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College students' use of cocaine: Results from a longitudinal study

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Abstract

College students have high rates of heavy drinking and other risky behaviors, but little is known about trends in their use of cocaine. In this longitudinal study of 1,253 college students at one large, public university in the mid-Atlantic region, annual interviews assessed opportunity to use cocaine, cocaine use, and DSM-IV criteria for cocaine abuse and dependence. Follow-up rates exceeded 87% annually. Data from the first four years of college were analyzed to detect changes over time and possible gender differences. By their fourth year of college, 36%$_{wt}$ of students had been offered cocaine at least once in their lifetime, and 13%$_{wt}$ had used cocaine. Annual prevalence of cocaine use increased significantly over time (4%$_{wt}$ in Year 1 to 10%$_{wt}$ in Year 4) and remained similar across genders. Opportunities to use cocaine were significantly more prevalent for males than females during Years 2 through 4. Cocaine use given opportunity increased significantly over time for both males and females. Among 243 cocaine users, females (n=113) had more serious use patterns than males, with higher average frequency of use (18.39 vs. 8.83 days during the peak year of use, p<.05) and greater likelihood of meeting criteria for cocaine dependence (9.3% vs. 2.5%, p<.05). Gender differences in typical cocaine dosage were not apparent. College administrators and health providers should be aware of the prevalence of cocaine use among student populations and design strategies to address the problem.

Keywords

Cocaine use; Cocaine abuse; cocaine dependence; gender differences; college students; longitudinal studies

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1. Introduction*

Cocaine is a powerful stimulant with high dependence liability whose use is associated with numerous psychosocial and physical consequences. In 2007, over two million individuals aged 12+ in the US were current cocaine users; use was most prevalent among young adults [Substance Abuse and Mental Health Services Administration (SAMHSA), 2008]. College students represent a large segment of the young adult population, wherein heavy drinking and drug use are prevalent (Arria et al., 2008; Caldeira et al., 2009a; Johnston, O'Malley, Bachman, & Schulenberg, 2008; O'Grady, Arria, Fitzelle, & Wish, 2008; SAMHSA, 2008; Wechsler et al., 2002). Past-year prevalence of cocaine use among college students has increased over the past decade, from 2.9% in 1996 to 5.1% in 2007 (Johnston, O'Malley, Bachman, & Schulenberg, 2007).

Regarding correlates of use, cocaine users often display a history of heavy alcohol and illicit drug use (Jones, Oeltmann, Wilson, Brener, & Hill, 2001; Spalt, 1991). Use is more prevalent among males than females (SAMHSA, 2005), perhaps because males experience greater opportunities (Van Etten, Neumark, & Anthony, 1999), although females are exposed at a younger age (Van Etten & Anthony, 1999). Once given opportunity, males and females are equally likely to try cocaine (Van Etten & Anthony, 1999), and female users are just as likely as male users to become dependent, especially in the early years following initiation (Wagner & Anthony, 2007). Progression from exposure opportunity to use typically occurs within one year (Van Etten & Anthony, 1999).

Clinical and laboratory studies provide conflicting evidence regarding gender differences in sensitivity to cocaine's effects (Collins, Evans, Foltin, & Haney, 2007; Lukas et al., 1996; Lynch et al., 2008). One study suggested that, compared to males, adolescent—but not adult—females use more frequently, experience symptoms at lower doses, and are at greater risk for dependence (Chen & Kandel, 2002). Given that college students are transitioning between adolescence and adulthood, it is possible they might exhibit similar gender differences. These findings suggest a need for more complete information about patterns of cocaine use in college.

This study aimed to: 1) describe trends in the prevalence of cocaine exposure opportunity and use among college students; 2) compare users and non-users on demographic and substance use characteristics; and, 3) examine gender differences among cocaine users with respect to quantity and frequency of use and the proportion meeting DSM-IV criteria for cocaine use disorder (CoUD).

2. Methods

2.1. Design

This study used data from the College Life Study, a longitudinal study of college students at a large, mid-Atlantic university. Details regarding recruitment and design have been described previously (Arria et al., 2008). The study was approved by the university's Institutional Review Board and a federal Certificate of Confidentiality was obtained.

2.2. Participants

Participants, drawn from 1,253 individuals (48.5% male, 70.8% White) recruited during their first year of college and assessed annually regardless of continued college attendance

*Abbreviations: AUD: alcohol use disorder; CoUD: cocaine use disorder; CUD: cannabis use disorder; DSM-IV: Diagnostic and Statistical Manual of Mental Disorders-IV; GEE: generalized estimating equations; NSDUH: National Survey on Drug Use and Health; SAMHSA: Substance Abuse and Mental Health Services Administration; SES: socioeconomic status

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(88% still enrolled at the same university by Year 4), were divided into cocaine users and non-users. Data from the first four annual assessments (Years 1 through 4) were used; follow-up rates ranged from 91.1% in Year 2 (*n*=1,142) to 87.6% in Year 4 (*n*=1,097). Participants were restricted to 1061 individuals for whom lifetime use or non-use of cocaine could be reliably determined (*n*=192 excluded due to missing data).

