non-medical use ranged from zero to 25% at individual colleges. Multivariate regression analyses indicated non-medical use was higher among college students who were male, white, members of fraternities and sororities and earned lower grade point averages. Rates were higher at colleges located in the north-eastern region of the US and colleges with more competitive admission standards. Non-medical prescription stimulant users were more likely to report use of alcohol, cigarettes, marijuana, ecstasy, cocaine and other risky behaviors.

Conclusions The findings of the present study provide evidence that non-medical use of prescription stimulants is more prevalent among particular subgroups of US college students and types of colleges. The non-medical use of prescription stimulants represents a high-risk behavior that should be monitored further and intervention efforts are needed to curb this form of drug use.

KEYWORDS Adderall, ADHD, amphetamines, college students, Dexedrine, methylphenidate, non-medical use, prescription stimulants, Ritalin.

INTRODUCTION

Methylphenidate, dextroamphetamine and mixed-salts amphetamine are considered first-line pharmacotherapy for the treatment of attention deficit hyperactivity disorder (ADHD) (Greenhill *et al.* 2002). Brand names for these compounds include Ritalin, Dexedrine and Adderall, respectively. Several studies have reported recent increases in the prescribing of psychoactive medications in the United States (Olfson *et al.* 2002; Zito *et al.* 2003), including amphetamines and other stimulant medications for ADHD (Robison *et al.* 1999, 2002; Olfson *et al.* 2003). The rise in these medical prescriptions is due to several factors, including an increased awareness

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regarding the signs and symptoms of certain disorders (e.g. ADHD) (Goldman *et al.* 1998) and an increased duration of treatment (Safer, Zito & Fine 1996). In order to put these increased US rates of prescription stimulants into an international perspective, it is important to recognize that the use of prescription stimulants, such as methylphenidate, is higher in the United States than in other countries (Berbatis *et al.* 2002). Indeed, the United States consumes a majority of the world's supply of methylphenidate (Woodworth 2000). The prevalence of the ADHD diagnosis is also higher in the United States than in other countries (Popper & West 1999). Furthermore, increases in the use of prescription psychostimulants, such as methylphenidate, have occurred in countries outside the United States as well (Berbatis *et al.* 2002). The implications of this increased use of prescription stimulants remain to be determined.

Despite the efficacy of prescription stimulants for treating symptoms of ADHD, the increase in prescription rates has raised some public health concerns because of the abuse potential of these medications (Kollins, MacDonald & Rush 2001) and the evidence that the non-medical use of prescription stimulants represents a problem among young adults in general (Office of Applied Studies 2003; SAMHSA 2003a, 2003b) and among college students in particular (Babcock & Byrne 2000; Johnston, O'Malley & Bachman 2003a, 2003b; Teter *et al.* 2003). National epidemiological studies (Office of Applied Studies 2002a, 2002b; Johnston *et al.* 2003a, 2003b), national surveillance reports (SAMHSA 2003a, 2003b) and college-based studies (e.g. Babcock & Byrne 2000; Teter *et al.* 2003; McCabe, Teter & Boyd in press) provide strong evidence that the non-medical use of prescription stimulants is a growing problem among young adults and college students in the United States. The Monitoring the Future Study (MTF) found that college students (5.7%) reported higher rates of non-medical use of methylphenidate (Ritalin) than their same-age peers not attending college (2.5%) in the past year (Johnston *et al.* 2003a).

Several studies have examined the non-medical use of prescription stimulants at individual US colleges or universities using random sampling (e.g. Babcock & Byrne 2000; Teter *et al.* 2003; McCabe *et al.* in press). Collectively, these college-based studies suggest that there may be variation in the non-medical prevalence rate of prescription stimulants across different types of colleges. Although these single institutional studies provide valuable information, they provide only a partial picture of the spectrum of non-medical use of prescription stimulants on college campuses in the United States. We could find no studies that have examined the prevalence and correlates of non-medical use of prescription stimulants among a national sample of college students.

The main aims of the present study were to assess the prevalence of non-medical prescription stimulant use (Ritalin, Dexedrine or Adderall) within a large national sample of randomly selected students attending 4-year colleges and to determine the correlates of non-medical use in terms of demographic characteristics, institutional characteristics and other substance use behaviors.

