

# Simultaneous and Concurrent Polydrug Use of Alcohol and Prescription Drugs: Prevalence, Correlates, and Consequences\*

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**ABSTRACT. Objective:** In this study, we sought to examine the prevalence, correlates, and consequences associated with simultaneous polydrug use and concurrent polydrug use of alcohol and prescription drugs. For purposes of this investigation, simultaneous polydrug use referred to the co-ingestion of different drugs at the same time, and concurrent polydrug use referred to the use of different drugs on separate occasions within the past 12 months. **Method:** Undergraduate students attending a large public midwestern university in the United States were randomly selected to self-administer a Web survey. The sample consisted of 4,580 undergraduate students, with a mean (SD) age of 19.9 (2.0) years; the sample consisted of 50% women, and the racial breakdown was 65% white, 13% Asian, 7% black, 5% Hispanic, and 10% other race/ethnicity. The survey assessed simultaneous polydrug use and concurrent polydrug use of alcohol and four classes of prescription drugs: (1) pain medication, (2) stimulant medication, (3) sedative medication, and

(4) sleeping medication. **Results:** The 12-month prevalence for polydrug use involving alcohol and abusable prescription drugs was 12.1% (including 6.9% simultaneous polydrug use). The majority of polydrug use involving alcohol and each class of prescription drugs was simultaneous polydrug use, with the exception of sleeping medication. Simultaneous polydrug use was more prevalent among undergraduate students who were male, were white, and reported early initiation of alcohol use. Simultaneous polydrug use was associated with more alcohol-related and other drug use-related problems than concurrent polydrug use. **Conclusions:** Based on the high prevalence and increased risk for consequences associated with simultaneous polydrug use of alcohol and prescription drugs, collegiate prevention efforts aimed at reducing substance abuse should clearly focus on co-ingestion of alcohol and prescription drugs. (*J. Stud. Alcohol* 67: 529-537, 2006)

NATIONAL SURVEILLANCE DATA and several anecdotal case reports document the potential severe consequences that can occur as a result of simultaneous use of alcohol and prescription drugs (e.g., Barrett and Pihl, 2002; Cone et al., 2003; Koski et al., 2002; Substance Abuse and Mental Health Services Administration [SAMHSA], 2004a,b; Watson et al., 2004). For instance, data from the Drug Abuse Warning Network indicate that the majority of prescription benzodiazepines, opioids, and related emergency department visits also involved the use of another substance, most frequently alcohol (SAMHSA, 2004a,b). Furthermore, of the deaths attributed to oxycodone between August 1999 and January 2002 in 23 states in the United States, only 3.3% ( $n = 30$ ) reported oxycodone as the single causal agent; alcohol and benzodiazepines were the most

prevalent drugs involved in oxycodone-related deaths (Cone et al., 2003). Finally, popular press reports have documented several deaths of undergraduate college students as a result of co-ingestion of alcohol and prescription drugs (e.g., Ensslin, 2004; Leinwand, 2005; Petrillo and Cantlupe, 2005). Despite the potential tragedies associated with co-ingestion of alcohol and prescription drugs, there is a paucity of epidemiological research examining the prevalence, correlates, and consequences associated with this drug-use behavior.

Several recent studies suggest that the nonmedical use of prescription drugs is associated with heavy drinking behavior among adolescents and young adults in the United States (e.g., Inciardi et al., 2004; McCabe et al., 2004, 2005a,b; SAMHSA, 2004a,b). In a national study of U.S. college students, nonmedical users of prescription stimulants were over six times more likely to report frequent heavy drinking than their peers who did not report nonmedical use of prescription stimulants (McCabe et al., 2005a). In another national study of U.S. college students, nonmedical users of prescription opioids were over four times more likely to report frequent heavy drinking than their peers who did not report nonmedical use of either of these prescription opioids (McCabe et al., 2005b). Finally,

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a third study surveyed 8th- and 11th-grade students in the Delaware Public Schools and found that the majority of 8th-grade nonmedical users of pain medication (71%) and almost all of the 11th-grade nonmedical users of pain medication (92%) also misused alcohol (Inciardi et al., 2004). Although the nonmedical use of prescription drugs seems to be strongly associated with heavy drinking behavior, little is known about the extent to which this drug-use behavior is concurrent versus simultaneous, and very little research has examined the prevalence, correlates, and consequences associated with these two types of polydrug use.

To date, many studies have not differentiated between concurrent and simultaneous polydrug use (see Schensul et al., 2005). Concurrent polydrug use refers to the use of more than one drug in the same time period (e.g., 12 months) but not necessarily at the same time (Martin et al., 1992, 1993). Simultaneous polydrug use refers to the co-ingestion of different drugs at the same time (e.g., Collins et al., 1998; Earleywine and Newcomb, 1997; Martin et al., 1992). Thus, simultaneous polydrug use is a subset of concurrent polydrug use. Although marijuana and alcohol are the most common drugs used simultaneously, adolescents and young adults have particularly high rates of other types of simultaneous polydrug use (e.g., Collins et al., 1998; Earleywine and Newcomb, 1997).