2.3. Measures

2.3.1. Cocaine opportunity/use—Participants were asked their age at first offer <first use> of cocaine in Year 1, and annually thereafter the number of times they were offered <used> cocaine in the past 12 months. Binary variables were created to indicate the presence or absence of opportunity and use.

2.3.2. Cocaine use disorder—Questions were adapted from the National Survey on Drug Use and Health [NSDUH; (SAMHSA, 2003)] to measure past-year CoUD (abuse or dependence) in Years 3 and 4. CoUD was not assessed in Years 1 and 2, due to the low prevalence of cocaine use. While the questionnaire is not a substitute for a clinical diagnosis, items map to eleven DSM-IV criteria for abuse and dependence (American Psychiatric Association, 1994). Dependence was defined by endorsing three or more of the seven dependence criteria, and abuse by one or more of the four abuse criteria (in the absence of dependence). Individuals who used cocaine less than five days in the past 12 months skipped out of the CoUD questions, similar to procedures used in the NSDUH, and were coded for the absence of CoUD and all CoUD criteria. Annual data were later consolidated into one variable representing the highest level of disorder for each participant (e.g., if a participant met criteria for abuse in Year 3 and dependence in Year 4, Year 4 was used).

2.3.3. Other substance use disorders—Alcohol and cannabis use disorders (AUD and CUD) were assessed at Year 1 in a similar fashion (see Caldeira et al., 2009b).

2.3.4. Drug use history—An index of past-year drug involvement (besides cocaine) was computed by counting the number of substances used in Year 1, including alcohol, tobacco, marijuana, inhalants, hallucinogens, amphetamines/methamphetamine, heroin, ecstasy and nonmedical use of prescription stimulants, analgesics, and tranquilizers. Scores ranged from zero to ten (*m*=2.49, SD=1.64).

2.3.5. Cocaine use characteristics—For individuals who initiated cocaine use prior to Year 1, *age at first use* was captured by self-report (see 2.3.1.). When initiation occurred after Year 1, age at first use was assigned as age at the first assessment in which use was reported. *Age at first opportunity* was computed similarly. *Use given opportunity* was denoted as use in the past 12 months when exposure opportunity occurred in the same period. *Latency from first opportunity to first use* was computed in years as age at first use minus age at first opportunity. *Lifetime frequency of use* was the sum of the number of times participants used cocaine in each annual interview (range=1–194 days). *Peak annual use frequency* was the maximum annual frequency for each individual (range=1–120 days). *Typical quantity used* was captured verbatim from an open-ended question, and later converted into metric weights based on a dose equivalency standard of 50 milligrams per line and 35 milligrams per bump, based on our review of laboratory studies (Cox et al., 2009; Stoops, Blackburn, Hudson, Hays, & Rush, 2008) and drug user testimonials (www.thegooddrugsguide.com).

2.3.6. Demographic characteristics—Sex was coded as observed. Race was self-reported and later dichotomized as White and non-White. Mother's education was self-reported as a proxy for socioeconomic status (SES).

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2.4. Statistical Analysis

Sampling weights based on race, sex, and drug use were computed, such that weighted ($_{wt}$) prevalence estimates approximate the general population of screened students in the university's incoming freshman class in 2004. Inferential statistics were evaluated using unweighted data.

To evaluate trends over time and gender differences, generalized estimating equations (GEE) were used, testing each dependent variable (opportunity, use, and use given opportunity), with year as the repeated factor and sex as a between-subjects effect. The first-order interaction of sex and year was included. Estimated marginal means were reported to represent weighted past-year prevalence estimates by year and sex. Pair-wise comparisons were evaluated using Bonferroni correction for multiple comparisons. All available opportunity and use data were used for each year; the amount of missing data, albeit minimal, varied by year.

Cocaine users (n=243) and non-users (n=818) were compared on Year 1 characteristics using t-tests and χ^2 tests (α =.05). A subgroup of 243 lifetime cocaine users were analyzed for possible gender differences with respect to cocaine use characteristics.

3. Results

3.1. Prevalence of Opportunity and Use

By Year 4, 36%$_{wt}$ of students had cocaine exposure opportunity in their lifetime, and 13%$_{wt}$ had used at least once (Table 1). Opportunity and use were significantly more prevalent in males than females; however, among individuals with exposure opportunity, use was similarly prevalent for both genders (37%$_{wt}$).