METHOD

The present study used data from the 2001 College Alcohol Study (CAS) survey of 119 American 4-year colleges and universities in 39 states. An administrator from each college or university provided a list of 215 randomly selected college students. One school was excluded because the response rate was considerably lower than the other 119 schools. A total of 10 904 students returned questionnaires, yielding an overall response rate of approximately 52% (range 22–86%). Response rate was not associated with the main outcome variable (i.e. the Pearson correlation coefficient between the non-medical use of stimulant medication and the response rate at the college-level was 0.12 in absolute value with $P = 0.19$). Consistent with previous studies, the data were weighted based on gender, age and ethnicity in order to be more representative of each school. Study design and procedures are described in more detail elsewhere (Wechsler *et al.* 2002).

The final sample of 119 colleges represented a national cross-section of students enrolled at 4-year colleges in the United States. Sixty-nine per cent of students in the CAS sample attended public institutions and 31% attended private institutions, which closely resembles the US national distribution of 68% and 32%, respectively, for full-time, 4-year college students. Sixty-nine per cent of students in the CAS sample attended schools in medium- to large-sized cities and 31% attended colleges in small towns and rural areas, which approximates the US national distribution of 71% and 29%, respectively. Eighty-seven per cent of students in the CAS sample attended non-religiously affiliated colleges and 13% attended religiously affiliated schools compared to 84% and 16% of full-time, 4-year college students nation-wide. In addition, 47% of students in the CAS sample attended large institutions (>10 000 students), 23% medium-sized institutions (5001–10 000 students) and 29% small institutions (1000–5000 students). Twenty-three per cent of students in the CAS sample attended schools located in the North-east, 29% in the South, 30% in the North Central and 18% in the West. Finally, 5% of students in the CAS sample attended women's colleges and 2% attended historically black colleges and universities.

The questionnaire and measures

Students completed a 20-page survey, which contained questions regarding demographic characteristics, substance use and other health behaviors.

Non-medical use of prescription stimulants

Respondents were asked 'How often, if ever, have you used any of the drugs listed below? Do not include anything you used under a doctor's orders.' Drug items included 'Ritalin, Dexedrine or Adderall.' The response scale was (1) never used; (2) used, but not in the past 12 months; (3) used, but not in the past 30 days; and (4) used in the past 30 days.

Illicit drug use

Respondents were asked 'How often, if ever, have you used any of the drugs listed below? Do not include anything you used under a doctor's orders.' Drug items included each of the following: 'marijuana, crack cocaine, other forms of cocaine, ecstasy (MDMA) and opiate-type prescription drugs (e.g. codeine, morphine, Demerol, Percodan, Percocet, Vicodin, Darvon, Darvocet).' The response scale ranged from (1) never used to (4) used in the past 30 days.

Cigarette use

Respondents were asked 'How often, if ever, have you used any of the drugs listed below? Do not include anything you used under a doctor's orders.' Drug items included 'cigarettes.' The response scale ranged from (1) never used to (4) used in the past 30 days.

Alcohol use

Heavy episodic drinking (or binge drinking) was defined as the consumption of at least five drinks in a row for men and at least four drinks in a row for women during the 2 weeks preceding completion of the questionnaire (Wechsler *et al*. 1995). 'Frequent binge drinking' was defined as having three or more binge drinking episodes in the past 2 weeks. 'Drink to get drunk' was assessed with one item that asked students whether drinking 'to get drunk' was an important reason to drink alcohol.

Data analysis

Data analysis included 10 904 undergraduate student respondents from 119 institutions. Statistical analyses were carried out using procedures available in the Stata software package for analysis of complex sample survey data (StataCorp 2001). Data were weighted to account for colleges' varying sampling fractions. We used contingency tables to present the prevalence estimates of non-medical use of prescription stimulants in terms of student and college characteristics. Differences among the prevalence of non-medical use between student and college characteristics were compared using Pearson's χ^2 statistics corrected for the survey clustered design. Pearson's χ^2 tests were conducted for the following individual-level characteristics (gender, race, Hispanic ethnicity, age, living arrangement, fraternity/sorority membership, grade point average, father's level of education, mother's level of education) and college-level characteristics (admissions selectivity, public versus private college, geographical region, commuter status, co-educational status, size of school enrollment, urbanization). Multiple logistic regressions accounting for the complex design of the sample were used to predict the student level outcomes of past year and past month non-medical use of prescription stimulants, while controlling for the individual-level and college-level characteristics that were significantly associated with either past year or past month non-medical use of prescription stimulants according to the bivariate results ($P < 0.01$). Odds ratios were adjusted for gender, race, age, living arrangement, fraternity and sorority membership status, grade point average, mother's educational level, father's educational level, admissions selectivity, geographical region and commuter status; 95% confidence intervals (CI) were reported for the odds ratios. Interactions between college-level and individual-level characteristics were examined in the logistic regression models in order to investigate whether the relationships of individual-level characteristics with non-medical use of prescription stimulants varied by college-level characteristics. A similar multivariate approach was used to examine the relationship of non-medical use of prescription stimulants with the likelihood of engaging in various substance use behaviors, adjusting for other factors. We used stata to obtain correct standard errors of the estimated regression coefficients accounting for the clustered design of the sample.

