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Nonmedical use of prescription stimulants and depressed mood among college students: Frequency and routes of administration

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Abstract

Studies demonstrate associations between nonmedical use of prescription stimulants (NMUPS) and depressed mood; however, relevance of NMUPS route of administration and frequency of use have not been examined. We hypothesized frequent NMUPS and nonoral routes would be significantly associated with depressed mood. A Web survey was self-administered by a probability sample of 3,639 undergraduate students at a large U.S. university. The survey contained substance use (e.g., frequency, route of administration) and depressed mood measurement. Past-year prevalence of NMUPS was 6.0% ($n = 212$). Approximately 50% of frequent or nonoral NMUPS reported depressed mood. Adjusted odds of depressed mood were over two times greater among frequent monthly NMUPS (adjusted odds ratio [AOR] = 2.3, 95% confidence interval [CI] = 1.01–5.15) and nonoral routes of administration (AOR = 2.2, 95% CI = 1.36–3.70), after controlling for other variables. Nonmedical users of prescription stimulants should be screened for depressed mood, especially those who report frequent and nonoral routes of administration.

Keywords

Depressed mood; Prescription stimulants; Nonmedical use; College students; Substance use

1. Introduction

Taking the pills made it very hard for me to sleep and I would often have to take more the next day to make up for the sleep I had lost...and usually experienced depressed feelings coming down off (of Adderall). – Female undergraduate college student

Although quotations such as this demonstrate the “crashes” or “depressed mood” that may occur following the nonmedical use of prescription stimulants (NMUPS), large-scale research has only begun to examine these associations in more detail. It is crucial to understand these relationships given considerable evidence that major depressive episodes and NMUPS are each most prevalent among young adults 18 to 25 years of age (Colliver, Kroutil, Dai, & Gfroerer, 2006; Compton, Conway, Stinson, & Grant, 2006; McCabe, Cranford, & Boyd, 2006; Substance Abuse and Mental Health Services Administration [SAMHSA], 2007a). Depressed mood may also be more severe in this age group, especially among college students. For example, the American College Health Association—National College Health Assessment (NCHA) II found that many college students self-report being so depressed that they have difficulty functioning (NCHA, 2004). Despite the elevated risk of depressed mood and their consequences in this age group, young adults 18 to 25 years of age with past-year depressed mood are the least likely to report receiving treatment (SAMHSA, 2008b).

Epidemiologic studies have found relationships between NMUPS and the presence of depressed mood among both adolescents (Poulin, 2007; SAMHSA, 2008a) and young adults (Huang et al., 2006; SAMHSA, 2007b). However, differences as a function of clinically relevant NMUPS behaviors, such as frequency and route of administration, have not been examined. For example, relationships have been found between depressed mood and the quantity/frequency of drug use such as cigarette smoking (Fergusson, Goodwin, & Horwood, 2003), alcohol consumption (Rehm et al., 2003), crack cocaine (Falck, Wang, Carlson, Eddy, & Siegal, 2002), and methamphetamine use (Semple, Patterson, & Grant, 2005). Although the methods and populations in these studies differ widely, these findings lend support to the examination of depressed mood as a function of various subgroups of nonmedical users of prescription stimulants. Furthermore, given similar neurotransmitter changes that may accompany both stimulant withdrawal and depression (Markou, Kosten, & Koob, 1998), routes of administration that lead to rapidly fluctuating drug concentrations (e.g., nonoral) may be associated with a greater likelihood of causing or exacerbating depressed mood. In fact, there are at least two studies that have documented higher rates of depressed mood among methamphetamine users who inject as compared to other routes of administration (Zweben et al., 2004; Glasner-Edwards et al., 2009). Given the available literature for other substance use in relation to depressed mood, we hypothesized that frequent NMUPS and nonoral routes of NMUPS administration would each be associated with higher rates of depressed mood. We will also conduct exploratory analyses on the relationships between other student variables (e.g., gender, race) and depressed mood.

2. Materials and methods

2.1. Database and data collection procedures

This investigation was part of a larger study of college students conducted in January and February of 2005. Additional information describing the measures in more detail can be found elsewhere (McCabe, & Teter, 2007; Teter, McCabe, LaGrange, Cranford, & Boyd, 2006). In fact, we have provided an extensive flow diagram adapted from Teter et al. (2006) that thoroughly describes the data collection procedures related to the NMUPS (please see Appendix 1). After receiving institutional review board approval, a random sample of 5,389 full-time undergraduate students was drawn from the total undergraduate population of 20,138 full-time students (10,339 women and 9,799 men) at a large Midwestern university. The entire

sample was mailed a pre-notification letter with \$2 enclosed describing the study and inviting students to self-administer a Web survey by using a URL address and unique password. Informed consent was obtained online from each participant. Nonrespondents were sent up to four reminder e-mails. The Web survey was maintained on an Internet site running under the secure socket layer protocol to ensure privacy and security. By participating in the survey, students became eligible for a sweepstakes that included cash and other prizes. The final response rate was 68%.