Most users (69%) started using cocaine after college entry. From Year 1 to Year 4, lifetime prevalence of cocaine use more than tripled, from 4%$_{wt}$ to 13%$_{wt}$. Gender differences in exposure opportunity changed over time; at Year 1, males and females were indistinguishable with respect to lifetime exposure opportunity (18%$_{wt}$ *vs*. 17%$_{wt}$), but in subsequent years, cocaine was significantly more available to males.

3.2. Correlates of Use

Relative to non-users, cocaine users were significantly more likely to be male (53.5% v. 44.1%), White (81.5% *v*. 68.0%), and meet criteria for AUD (49.6% *v*. 21.3%) or CUD (39.7% *v*. 8.5%) in Year 1. They also used a greater number of other drugs in the past year [4.1(1.9) *v*. 2.0(1.2); all p<.05]. Cocaine use was not associated with SES.

3.3. Gender Differences

Comparisons between male and female cocaine users indicate heavier use patterns for females (Table 2). By Year 4, females had used cocaine significantly more frequently than males in both their lifetime (27.78 *vs*. 12.75 days) and their peak year of use (18.39 *vs*. 8.83 days). No gender difference was observed in latency between first opportunity and first use. Among those offered cocaine, females, on average, had their first opportunity exposure at a younger age than males (18.32 *vs*. 18.71; data not shown).

The proportion of users meeting criteria for cocaine abuse was similar for females (8.4%) and males (5.8%), but females were more likely to be dependent (9.3% *vs*. 2.5%). Females were also more likely to endorse three of the seven individual dependence criteria (spending a lot of time getting or using cocaine, giving up important activities, and continued use despite mental/physical health problems).

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3.4. Comparison of Cocaine Quantity by Gender

Converting all dosages to milligrams, results were remarkably similar across gender and year (data not shown). For approximately two-thirds of users, the typical quantity consumed was 200 mgs (~4 lines) or less.

4. Discussion

This study provides new data regarding cocaine exposure opportunities and use among college students. More than one-third ($36\%_{wt}$) were offered cocaine by Year 4 of college. One in eight ($13\%_{wt}$) used at least once in their lifetime by Year 4, two-thirds of whom initiated in college. Lifetime exposure opportunity was significantly more prevalent among males than females ($41\%_{wt}$ vs. $31\%_{wt}$). Use given opportunity did not differ by gender.

A novel contribution of this study is that males experienced significant annual increases in exposure opportunity, while females did not. This raises questions about possible gender differences in how students experience the college environment as a context for experimenting with illicit drugs. In contrast to prior studies where exposure opportunity was greater for males than females (Van Etten et al., 1999), here exposure opportunity was similar at Year 1.

Female cocaine users used more frequently than males and were more likely to meet criteria for dependence. While the possibility of gender differences in reporting dependence symptoms cannot be ruled out, findings suggest that college-attending females might be more susceptible to developing serious problems with cocaine compared to their male counterparts. This finding is consistent with prior literature on adolescents (Chen & Kandel, 2002) and comports with animal studies suggesting sex differences in endocrine-related cocaine response (Lukas et al., 1996; Lynch, Roth, & Carroll, 2002; Sofuoglu, Dudish-Poulsen, Nelson, Pentel, & Hatsukami, 1999).

4.1. Limitations and Strengths

Findings have limited generalizability to other types of colleges and geographic regions. Cell sizes for comparisons among users were modest and provided limited power for detecting gender differences.

An important strength of this study is its longitudinal design. Studying cocaine dependence in early stages of development is unusual, especially with the high follow-up rates and breadth of constructs this study affords. Future studies with this sample will identify other precursors of emerging cocaine dependence, and describe the post-college course of cocaine use patterns.

4.2. Conclusions

Given the substantial proportion of students that had exposure opportunities or used cocaine during college, college administrators must proactively recognize and address illicit drug use problems, in addition to underage drinking which receives the majority of attention. Prevention strategies should address risk and protective factors common to all types of risky behavior, including illicit drug use. Opportunities exist for early identification and treatment of individuals who have diagnosable substance use disorders in college.