RESULTS

Prevalence of non-medical use of prescription stimulants by student characteristics

Approximately 6.9% (SE = 0.005) of college students reported life-time non-medical use of prescription stimulants, 4.1% (SE = 0.004) reported non-medical use in the past year and 2.1% (SE = 0.002) reported past month use. As illustrated in Table 1, the past year and past month prevalence of non-medical use of prescription

Table 1 Prevalence of non-medical use of prescription stimulants by student characteristics, 2001.

Student characteristics	*n*	*Past year use % (95% CI)*	χ^2 *P-value*[a]	*Past month use % (95% CI)*	χ^2 *P-value*[a]
Gender					
Female	6952	2.9 (2.3, 3.6)	<0.001	1.6 (1.2, 2.0)	<0.001
Male	3868	5.8 (4.6, 7.2)		2.8 (2.2, 3.7)	
Race					
White	8195	4.9 (4.1, 6.0)	<0.001	2.5 (2.0, 3.1)	<0.001
African American	787	1.6 (0.6, 4.2)		0.4 (0.1, 1.3)	
Asian	835	1.3 (0.7, 2.6)		0.7 (0.2, 2.0)	
Other	938	3.1 (1.9, 4.9)		2.0 (0.1, 3.4)	
Age (years)					
Under 21	5437	4.5 (3.6, 5.6)	<0.001	2.5 (1.9, 3.2)	<0.01
21–23	3959	4.5 (3.6, 5.6)		2.1 (1.5, 2.8)	
24 or older	1438	1.6 (0.9, 2.6)		0.7 (0.3, 1.7)	
Living arrangement					
Single-sex residence hall	1291	3.5 (2.3, 5.5)	<0.001	2.0 (1.1, 3.4)	<0.001
Co-ed residence hall	2543	4.5 (3.3, 6.2)		2.5 (1.8, 3.5)	
Other university housing	399	4.0 (2.3, 6.8)		1.8 (0.7, 4.4)	
Fraternity/sorority house	267	13.3 (7.8, 21.8)		8.0 (4.7, 13.3)	
Off campus house or apartment	6241	3.7 (2.9, 4.6)		1.8 (1.3, 2.3)	
Fraternity/sorority membership					
Non-member	9395	3.5 (2.8, 4.4)	<0.001	1.8 (1.4, 2.3)	<0.001
Member	1331	8.6 (6.2, 11.8)		4.7 (3.2, 6.7)	
Grade point average					
B or lower	4661	5.2 (4.2, 6.5)	<0.001	2.6 (2.0, 3.4)	<0.01
B + or higher	6179	3.3 (2.6, 4.1)		1.7 (1.3, 2.2)	
Father's level of education					
Less than high school diploma	665	1.6 (0.7, 3.3)	<0.001	0.7 (0.3, 1.9)	<0.001
High school diploma	1921	2.5 (1.7, 3.6)		0.9 (0.1, 1.7)	
Some college	2742	3.0 (2.3, 3.9)		1.4 (0.1, 2.0)	
Four year college degree or more	5185	5.7 (4.6, 7.1)		3.1 (2.4, 3.9)	
Don't know	144	1.5 (0.5, 4.7)		1.5 (0.1, 4.7)	
Not applicable	146	3.6 (0.9, 13.2)		3.0 (0.1, 13.7)	
Mother's level of education					
Less than high school diploma	589	2.0 (1.0, 4.0)	<0.001	0.5 (0.2, 1.7)	<0.01
High school diploma	2382	3.1 (2.2, 4.3)		1.5 (0.9, 2.3)	
Some college	3193	3.5 (2.7, 4.5)		1.7 (1.2, 2.3)	
Four year college degree or more	4514	5.5 (4.3, 6.9)		3.0 (2.3, 3.9)	
Don't know	72	0.1 (<0.1, 3.9)		0.5 (<0.1, 3.9)	
Not applicable	42	9.0 (1.9, 33.2)		7.1 (1.1, 34.8)	

[a]χ^2 *P*-values indicate whether percentages are significantly different by student characteristics. The results for individual characteristics that were not significantly ($P < 0.01$) associated with either past year or past month non-medical use of prescription stimulants are not shown and included Hispanic ethnicity.

stimulants differed significantly as a function of several student characteristics including gender, race/ethnicity, age, living arrangement, fraternity/sorority membership, grade point average and parental level of education.