Because of the possible risks associated with simultaneous polydrug use, more research is needed to examine the extent of simultaneous polydrug use as well as the factors and consequences associated with this drug-use behavior. To fill this gap in the literature, the present study reports results from a large Web-based survey of 4,580 college students and focuses on distinguishing concurrent and simultaneous polydrug use in terms of prevalence, correlates, and consequences. Although there are many possible combinations of polydrug use, this study examines the concurrent and simultaneous use of alcohol and prescription drugs.

### Method

This study was conducted during a 2-month period in January and February 2005, drawing on a total undergraduate population of 20,138 full-time students (10,339 women and 9,799 men). After receiving institutional review board approval, a random sample of 5,389 full-time undergraduate students was drawn from the registrar's office. Additionally, 652 Hispanic, 634 black, and 244 Asian undergraduate students were oversampled. A Web-based survey method was used; similar methods have been shown to be feasible and effective for research on alcohol and other drug use in college student samples (e.g., Kypri et al., 2004; McCabe et al., 2002). The entire sample population was mailed \$2 and a notification letter describing the study and inviting them to self-administer the confidential Student Life Survey by typing a link and using a unique

password to access the Web survey. The Web survey was maintained on an Internet site running under the secure socket layer protocol to ensure security, and respondents gave informed consent online. Nonrespondents were sent an invitation email and up to four reminder emails. By participating in the survey, students became eligible for a sweepstakes that included cash prizes, travel vouchers, field passes to athletic events, and iPods. The final response rate was 66.2%, which exceeded the average response rate for national college-based alcohol and other drug studies (Wechsler et al., 2002). Furthermore, of those students who started the Web survey, the proportion of respondents who completed the entire survey (completion rate) was 97.4%.

### Measures

The Student Life Survey included questions on a wide range of topics, including demographic information (e.g., gender, race/ethnicity, living arrangement, social fraternity/sorority membership, and family income), alcohol and other drug use, gambling behavior, and mental health. Herein, we describe the measures used in the present study.

Past-year alcohol use was assessed with the following question: "On how many occasions (if any) have you had alcohol to drink (more than just a few sips) during the past 12 months?" 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.

Age of drinking onset was assessed with the following question: "What grade were you in when you first started drinking alcohol (more than just a few sips)?" The response scale was 1 = kindergarten-Grade 4, 2 = Grades 5-6, 3 = Grades 7-8, 4 = Grades 9-10, 5 = Grades 11-12, and 6 = college. Because of the skewed distribution of responses, kindergarten-Grade 4, Grades 5-6, and Grades 7-8 were collapsed into one category.

Past-year nonmedical use of prescription drugs was assessed with the following question: "On how many occasions in the past 12 months have you used the following types of drugs, not prescribed to you?" There were separate questions for four classes of prescription drugs: (1) pain medication (i.e., opioids such as Vicodin, OxyContin, Tylenol 3 with codeine, Percocet, Darvocet, morphine, hydrocodone, oxycodone); (2) stimulant medication (e.g., Ritalin, Dexedrine, Adderall, Concerta, methylphenidate); (3) sleeping medication (e.g., Ambien, Halcion, Restoril, temazepam, triazolam); and (4) sedative/anxiety medication (e.g., Ativan, Xanax, Valium, Klonopin, diazepam, lorazepam). The response scale for each drug 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.

Past-year simultaneous polydrug use was assessed with the following question: "In the past 12 months how many

days have you used prescription stimulant medication (e.g., Ritalin, Dexedrine, Adderall, Concerta, methylphenidate), not prescribed to you by a doctor at the same time you were drinking alcohol?" Respondents were asked to enter the number of days in a text box. The same question was asked for simultaneous use of alcohol and for each of the following drug classes: pain medication, sedative/anxiety medication, and sleeping medication. These variables were dichotomized, and five measures of past-year simultaneous use were constructed: (1) simultaneous polydrug use of alcohol and prescription opioids, (2) simultaneous polydrug use of alcohol and stimulant medication, (3) simultaneous polydrug use of alcohol and sleeping medication, (4) simultaneous polydrug use of alcohol and sedative/anxiety medication, and (5) simultaneous polydrug use of alcohol and any nonmedical use of prescription drugs.

Past-year concurrent polydrug use was based on respondents reporting any use of alcohol and nonmedical use of one of the prescription drugs in the past 12 months but no simultaneous polydrug use. The measures of past-year nonmedical use of prescription drugs and past-year alcohol use were dichotomized, and five measures of past-year concurrent polydrug use were constructed: (1) concurrent polydrug use of alcohol and prescription opioids, (2) concurrent polydrug use of alcohol and stimulant medication, (3) concurrent polydrug use of alcohol and sleeping medication, (4) concurrent polydrug use of alcohol and sedative/anxiety medication, and (5) concurrent polydrug use of alcohol and any nonmedical use of prescription drugs.