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Table 1

Cocaine use and opportunity to use among college students[a]

	Total		Males		Females	
	n	**%$_{wt}$**	***n***	**%$_{wt}$**	***n***	**%$_{wt}$**
Opportunity to use cocaine (*n*=1,253)[b] (cumulative over four years)	**584**	**36%**	**322**	**41%**	**262**	**31%**
Lifetime by Year 1	293	17%	152	18%	141	17%
Past Year, Year 2	300	21%	164	23%	136	18%
Past Year, Year 3	332	24%	185	28%	147	19%
Past Year, Year 4	335	25%	186	31%	149	20%
Cocaine use (*n*=1,253)[c] (cumulative over four years)	**243**	**13%**	**130**	**15%**	**113**	**11%**
Lifetime by Year 1	76	4%	42	5%	34	3%
Past Year, Year 2	106	7%	51	7%	55	7%
Past Year, Year 3	145	10%	72	11%	73	9%
Past Year, Year 4	141	10%	70	11%	71	9%
Used cocaine given the opportunity (*n*=584)[d] (cumulative over four years)	**243**	**37%**	**130**	**37%**	**113**	**37%**
Lifetime by Year 1	75	19%	41	22%	34	17%
Past Year, Year 2	104	27%	50	25%	54	29%
Past Year, Year 3	143	36%	71	33%	72	39%
Past Year, Year 4	140	37%	69	33%	71	41%

[a] Results are presented as unweighted counts (*n*) and weighted percentages (%$_{wt}$), the latter being computed as estimated marginal means in generalized linear models after being statistically adjusted to correct for the purposive sampling design. Four-year totals, shown in **bold**, were computed as the cumulative number of people who, at some point through Year 4, were offered (or used) cocaine. Annual frequencies do not sum to four-year totals, because some individuals experienced opportunity (or use) in multiple years. In every year there were individuals who used cocaine without being given the opportunity to use in that same year; however, cumulatively, every person who used cocaine was given the opportunity at some point.

[b] Males and females were significantly different within Years 2 (p=.003), 3 (p<.001), and 4 (p<.001). Annual changes were statistically significant for males only from Year 1 to Year 2 (p<.03) and Year 2 to Year 3 (p=.005).

[c] Males and females were not significantly different within any year. For males, the change from Year 2 to Year 3 was statistically significant (p=.001). For females, annual changes were statistically significant from Year 1 to Year 2 (p=.001) and Year 2 to Year 3 (p=.009).

[d] Males and females were not significantly different within any year, but approached significance in Year 4 (p<.06). For males, annual changes were not statistically significant; however the change from Year 1 to Year 3 was significant (p=.01). For females, annual changes approached significance from Year 1 to Year 2 (p<.08) and Year 2 to Year 3 (p<.07), but the changes from Year 1 to Years 3 and 4 were significant (p<.001 for both).

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Table 2

Cocaine use characteristics among 243 lifetime cocaine users by Year 4 of college

	Males (*n*=130)		Females (*n*=113)		
	M	***SD***	***M***	***SD***	***p***
Age at first opportunity	18.35	1.54	17.97	1.75	
Age at first use	19.18	1.69	19.05	1.78	
Latency between first opportunity and first use	0.83	1.14	1.10	1.36	
Past-year frequency of use (number of days) during peak year	8.83	14.27	18.39	25.88	*
Lifetime frequency of use (number of days)	12.75	21.34	27.78	38.69	*
	n	**%**	***n***	**%**	
Lifetime frequency of use (number of days)					
1–2	50	38.5	30	26.5	
3–6	29	22.3	19	16.8	
7–10	11	8.5	11	9.7	
11–15	7	5.4	5	4.4	
16+	33	25.4	48	42.5	
DSM-IV Cocaine Use Disorder (CoUD)[a]					
No cocaine use	54	45.0	42	39.3	
Cocaine use without disorder	56	46.7	46	43.0	
Cocaine abuse	7	5.8	9	8.4	
Cocaine dependence	3	2.5	10	9.3	*b*
Individual DSM-IV criteria for cocaine dependence[a]					
Increased tolerance	9	7.5	12	11.2	
Withdrawal	6	5.0	12	11.2	
Using more than intended	2	1.7	4	3.7	
Being unable to cut down	7	5.8	10	9.3	
A lot of time spent obtaining or using cocaine	4	3.3	25	23.4	*
Giving up important activities	1	0.8	6	5.6	*
Continuing use despite problems with physical/mental health	2	1.7	16	15.0	*

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[a] CoUD results (i.e., DSM-IV abuse, dependence and criteria) are based on the subset of 227 lifetime cocaine users (120 male, 107 female) who were assessed in Years 3 and/or 4, regardless of whether continued cocaine use occurred at those times. Results reflect the more severe of the two annual CoUD observations, or the non-missing observation where only one CoUD assessment was completed. The remaining 16 cocaine users (10 male, 6 female) were excluded because they were not assessed in either Year 3 or 4.

[b] Overall Chi-square for the 4-level CoUD variable approached but did not attain statistical significance (p=.12). However, the dichotomous comparison of dependence vs. no dependence was significantly different (χ^2 (1)=4.9, p<.05).

* p<.05

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