Prevalence of non-medical use of prescription stimulants by college characteristics

There was a great deal of variation across campuses with respect to the non-medical use of prescription stimulants. As illustrated in Fig. 1, the aggregate past year prevalence rates of non-medical use at individual colleges ranged from 0% to 25%, with 20 schools having a prevalence of 0% and 12 schools having a prevalence of 10% or higher. Based on the overall past year prevalence of 4.1% and an average college sample size of 90, the standard error at the typical/average college was approximately 2%. The past month prevalence rates of non-medical use at individual colleges ranged from 0% to 13%.

As illustrated in Table 2, the prevalence of past year and past month non-medical use of prescription

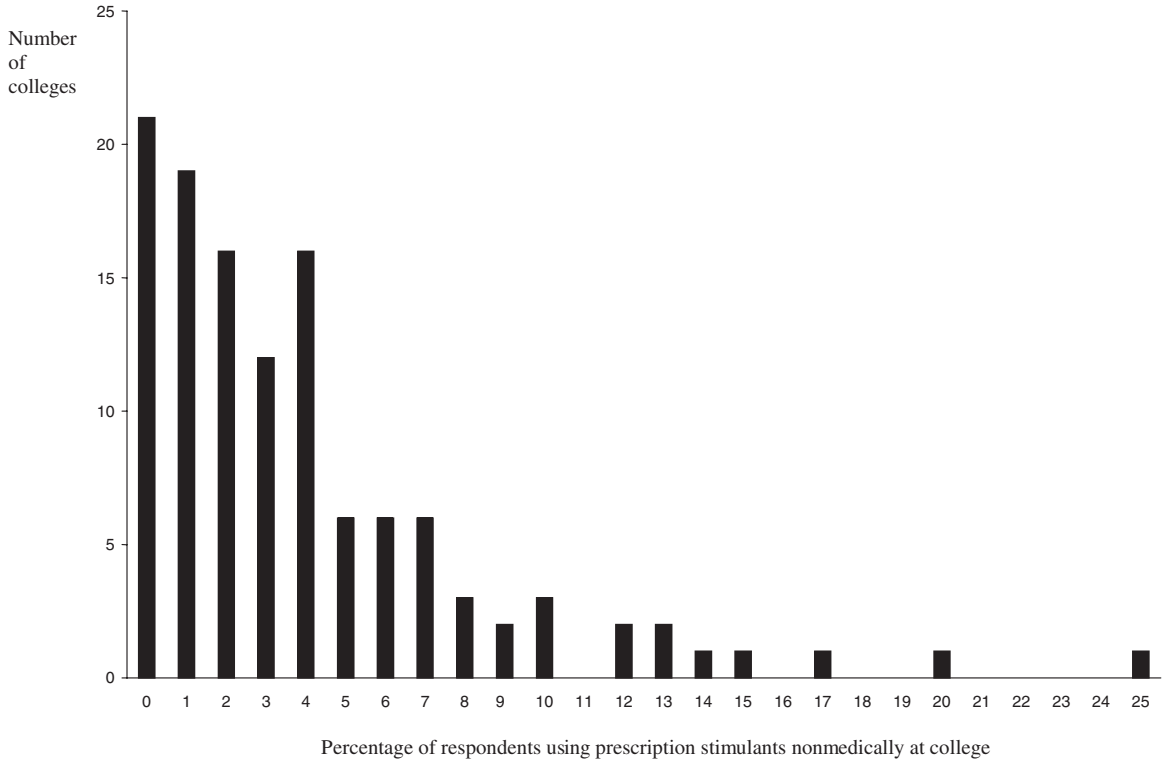

Figure 1 Distribution of past year non-medical use of prescription stimulants across 119 colleges, 2001

Table 2 Prevalence of non-medical use of prescription stimulants by college characteristics, 2001.

Student characteristics	*College sample n*	*Student sample n*	*Past year use % (95% CI)*	χ^2 *P-value*[a]	*Past month use % (95% CI)*	χ^2 *P-value*[a]
Admission criteria						
Less competitive	26	2288	1.3 (0.9, 2.1)	<0.001	0.7 (0.4, 1.4)	<0.01
Competitive	71	6375	4.5 (3.6, 5.7)		2.3 (1.7, 3.0)	
Most competitive	22	2177	5.9 (4.0, 8.5)		3.1 (2.1, 4.4)	
Geographical region						
North-east	29	2544	6.3 (4.4, 9.0)	<0.01	3.1 (2.1, 4.6)	<0.05
South	37	3162	4.6 (3.3, 6.3)		2.7 (2.0, 3.7)	
North Central	33	3208	2.8 (2.1, 3.8)		1.3 (0.9, 1.8)	
West	20	1926	3.2 (1.9, 5.4)		1.5 (0.8, 3.1)	
Commuter status						
Non-commuter school	104	9499	4.6 (3.8, 5.6)	<0.001	2.3 (1.8, 2.9)	<0.01
Commuter school	15	1341	1.2 (0.7, 1.9)		0.9 (0.4, 1.7)	