2.2. Sample

The final sample consisted of 3,639 undergraduate students (68% response rate). The demographic characteristics of the sample closely resembled the overall student population of the university. The sample consisted of 53.6% women and 46.4% men. The racial/ethnic distribution of the sample was 67.4% White, 12.1% Asian, 6.0% African American, 4.5% Hispanic, and 10.2% from other ethnic categories. The sample was composed of 28.5% freshmen, 23.4% sophomores, 23.1% juniors, and 25.0% seniors. The mean age of students in the sample was 19.9 years ($SD = 2.0$).

2.3. Measurement

A variety of measures were included in the survey (e.g., demographic characteristics, substance use behaviors, psychiatric symptoms, prescribed medications); however, for the purposes of this exploratory study, we have provided details for the primary variables of interest.

NMUPS was assessed with the following question: "On how many occasions in (a) your lifetime or (b) the past 12 months or (c) the past 30 days have you used the following types of drugs, not prescribed to you? Stimulant medication (e.g., Ritalin, Dexedrine, Adderall, Concerta, methylphenidate)." Consistent with previous research (Johnston, O'Malley, Bachman, & Schulenberg, 2009; Teter et al., 2006), 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. For purposes of analyses, *frequent NMUPS* was operationally defined as the endorsement of three or more occasions in the past month. This cutoff was based on previous work demonstrating that drug use-related problems (e.g., felt bad or guilty about drug use) were reported by a greater percentage of NMUPS respondents using on 3 to 5 occasions (58.2%), 6 to 9 occasions (58.3%), and 10 or more occasions (76.3%) as compared to 1 to 2 occasions (42.2%; McCabe, & Teter, 2007).

Routes of administration were assessed by asking respondents who reported NMUPS to indicate the route(s) of administration they used for taking prescription stimulants not prescribed to them by a doctor (Teter et al., 2006). Respondents were asked to select all that apply from a list of five routes including (a) orally, (b) snorting, (c) smoking, (d) injecting, and (e) inhaling. For purposes of analyses, a two-level indicator variable was created for route of administration consisting of oral only and nonoral (i.e., snorting, smoking, injecting, inhaling). This comparison was chosen based on the high prevalence of oral (95.3%) and snorting (38.1%) routes of administration as compared to less than 1% for other routes of administration, such as injection or inhalation (Teter et al., 2006).

Depressed mood was assessed using a modified version of the two-item Patient Health Questionnaire (PHQ-2; Kroenke, Spitzer, & Williams, 2003). Recent studies have shown that two items may be effective at detecting major depressive disorder (Henkel et al., 2004; Whooley, Avins, Miranda, & Browner, 1997). For example, the sensitivity (0.83) and specificity (0.92) were found to be acceptable when examining the criterion validity of the PHQ-2 against an independent structured interview (Kroenke et al., 2003). Therefore, to examine depressed mood using an instrument that would not significantly add to respondent

burden, we used the PHQ-2, which asks about depressed mood and anhedonia in the past 30 days: (a) “During the past 30 days, have you often been bothered by feeling down, depressed, or hopeless?” (b) “During the past 30 days, have you often been bothered by little interest or pleasure in doing things?” To reduce false-positive rates, we classified participants as having a past-month depressed mood only if they responded “yes” to both of the PHQ-2 items. For purposes of analyses, a two-level indicator variable was created indicating the presence or absence of depressed mood.

2.4. Data analysis

Bivariate associations were tested using chi-square analyses for dichotomous and categorical outcomes. Multiple logistic regression analyses were conducted to examine the associations between behaviors associated with NMUPS and depressed mood. All multivariate analyses statistically controlled for student characteristics and other variables (e.g., gender, race, class year, living arrangements, family income, social fraternity/sorority membership, route of NMUPS administration, frequency of NMUPS, and prescribed use of antidepressants). Adjusted odds ratios (AORs) and 95% confidence intervals (95% CIs) were reported. All statistical analyses were performed using SPSS 15.0 statistical software.