Alcohol misuse was assessed with the following question: "Please indicate how often during the past 12 months you have experienced the following as a result of drinking." Students were asked 16 items based on past research regarding alcohol use-related problems, such as personal, social, academic, or legal problems (O'Hare and Tran, 1997; Wechsler et al., 2000). The response scale for each item ranged from 1 = "no occasions" to 5 = "10 or more occasions." A modified version of the CAGE, which is a standard four-item brief screening instrument, was used to screen for alcohol misuse (Ewing, 1984; Mayfield et al., 1974). The four CAGE items included the following: *C*: "Felt you should cut down your drinking"; *A*: "Annoyed by people criticizing your drinking"; *G*: "Felt guilt or remorse after drinking"; and *E*: "Had a drink first thing in the morning as an 'eye opener' to get rid of a hangover." If students indicated that they had experienced two or more of the CAGE items in the past 12 months, this was considered a "positive" screening test result. If students had experienced none or only one of the four criteria, they were assigned a "negative" test result. This is standard scoring for the CAGE instrument among college students (Heck, 1991).

Drug misuse was assessed with a modified version of the Drug Abuse Screening Test-Short Form (DAST-10), which is a self-report instrument that can be used in clinical

and nonclinical settings to screen for drug misuse on a wide variety of substances other than alcohol (Skinner, 1982). Using Web-based skip logic, respondents who reported use of any of the following drugs in the past 12 months received the DAST-10 items: marijuana or hashish, cocaine, lysergic acid diethylamide (LSD), other psychedelics, crystal methamphetamine, heroin, inhalants, 3,4-methylenedioxymethamphetamine (MDMA; also known as Ecstasy), sleeping medication, sedative/anxiety medication, stimulant medication, and pain medication. Respondents were instructed that the DAST-10 questions were about drugs other than alcohol and to answer "yes" or "no" to each of the DAST-10 items. Respondents were informed that "drug" refers to use of prescription drugs not prescribed to you or in a manner not intended by the prescribing clinician or use of other drugs such as marijuana, cocaine, LSD, Ecstasy, etc. A score of three or more for the DAST-10 was considered a "positive" screening test result based on previous research (e.g., Cocco and Carey, 1998; French et al., 2001; Maisto et al., 2000; Skinner, 1982).

#### *Data analysis*

Statistical analyses were performed using SAS 9.0 (SAS Institute, Inc., Cary, NC). Data were weighted to account for the overall student population sampling fractions. The weight variable was centered (normalized) to ensure that the sample size was identical after weighting. To determine the prevalence of simultaneous and concurrent polydrug use of alcohol and prescription drugs, the number of students reporting each of these behaviors was divided by the total number of students in the final sample. Chi-square tests were used to compare the prevalence of concurrent and simultaneous polydrug use according to several individual characteristics. Chi-square tests and multiple logistic regression analyses were used to compare alcohol or other drug use and consequences across two distinct types of polydrug use: (1) undergraduate students who reported concurrent (but not simultaneous) polydrug use involving alcohol and nonmedical use of prescription drugs in the past year and (2) undergraduate students who reported simultaneous polydrug use involving alcohol and nonmedical use of prescription drugs in the past year. In all multiple logistic regression analyses, we statistically controlled for gender, race/ethnicity, age of alcohol onset, and fraternity/sorority membership. In multiple logistic regression analyses of associations between simultaneous polydrug use and alcohol use-related problems, we also statistically controlled for frequency of past 12-month alcohol use. In multiple logistic regression analyses of associations between simultaneous polydrug use and drug use-related problems, we also statistically controlled for frequency of past 12-month nonmedical use of pain, stimulant, sedative, and sleeping medication.

### Sample

The final sample consisted of 4,580 undergraduate students, and the sample closely resembled the overall student population with respect to demographic characteristics. The sample consisted of 50.3% women, and the racial breakdown was 65.1% white, 13.1% Asian, 6.9% black, 4.5% Hispanic, and 10.3% other race/ethnicity. With respect to age of drinking onset, the distribution was 7.1% kindergarten-Grade 8, 22.0% Grades 9-10, 36.3% Grades 11-12, and 34.6% college. Thirteen percent of the sample indicated social fraternity/sorority membership. The mean (SD) age of the sample was 19.9 (2.0) years old.