[a]χ^2 P-values indicate whether distributions are significantly different by college characteristics. The results for college characteristics that were not significantly ($P < 0.01$) associated with either past year or past month non-medical use of prescription stimulants are not shown and included public versus private college status, co-educational status, size of school enrollment and urbanization.

stimulants differed significantly as a function of admissions selectivity, commuter status and geographical region (past year only). For example, more than 80% of the colleges with an aggregate past year prevalence rate of 10% or higher had highly competitive admissions standards and were located either in the North-east or Southern regions of the United States. In addition, among all students attending three historically black colleges in the sample, there were no students who reported non-medical use of prescription stimulants in the past year.

Multivariate results

As illustrated in Table 3, logistic regression analyses confirmed that past year and past month non-medical use of prescription stimulants was higher among college

Table 3 Correlates of non-medical use of prescription stimulants by student and college characteristics.[a]

	Past year		*Past month*	
Characteristic	*Adjusted OR*[b]	*95% CI*	*Adjusted OR*[b]	*95% CI*
Gender				
Female	–	–	–	–
Male	1.92***	(1.49, 2.48)	1.66***	(1.24, 2.21)
Race				
White	–	–	–	–
African American	0.39	(0.15, 1.07)	0.18**	(0.05, 0.62)
Asian	0.26***	(0.13, 0.52)	0.30*	(0.10, 0.92)
Other	0.75	(0.47, 1.20)	1.03	(0.60, 1.67)
Fraternity/sorority membership				
Non-member	–	–	–	–
Member	2.07***	(1.38, 3.09)	2.04**	(1.21, 3.45)
Grade point average				
B or lower	–	–	–	–
B + or higher	0.54***	(0.42, 0.70)	0.57***	(0.42, 0.78)
Admission criteria				
Less competitive	–	–	–	–
Competitive	2.29**	(1.34, 3.91)	1.88	(0.95, 3.71)
Most competitive	2.57**	(1.36, 4.84)	2.06	(0.98, 4.34)
Geographical region				
North-east	–	–	–	–
South	0.68	(0.42, 1.09)	0.86	(0.54, 1.39)
North Central	0.46**	(0.30, 0.72)	0.44**	(0.26, 0.72)
West	0.56	(0.30, 1.05)	0.52	(0.22, 1.22)

*$P < 0.05$, **$P < 0.01$, ***$P < 0.001$. – Reference category. [a]The sample size for both models was 10 556 cases. [b]Odds ratios are adjusted for all predictors in both models, which included gender, race, age, living arrangement, mother's level of education, father's level of education, fraternity and sorority membership status, grade point average, admissions selectivity, geographical region and commuter status. The results for variables that were not significantly ($P < 0.01$) associated with either past year or past month non-medical use of prescription stimulants are not shown and included age, living arrangement, mother's level of educational level, father's level of education and commuter status.

students who were male, white, members of fraternities and sororities, had lower grade point averages, attended colleges located in the North-eastern region of the United States and attended more selective colleges (past year only). Specifically, after adjusting for other factors, college men were almost two times more likely than women to report non-medical use of prescription stimulants. In addition, white students were more likely than Asian and African American students to report non-medical use. Fraternity and sorority members were over two times more likely than non-members to report non-medical use of prescription stimulants. Students who earned a B or lower grade point average were almost two times more likely to report non-medical use compared to students who earned a B + or higher. In terms of college characteristics, students attending colleges located in the North-eastern region of the United States were more likely to report non-medical use than students attending colleges located in North Central region of the United States. Finally, students who attended colleges with competitive or highly competitive admissions criteria were over two times more likely than students who attended less competitive colleges to report past year non-medical use of prescription stimulants.

Interactions between college-level and individual-level characteristics were examined in the multiple logistic regression models in order to investigate whether the relationships of individual-level risk factors that significantly predicted non-medical use of prescription stimulants in Table 3 varied by college-level characteristics (results not shown). There were no significant interactions for past month non-medical use and only one significant interaction was found for past year non-medical use. In particular, attending college in the North Central United States served as a stronger risk factor for non-members of fraternities and sororities relative to members for past year non-medical use ($P = 0.005$).

Interactions between individual-level characteristics were also examined and very few were found. There were no significant interactions for past month non-medical use and only one statistically significant interaction was found for past year non-medical use. Being African American served as a stronger risk factor for past year non-medical use of prescription stimulants in fraternity/

Table 4 Substance use behaviors associated with past year non-medical use of prescription stimulants.[a]

Substance use behaviors	*Non-medical use (n = 422) % (95% CI)*	*No non-medical use (n = 10 399) % (95% CI)*	*Adjusted OR*[b,c]	*95% CI*
Tobacco and alcohol use				
Cigarette use in the past 30 days	66.7 (61.7, 71.4)	23.6 (22.0, 25.2)	6.15***	(4.88, 7.76)
Frequent binge drinking	69.4 (63.0, 75.1)	20.6 (18.7, 22.6)	6.75***	(5.01, 9.08)
Drink to get drunk	80.8 (76.2, 84.7)	46.8 (44.7, 49.0)	3.79***	(2.85, 5.04)
Drug use in the past 30 days				
Marijuana	67.8 (62.5, 72.8)	14.6 (13.4, 15.8)	10.59***	(8.16, 13.73)
Ecstasy	18.9 (14.5, 24.3)	1.3 (1.1, 1.7)	16.50***	(11.06, 24.62)
Cocaine	17.3 (13.8, 21.5)	0.9 (0.7, 1.1)	19.70***	(13.36, 29.05)
Opiates (other than heroin)	19.4 (15.7, 23.7)	2.1 (1.8, 2.5)	10.58***	(7.85–14.26)
Drug use in the past year				
Marijuana	84.6 (80.0, 88.4)	27.3 (25.5, 29.1)	12.29***	(8.86, 17.06)
Ecstasy	51.7 (46.1, 57.2)	5.1 (4.5, 5.9)	17.96***	(13.63, 23.67)
Cocaine	34.6 (29.2, 40.4)	2.3 (1.9, 2.7)	22.02***	(15.84, 30.61)
Opiates (other than heroin)	44.2 (39.2, 49.3)	5.5 (4.9, 6.2)	13.00***	(9.99, 16.93)
Other risky behaviors				
Drove after binge drinking	35.2 (29.4, 41.4)	9.4 (8.1, 10.8)	5.37***	(4.09, 7.04)
Passenger with a drunk driver	66.0 (60.5, 71.1)	21.3 (19.7, 23.1)	6.83***	(5.38, 8.69)
Drove after drinking	58.7 (51.6, 65.4)	26.9 (24.7, 29.2)	4.03***	(2.98, 5.45)

***$P < 0.001$. [a]The sample sizes for logistic regression models ranged from 10 474 to 10 555 with the exception of 'drink to get drunk', which was based on only those who consumed alcohol in the past 30 days ($n = 8576$). [b]Odds ratios are also adjusted for gender, race, age, living arrangement, parental education, fraternity/sorority membership, grade point average, geographical region, commuter status and admissions selectivity. The results for these variables are not shown. [c]The reference group for each logistic regression model was students who did not report non-medical use of prescription stimulants in the past year.

sorority members compared to non-members ($P = 0.007$).

The relationship of non-medical use of prescription stimulants to other substance use

As illustrated in Table 4, non-medical use of prescription stimulants was highly related to substance use and other risky behaviors after adjusting for the same factors in Table 3. For instance, past year non-medical prescription stimulant users were ten times more likely to report marijuana use in the past year, almost seven times more likely to report frequent binge drinking, over 20 times more likely to report cocaine use in the past year, and over five times more likely to report driving after binge drinking than college students who had not used prescription stimulants non-medically. Results were similar for the relationship between past month non-medical use and other drug use (results not shown).

At the college-level of analysis, the correlation of non-medical prescription stimulant use and substance use at the 119 colleges and universities was examined. The correlation between a school's past year aggregate rate of non-medical use of prescription stimulants and marijuana use in the past year was $r = 0.55$ ($P < 0.001$). The correlation between a school's past year aggregate level of non-medical use of prescription stimulants and aggregate level of binge drinking was $r = 0.52$ ($P < 0.001$). Finally, college campuses with high (over 50%) or medium (36–50%) aggregate levels of binge drinking had significantly higher past year aggregate rates of non-medical prescription stimulant use than schools with lower (35% or less) aggregate levels of binge drinking (6%, 5% and 1%, respectively, $P < 0.001$).