### Results

#### Prevalence of polydrug use of alcohol and prescription drugs

The 12-month prevalence of concurrent and simultaneous polydrug use of alcohol and *any* prescription drug was 12.1% ( $n = 544$ ). The 12-month prevalence of simultaneous polydrug use involving alcohol and *any* prescription drug was 6.9% ( $n = 309$ ). As illustrated in Figure 1, among

individual prescription drug classes, the 12-month polydrug use (concurrent and simultaneous) involving alcohol and prescription opioids was the most prevalent type of polydrug use (7.2%;  $n = 322$ ), followed by alcohol and prescription stimulants (6.0%;  $n = 267$ ), alcohol and sedatives (2.4%;  $n = 110$ ), and alcohol and sleeping medication (2.3%;  $n = 107$ ). The majority of polydrug use involving alcohol and each class of prescription drugs was simultaneous (rather than concurrent only), with the exception of sleeping medication. Overall, polydrug use of alcohol and *any* prescription drug was 56.8% ( $n = 309$ ) simultaneous polydrug use and 43.2% ( $n = 235$ ) concurrent polydrug use.

Although simultaneous use of alcohol and prescription opioids was more prevalent than other types of simultaneous polydrug use involving alcohol and prescription drugs, results indicated that the simultaneous use of alcohol and stimulants was more frequent than polydrug use of alcohol and other prescription drugs. Among those who reported simultaneous polydrug use in the past year, the mean (SD) number of days of simultaneous polydrug use in the past year for (1) alcohol and prescription opioids was 3.2 (5.0) (range: 0-40 days), (2) alcohol and prescription stimulants was 3.3 (5.6) (range: 0-30 days), (3) alcohol and sedative medication was 2.2 (2.6) (range: 0-15 days), and (4)

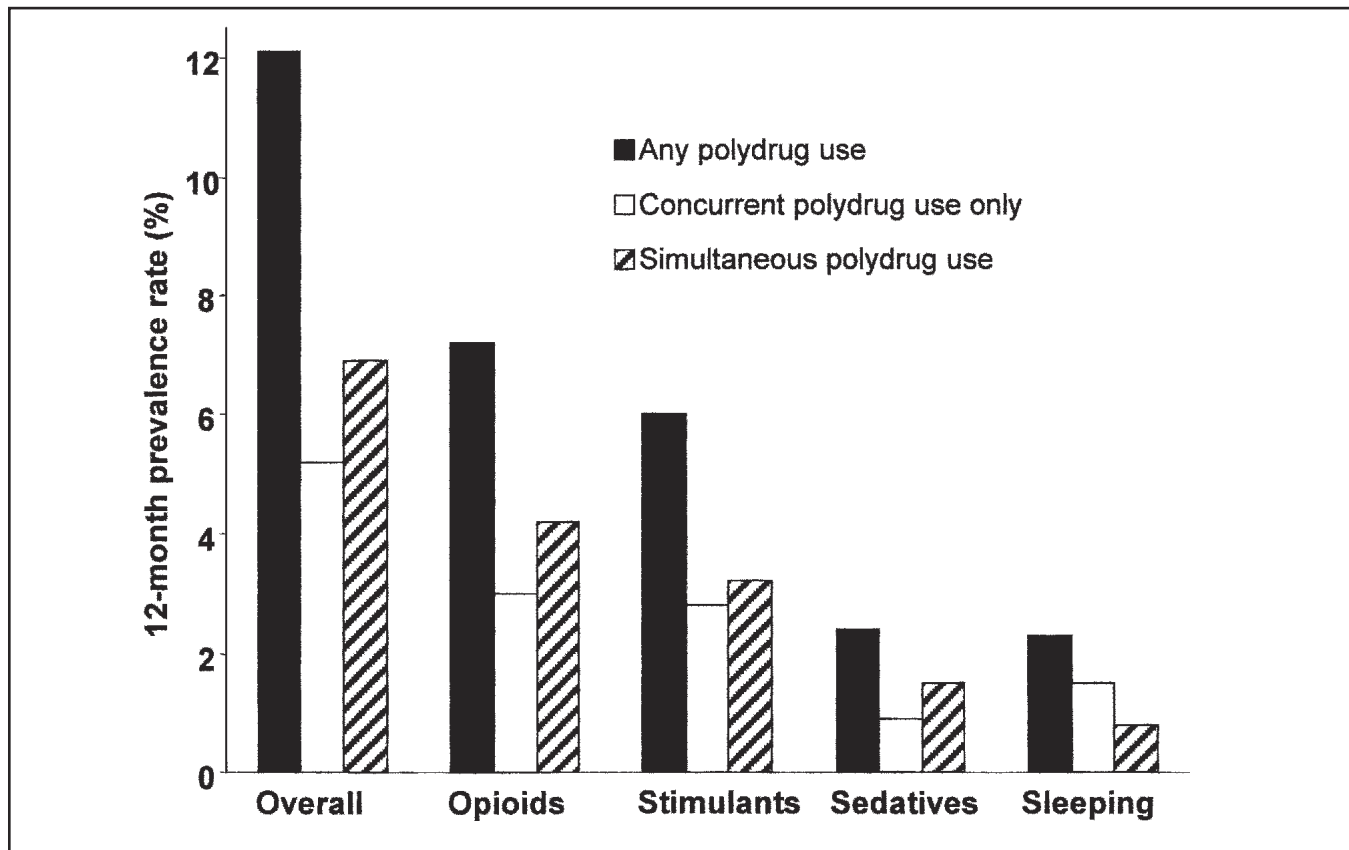


FIGURE 1. Twelve-month prevalence of polydrug use of alcohol and prescription drugs ( $n = 4,500$ )

alcohol and sleeping medication was 1.0 (2.0) (range: 0-15 days).