DISCUSSION

The present study found that the population of US college students reporting life-time non-medical use of prescription stimulants was 6.9%, past year use was 4.1% and past month use was 2.1%. These prevalence rates are similar to recent rates from other national studies of college students (e.g. Johnston *et al.* 2003a) and young adults (Office of Applied Studies 2002a, 2002b). Non-medical prescription stimulant use was higher among certain types of college students, in particular among men, white students, members of fraternities and sororities and those with lower grade point averages. Collectively, many of these individual-level characteristics have been shown previously to be associated with higher rates of substance use among American college

students such as heavy episodic drinking (e.g. Cashin, Presley & Meilman 1998; Wechsler *et al.* 2000; Wechsler *et al.* 2002), marijuana use (e.g. Bell, Wechsler & Johnston 1997; Gledhill-Hoyt *et al.* 2000), and ecstasy use (e.g. Strote, Lee & Wechsler 2002; Yacoubian 2003),

At least two other studies have shown that undergraduate college men were more likely than women to report non-medical use of prescription stimulants (Johnston *et al.* 2003a; McCabe *et al.* in press). Despite gender differences in prevalence of non-medical use, the results of the present study indicated that risk factors for non-medical use of prescription stimulants generally operated in a similar way for women and men. The higher rates of non-medical prescription stimulant use found among white college students compared to other racial groups is consistent with racial differences in non-medical use of prescription stimulants among college students (McCabe *et al.* in press) as well as racial differences found in the prescription rates for stimulant medications (e.g. LeFever, Dawson & Morrow 1999; Safer & Malever 2000; Cox *et al.* 2003; Zito *et al.* 2003; McCabe *et al.* in press). Finally, the higher non-medical rates of prescription stimulants use among members of social sororities and fraternities are consistent with studies that have found higher prevalence rates of other drug use among students who belong to these organizations (e.g. Bell, Wechsler & Johnston 1997; Wechsler *et al.* 2002; Yacoubian 2003).

Consistent with previous studies examining other illicit drug use, the non-medical use of prescription stimulants varied across different types of colleges and universities (Bell *et al.* 1997; Gledhill-Hoyt *et al.* 2000; Strote *et al.* 2002). In the present study, the annual non-medical use of prescription stimulants had a wide range across schools from zero per cent at the lowest to 25% at the highest. The variation in non-medical use was consistent with differences observed across previous single institution studies and reinforces the value of collecting representative samples from multiple colleges and universities. The present study found similar geographical patterns of non-medical use of prescription stimulants, as was found in the MTF study among young adults ages 19–30, with the highest annual rates of non-medical methylphenidate use found among young adults residing in the North-eastern region of the United States (Johnston *et al.* 2003a). The high prevalence rates found among colleges in the North-eastern region of the United States also resembles at least two single institution studies that found high rates of non-medical use of prescription stimulants at small colleges in the North-east (Babcock & Byrne 2000; Low & Gendaszek 2002).

Taken together, the findings that associate higher rates of non-medical prescription stimulant use with more competitive admissions standards as well as fraternity/sorority membership suggest these factors are serving collectively as a proxy for higher socio-economic status. Indeed, at least one study has found that undergraduate students with higher family incomes reported higher rates of non-medical prescription stimulant use (Teter *et al.* 2003).

The present study found that non-medical users of prescription stimulants were dramatically more likely to use other drugs and engage in other risky behaviors, which is consistent with at least three other college-based studies (Teter *et al.* 2003; McCabe *et al.* in press; Teter *et al.* in press). In addition, Teter *et al.* in press) found the most prevalent motivations for non-medical use of prescription stimulants among college students were to improve concentration, enhance alertness and to get high. Over 50% of non-medical users reported using prescription stimulants to get high and substance use rates were significantly higher among non-medical users than non-users, regardless of motivation for non-medical use (Teter *et al.* in press). The higher rates of substance use and other risky behaviors found among non-medical prescription stimulant users may be an indication that the non-medical use of prescription stimulants is part of a larger cluster of problem behaviors among college students (Jessor, Donovan & Costa 1991).

Several anecdotal case reports document the possible consequences of non-medical use of stimulants (e.g. Parran & Jasinski 1991; Massello & Carpenter 1999; Barrett & Pihl 2002). Epidemiological studies have found that a significant proportion of non-medical prescription stimulant users develop problem use and dependence behaviors (Zacny *et al.* 2003; Simoni-Wastila & Strickler 2004). In addition, McCabe *et al.* in press) found in a random sample of 9161 undergraduate students that over 90% of non-medical users of prescription stimulants who reported a source indicated they obtained prescription stimulants from peers and friends (McCabe *et al.* 2004b). In these cases, the non-medical 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.