Because the number of participants who reported non-medical use of prescription drugs in the past year without any alcohol use in the past year was too small ( $n = 10$ ) for meaningful analyses, past-year nonmedical users of prescription drugs were divided into two groups of polydrug users: (1) concurrent polydrug use only ( $n = 235$ ; 43.2%) and (2) simultaneous polydrug use ( $n = 309$ ; 56.8%). Results from bivariate analyses showed that, among past-year polydrug users ( $n = 544$ ), prevalence of past 12-month simultaneous polydrug use was higher among men (64.2%) compared with women (49.5%) ( $\chi^2 = 11.9$ , 1 df,  $p < .05$ ). In addition, prevalence of past 12-month simultaneous polydrug use was significantly associated with race ( $\chi^2 = 9.8$ , 4 df,  $p < .05$ ). Whites (58.5%) and Hispanics (56.8%) showed higher prevalence rates of simultaneous polydrug use, compared with blacks (42.9%) and Asians (38.6%). Results also indicated a statistically significant bivariate association between age of drinking onset and simultaneous polydrug use ( $\chi^2 = 14.0$ , 3 df,  $p < .05$ ). Prevalence of simultaneous polydrug use was highest among those who reported onset of drinking prior to 9th grade (68.4%), followed by those who initiated alcohol use in Grades 9-10 (60.0%), Grades 11-12 (55.2%), and college (40.8%). Finally, results showed that prevalence of past 12-month simultaneous polydrug use was significantly higher among fraternity/sorority members (66.1%), compared with non-members (54.3%) ( $\chi^2 = 5.0$ , 1 df,  $p < .05$ ).

#### *Correlates of simultaneous polydrug use of alcohol and prescription drugs*

Multiple logistic regression analysis was used to examine predictors of past 12-month simultaneous use of alcohol and prescription drugs among past-year concurrent polydrug users. Predictors that showed strong bivariate associations with simultaneous polydrug use (gender, race/ethnicity, age of drinking onset, and fraternity/sorority membership) were included in models for simultaneous polydrug use of alcohol and any prescription drug. The criterion variable for this analysis was a dichotomous indicator coded as 0 = concurrent polydrug use and 1 = simultaneous polydrug use. As seen in Table 1, results indicated that gender (male), race/ethnicity (whites and others compared with Asians), and having an earlier onset of drinking were statistically significant correlates of simultaneous polydrug use of alcohol and any prescription drug.

#### *Association between simultaneous polydrug use and alcohol- and drug use-related problems*

Multiple logistic regression analysis was used to test the hypothesis that simultaneous polydrug use increases the odds

TABLE 1. Multiple logistic regression results predicting past 12-month simultaneous polydrug use: Odds ratios

Correlate	Simultaneous polydrug use of alcohol and any prescription drug AOR <sup>a</sup> (95% CI)
Gender	
Female	— <sup>b</sup>
Male	1.75 <sup>†</sup> (1.20-2.57)
Race/ethnicity	
Asian	— <sup>b</sup>
White	2.16* (1.10-4.29)
Hispanic	1.97 (0.90-4.32)
Black	1.54 (0.59-4.01)
Other	3.48 <sup>†</sup> (1.39-8.75)
Age of drinking onset	
College	— <sup>b</sup>
Grade 11-12	1.65 (0.92-2.97)
Grade 9-10	1.94* (1.08-3.48)
Kindergarten-Grade 8	2.60 <sup>†</sup> (1.26-5.39)
Fraternity/sorority member	
No	— <sup>b</sup>
Yes	1.50 (0.93-2.42)

Notes: Analyses based on 544 past 12-month polydrug users. Data weighted by gender and race/ethnicity. AOR = adjusted odds ratio; 95% CI = 95% confidence interval for the AOR. <sup>a</sup>AOR are from multiple logistic regression analyses with gender, race/ethnicity, age of drinking onset, and fraternity/sorority membership as predictors of past 12-month simultaneous polydrug use; <sup>b</sup>reference group.

\* $p < .05$ ; <sup>†</sup> $p < .01$ .

of alcohol-related problems relative to concurrent polydrug use after adjusting for gender, race/ethnicity, age of alcohol onset, and fraternity/sorority membership. To maximize statistical power, we limited the analyses to simultaneous and concurrent polydrug use of alcohol and any prescription drug. As illustrated in Table 2, simultaneous polydrug users were significantly more likely than their peers who reported only concurrent polydrug use to experience negative alcohol-related consequences in the past 12 months. Indeed, the first set of adjusted odds ratios in Table 2 shows that simultaneous polydrug use was associated with higher risk of 8 of the 16 (50%) alcohol-related problems.

The second set of odds ratios in Table 2 shows that simultaneous polydrug use remained a statistically significant correlate of 6 of the 16 (38%) alcohol-related problems, even when past 12-month frequency of alcohol use was statistically controlled. For example, simultaneous polydrug use was associated with greater odds of driving a car after consuming five or more drinks in a 2-hour period (also referred to as heavy episodic drinking) compared with concurrent polydrug use, even when past 12-month frequency of alcohol consumption was statistically controlled (31.4% vs 12.4%; adjusted odds ratio [AOR] = 2.36, 95% confidence interval [CI]: 1.38-4.04,  $p < .01$ ).

In addition to alcohol-related problems, simultaneous polydrug use was significantly associated with drug-related problems for substances other than alcohol. In particular, simultaneous polydrug users of alcohol and prescription

TABLE 2. Past-year alcohol use-related consequences based on polydrug use status

Past-year alcohol use-related consequences	Past-year simultaneous polydrug users (n = 309), %	Past-year concurrent polydrug users (n = 235), %	AOR <sup>a</sup> (95% CI)	AOR <sup>b</sup> (95% CI)
Performed poorly on a test or important project	27.6	15.4	1.83* (1.14-2.94)	1.57 <sup>§</sup> (0.98-2.51)
Missed class or work because of drinking	65.7	40.7	2.26 <sup>†</sup> (1.50-3.38)	1.92 <sup>†</sup> (1.26-2.92)
Driven a car while under the influence of alcohol	55.9	31.8	2.25 <sup>†</sup> (1.50-3.37)	1.97 <sup>†</sup> (1.29-2.99)
Driven a car after drinking 5 or more drinks in 2 hours	31.4	12.4	2.64 <sup>†</sup> (1.56-4.49)	2.36 <sup>†</sup> (1.38-4.04)
Been hurt or injured after drinking	40.8	27.4	1.48 (0.97-2.25)	1.27 (0.83-1.95)
Vomited	83.6	64.7	2.33 <sup>†</sup> (1.47-3.68)	1.85* (1.14-3.03)
Were taken advantage of sexually	18.3	13.7	1.18 (0.70-1.99)	1.07 (0.63-1.81)
Took advantage of another sexually	7.6	3.7	1.83 (0.84-4.01)	1.76 (0.80-3.92)
Seriously thought about suicide	8.1	3.8	1.71 (0.72-4.04)	1.62 (0.69-3.80)
Were afraid you were an alcoholic	19.1	11.0	1.53 (0.89-2.62)	1.36 (0.80-2.33)
Annoyed by people criticizing your drinking	24.2	23.2	1.07 (0.69-1.66)	1.00 (0.64-1.57)
Had a drink in the morning as an eye-opener	19.4	8.9	2.02* (1.11-3.62)	1.80 <sup>§</sup> (0.98-3.33)
Felt guilt or remorse after drinking	42.8	39.4	1.18 (0.80-1.74)	1.08 (0.92-1.26)
Felt you should cut down your drinking	45.0	34.1	1.39 (0.93-2.06)	1.20 (0.80-1.81)
Had unplanned sex	39.2	20.8	2.08 <sup>†</sup> (1.34-3.22)	1.81 <sup>†</sup> (1.15-2.84)
Had blackouts	58.5	36.7	2.16 <sup>†</sup> (1.45-3.20)	1.86 <sup>†</sup> (1.24-2.80)
CAGE instrument (positive on two or more items)	41.0	30.7	1.41 (0.95-2.10)	1.30 (0.87-1.94)

Notes: AOR = adjusted odds ratio; 95% CI = 95% confidence interval for the AOR. <sup>a</sup>AOR are adjusted for all other predictors in the model and the reference group for each model was past-year concurrent polydrug use; all of the models also included gender, race/ethnicity, age of alcohol onset, and fraternity/sorority membership; the odds ratio for these variables were not shown; <sup>b</sup>these models also controlled for frequency of past 12-month alcohol use.

<sup>§</sup>*p* = .06; \**p* < .05; <sup>†</sup>*p* < .01.

drugs reported significantly higher mean DAST-10 scores (3.02 [2.01]) than their college peers who reported concurrent polydrug use (1.82 [1.87]) (*t* = 7.11, 542 df, *p* < .01). Results from multiple logistic regression analyses also showed that simultaneous polydrug users were significantly more likely than concurrent polydrug users to experience negative drug-related problems in the past 12 months (see Table 3). As seen in the first set of odds ratios in Table 3,

simultaneous polydrug use was significantly associated with higher risk of 5 of the 10 (50%) drug-related problems.