Limitations

The 2001 CAS did not measure legitimate medical use of prescription stimulants or diagnosis, so it was not possible to assess how many students with legitimate prescriptions for stimulants may have misused their own or someone else's stimulant medication. As the data were cross-sectional, inferences about causality are limited and we could not assess whether certain factors preceded initiation of non-medical use of prescription stimulants. Longitudinal data are needed to further examine the directionality of these associations. Additional research is

needed to ascertain the behavioral patterns that lead to the high rates of non-medical use of prescription stimulants. Finally, the present study probably underestimates the extent of non-medical psychostimulant use on US college campuses because we focused exclusively on three stimulants (e.g. Ritalin, Dexedrine or Adderall) and did not examine the non-medical use of other methylphenidate formulations (e.g. Concerta) or other dextroamphetamine formulations (e.g. Dextrostat).

The CAS is subject to the limitations of self-report surveys. However, such surveys have been used widely and are considered generally valid in examining substance use when certain conditions of confidentiality are met (O'Malley, Bachman & Johnston 1983; Johnston & O'Malley 1985; Harrison & Hughes 1997; O'Malley & Johnston 2002). For instance, it was made clear to students in the present study that participation was voluntary, the relevance of the study was explained, and respondents were assured that their responses would remain anonymous. Next, non-response may have introduced potential bias in the present study. While we can never fully eliminate the possibility of bias introduced through non-response, we tried to minimize its impact through weighting procedures. In addition, we examined the impact of the response rate and found no significant relationship between response rate and the prevalence rates of non-medical use of stimulant medication. Furthermore, the prevalence rates of non-medical use of prescription stimulants reported in this study are comparable to rates found in other national substance use surveys of US young adults and college students (Johnston *et al.* 2003a, 2003b; Office of Applied Studies 2002a, 2002b). Finally, the study sample consisted of students attending 4-year US colleges and is not necessarily representative of all US college students, including those attending 2-year colleges. Therefore, our results may not be generalizable to the entire US college population or university students in other countries.

Future practice

Despite their potential for abuse, prescription stimulants remain a highly effective and safe medication for the majority of individuals with ADHD. At least one study has examined the prevalence rates of prescribed college stimulant users being approached to divert their stimulant medication (McCabe *et al.* in press). Of the undergraduate students who were medically prescribed stimulant medication for ADHD, approximately 54% had been approached to divert their medication (e.g. sell, trade or give away) in the past year which was higher than previous investigations of secondary school students (e.g. Musser *et al.* 1998; McCabe *et al.* 2004). Collegiate environments present unique challenges to implementing social control strategies compared to elementary and secondary schools because most college students are adults who are responsible for their own care, and parents or school officials are not as available to provide supervision of medications. One possible means of reducing diversion and abuse is the use of novel pharmaceutical delivery systems that are less prone to abuse (e.g. Concerta). Additionally, appropriate diagnosis, treatment and therapeutic monitoring of college students who are receiving prescription psychostimulants is crucial, not only to improve clinical outcomes but also to help prevent the abuse of these medications within a population that is largely responsible for their own medication management.

Future research

Given the proven therapeutic efficacy of prescription stimulants for the treatment of ADHD (Goldman *et al.* 1998), there is a need to balance the medical necessity of these drugs and the risk for non-medical use among adolescents and young adults. Future research should be conducted to better categorize non-medical users and examine how prescription stimulants are diverted to non-medical use. Further research is also needed to examine additional individual and contextual variables that might be associated with non-medical use of prescription stimulants, such as diagnosis of ADHD, route of administration and motivations for non-medical use. Finally, the present study focused exclusively on college students within the United States. Research is needed to examine whether the findings from this study generalize to other countries. International work is particularly important, as it is not known whether the higher prevalence rates of ADHD and the use of prescription psychostimulants in the United States are correlated with the increased non-medical use of these medications. Therefore, it is unclear if countries outside the United States are at less risk for the non-medical use of prescription stimulants.

While the national prevalence of drinking among US college students has remained steady for the past decade, the non-medical use of several prescription drugs has increased among college students (Gledhill-Hoyt *et al.* 2000; Wechsler *et al.* 2002; Johnston *et al.* 2003a; Mohler-Kuo, Lee & Wechsler 2003). The non-medical use of prescription medications among college students is second only to marijuana as the most common form of illicit drug use (Johnston *et al.* 2003a). Findings from the present study provide additional support to the hypothesis that the non-medical use of prescription stimulants represents a problem within some subgroups of college students that needs to be addressed with effective prevention efforts.

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