The second set of odds ratios in Table 3 shows that simultaneous polydrug use remained a statistically significant correlate of 4 of the 10 (40%) drug-related problems, even when past 12-month frequency of nonmedical pain, stimulant, sedative, and sleeping medications were statistically controlled. In addition, simultaneous polydrug users

TABLE 3. Past-year DAST-10 results based on polydrug use status

Past-year DAST-10	Past-year simultaneous polydrug users (n = 309), %	Past-year concurrent polydrug users (n = 235), %	AOR <sup>a</sup> (95% CI)	AOR <sup>b</sup> (95% CI)
Used drugs for nonmedical reasons	88.7	67.7	3.17 <sup>†</sup> (1.92-5.21)	3.14 <sup>†</sup> (1.72-5.73)
Used more than one drug at a time <sup>c</sup>	54.8	23.0	4.22 <sup>†</sup> (2.74-6.49)	2.86 <sup>†</sup> (1.75-4.66)
Unable to stop using drugs when you want to	17.9	11.0	1.54 (0.88-2.69)	1.29 (0.70-2.38)
Had blackouts as a result of your drug use	18.8	9.8	2.09* (1.18-3.69)	1.67 (0.89-3.14)
Felt bad or guilty about your drug use	48.5	26.2	2.50 <sup>†</sup> (1.67-3.75)	2.11 <sup>†</sup> (1.35-3.29)
Family members complained about your drug use	18.1	10.2	1.70 (0.96-3.01)	1.60 (0.88-2.91)
Stayed away from your family because of drugs	15.6	6.4	2.41* (1.22-4.76)	2.51* (1.27-4.95)
Engaged in illegal activities to obtain drugs	21.3	15.3	1.23 (0.75-2.03)	0.95 (0.53-1.71)
Experienced withdrawal symptoms	12.3	8.5	1.47 (0.76-2.84)	1.02 (0.49-2.13)
Had medical problems	6.5	4.2	1.50 (0.63-3.58)	1.36 (0.60-3.08)
DAST-10 (positive on three or more items) <sup>d</sup>	52.8	23.1	3.47 <sup>†</sup> (2.28-5.29)	2.58 <sup>†</sup> (1.60-4.16)

Notes: DAST-10 = Drug Abuse Screening Test-Short Form; AOR = adjusted odds ratio; 95% CI = 95% confidence interval for the AOR. <sup>a</sup>AOR are adjusted for all other predictors in the model, and the reference group for each model was past-year concurrent polydrug use; all of the models included gender, race/ethnicity, age of alcohol onset, and fraternity/sorority membership; the odds ratio for these variables were not shown; <sup>b</sup>these models also controlled for frequency of past 12-month nonmedical use of pain, stimulant, sedative, and sleeping medication; <sup>c</sup>“drug” refers to use of drugs other than alcohol, including marijuana or hashish, cocaine, lysergic acid diethylamide (LSD), other psychedelics, crystal methamphetamine, heroin, inhalants, Ecstasy, sleeping medication, sedative/anxiety medication, stimulant medication, and pain medication; <sup>d</sup>a score of three or more is considered a “positive” screening test result based on previous research (e.g., Cocco and Carey, 1998; French et al., 2001; Maisto et al., 2000).

\**p* < .05; <sup>†</sup>*p* < .01.

were over two times more likely to endorse three or more DAST-10 items than students who engaged in concurrent polydrug use only, even when past 12-month frequency of nonmedical prescription drug use was statistically controlled (52.8% vs 23.1%; AOR = 2.58, 95% CI: 1.60-4.16,  $p < .01$ ).

### Discussion

The present study makes a unique contribution in that it examines the prevalence, correlates, and consequences associated with simultaneous polydrug use of alcohol and prescription drugs. Although several past studies have found a strong association between the nonmedical use of prescription drugs and alcohol use, much of this research has not distinguished between simultaneous and concurrent polydrug use (Schensul et al., 2005), despite the fact that simultaneous polydrug use likely poses a much greater health risk than concurrent polydrug use. The current study found that more than 1 of 10 college students reported either simultaneous or concurrent polydrug use in the past year involving alcohol and prescription drugs. The majority of polydrug use involving alcohol and prescription drugs was simultaneous, a finding consistent with at least one other study indicating that the majority of concurrent polydrug use involving alcohol, tobacco, marijuana, and hallucinogens was simultaneous among college students (Martin et al., 1992). Most importantly, though, the present study found that simultaneous polydrug users were significantly more likely than concurrent polydrug users to experience alcohol- and other drug use-related problems, even after statistically controlling for frequency of alcohol and nonmedical prescription drug use. Thus, colleges and universities need to be cognizant and attend to simultaneous polydrug use because of the health risks associated with this behavior.

The factors that were significantly associated with various forms of simultaneous polydrug use among undergraduate students included being male, being white (compared with Asian), and experiencing early initiation of alcohol use. Our results are concordant with Martin and colleagues' (1992) findings that male gender is predictive of simultaneous polydrug use among college students. Furthermore, the heightened risk for simultaneous polydrug use among early initiators of alcohol augments a wealth of information showing early initiation of alcohol is associated with an increased risk for developing alcohol use disorders (Grant and Dawson, 1997).

The findings of the present study have several important implications for prevention and intervention efforts. The present study found that simultaneous polydrug users were more than two times more likely than concurrent polydrug users to report three or more drug use-related problems based on the DAST-10. These findings reinforce the importance of examining individuals who simultaneously co-ingest substances separately from those who report

concurrent use of substances. Previous studies that examined only concurrent polydrug use may not accurately reflect the short-term and long-term consequences associated with simultaneous polydrug use. The simultaneous use of alcohol and prescription drugs can be an especially dangerous form of drug misuse because simultaneous polydrug use can have several different effects on the consumer. For instance, using more than one drug at the same time can cause cumulative effects among the drugs (additive effect) or produce a synergistic effect beyond the additive effect of each drug (supra-additive effect). Based on a review of drug-induced fatalities, there is evidence that prescription opioids are much more toxic when they are taken with other drugs that depress the central nervous system, such as alcohol, as compared with when prescription opioids are taken alone (Cone et al., 2004). Collegiate prevention programs that provide drug-specific information and educate about blood alcohol concentration levels and safe-drinking guidelines may not be applicable when students are co-ingesting alcohol and other drugs. Therefore, future collegiate prevention efforts should also educate college students regarding the dangerous drug interactions that may occur when combining alcohol with prescription or illicit drugs.

The present study has several strengths that build on past research examining simultaneous polydrug use. First, the measures used in the present study were consistent with recent recommendations for measuring simultaneous and concurrent polydrug use (Schensul et al., 2005). Most notably, we examined several new specific combinations of simultaneous polydrug use, and we assessed the frequency of simultaneous polydrug use, which previous research has strongly encouraged (e.g., Collins et al., 1998; Schensul et al., 2005). Second, the focus of the present study extended beyond a single class of prescription drugs to four distinct classes of prescription drugs. Furthermore, many previous studies examining simultaneous polydrug use among adolescents and young adults have been limited by the use of general categories of prescription drugs such as "uppers" or "downers" without specific examples of drugs within each prescription drug class (e.g., amphetamine/dextroamphetamine, methylphenidate). Third, the present study focused on simultaneous and concurrent polydrug use involving alcohol and prescription drugs, because college students tend to drink more heavily than their noncollege peers and other age groups (Bachman et al., 1997, 2002; Johnston et al., 2005; O'Malley and Johnston, 2002). Also, the nonmedical use and misuse of prescription drugs has been increasing over the past decade and is higher among young adult drug users (18-24 years of age) relative to other age groups (Johnston et al., 2005; SAMHSA, 2003a,b, 2004c). Finally, the present study assessed several alcohol-related and drug-related problems, which allowed us to examine a wide range of consequences associated with simultaneous polydrug use.

The current study has some limitations that should be taken into account while considering implications of the findings. First, nonresponse may have introduced potential bias in the present study. Although we can never fully eliminate the possibility of bias introduced through nonresponse, we tried to assess its potential impact by conducting a brief telephone survey of 159 randomly selected nonrespondents. No significant differences in alcohol and other drug use between respondents and nonrespondents were found. Second, the findings of the present study may not generalize to other college and noncollege populations because they were obtained from undergraduate students at a single institution of higher education. Although the present sample resembles the demographic characteristics of students attending 4-year U.S. colleges and universities nationally, previous research has found that rates of alcohol use and nonmedical use of prescription drugs vary across different types of U.S. colleges and universities as well as between young adults attending college versus those not attending college (e.g., Johnston et al., 2005; McCabe et al., 2005a,b). Therefore, future work is needed to examine whether these findings are replicated within other college and noncollege populations. Third, we did not examine the quantity of alcohol and prescription drug consumed on each occasion or other combinations of polydrug use. Furthermore, our investigation likely underestimates the extent of simultaneous use of alcohol and prescription drugs, because we limited our focus to prescription drugs *not* prescribed to an individual, and thus we did not consider the co-ingestion of alcohol and prescription drugs that *were* prescribed to an individual.

This study points to the importance of recognizing and attending to simultaneous drug use, because it is a common practice among a minority of students and can lead to moderate or severe adverse health outcomes. Based on U.S. census data, it is estimated that there were 9,203,090 undergraduate students ages 18-24 in the United States in the year 2000 (Day and Jamieson, 2003). If the results from our study were extrapolated to the total undergraduate student population in the United States, more than 1.1 million undergraduate students were polydrug users (combined concurrent and simultaneous) of alcohol and prescription drugs in the past year, with more than 635,000 simultaneous polydrug users. Based on the increased risks associated with simultaneous polydrug use involving alcohol and prescription drugs, future studies need to explore in greater depth the individual and situational risk factors associated with simultaneous polydrug use and its developmental course.

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