3. Results

The past-year prevalence rate of NMUPS was 6.0% ($n = 212$), of which 41.5% ($n = 88$) endorsed nonoral routes of administration. Furthermore, 39.2% used on 1 to 2 occasions, 31.6% used on 3 to 5 occasions, 11.3% used on 6 to 9 occasions, and 17.9% used on 10 or more occasions. A past-month positive depressed mood screen was found among 26.2% ($n = 929$) of the sample. The prevalence of depressed mood among various categories of past-month substance use is shown in Fig. 1 to provide the reader with a broader context in which to place our prescription stimulant findings. A full comparison is beyond the scope of this article.

Several variables were significantly associated with depressed mood in bivariate analyses (please see Table 1 for bivariate results). Five variables remained statistically significantly associated with depressed mood after controlling for other variables using multiple logistic regression: Prescribed use of antidepressants, more frequent NMUPS, nonoral routes of NMUPS administration, and being Asian or other for race/ethnicity were related to higher risk for depressed mood. Conversely, reporting a higher family income was associated with a lower risk for depressed mood (please see Table 2 for multivariate results). We focus on the five variables that remained significantly related to depressed mood after controlling for other variables in the analyses.

As can be seen in Table 1, approximately one half of those endorsing frequent NMUPS during the past month experienced past-month depressed mood. These individuals were over twice as likely to report depressed mood after controlling for other variables, although the CI for this odds ratio is marginally significant (see Table 2). A very similar pattern was found among those endorsing nonoral routes of NMUPS administration. Again, more than one half of these individuals reported depressed mood, and again, these relationships remained statistically significant after controlling for other variables (see Tables 1 and 2). The remaining two student characteristics associated with increased depressed mood were those who reported being prescribed an antidepressant and Asian or other as their race/ethnicity. In contrast, one variable was associated with less risk for reporting depressed mood. Approximately one in five students who endorsed an annual family household income of \$150,000-\$249,999 experienced depressed mood, and this income level was associated with lower odds of depressed mood based on the multivariate analyses (see Tables 1 and 2).

4. Discussion

4.1. Conclusions

The present exploratory study examined depressed mood among college students as a function of various behaviors associated with NMUPS. We identified several relationships that were consistent with our original hypotheses that deserve mention.

Frequent NMUPS was associated with experiencing higher rates of depressed mood. It is certainly plausible that more involved drug use causes or exacerbates depressed mood or conversely that depressed mood leads to increased drug use as a form of self-medication. In fact, in an extensive, notable review of the topic, the neurobiological similarities between depression and substance use were reviewed as a possible explanation for the very high co-occurrence of these conditions, regardless of the direction of the relationship (Markou et al., 1998).

We also observed higher rates of depressed mood among those who report nonoral routes of NMUPS administration, which is consistent with previous research among methamphetamine users (Zweben et al., 2004; Glasner-Edwards et al., 2009). The rapid fluctuations in stimulant drug levels achieved by nonoral routes of administration could theoretically contribute to the well-known “crashes” found among stimulant users. In addition, just as Volkow & Swanson (2003) predicted that fluctuating versus steady-state drug concentrations can predict a drug’s reinforcing properties (Volkow, & Swanson, 2003), we propose that the fluctuating levels seen after nonoral NMUPS administration might contribute to depressed mood as well. This is a key point to consider given the evidence that stimulant withdrawal is associated with neurotransmitter changes that have also been found in depression (Markou et al., 1998).

In additional analyses, we found that prescribed use of antidepressants was associated with the presence of depressed mood. The presence of depressed mood, despite being treated with an antidepressant, could reflect a variety of phenomena such as treatment resistance or medication nonadherence (Teter, Kando, Hayes, & Wells, 2008). For example, these individuals have been identified as having depressive symptoms (or other closely related disorder symptomatology) by a clinician because they possess a prescribed medication. Populations of patients that are actively being treated for depressive symptoms will be more likely to contain individuals with residual symptoms, given the large percentage that will not achieve remission despite antidepressant treatment (Teter et al., 2008). Given that our study cannot determine causal relationships, the findings suggest that college students receiving a prescription for an antidepressant does not necessarily equate to effective treatment or the complete remission of depressed mood. In a college population that is exposed to a great deal of life changes and stressors (Kadison, 2005), the appropriate management of depressed mood is essential during this pivotal transitional period.

There are a couple of findings that relate to demographic differences that deserve future attention. For example, it is unclear why Asians or the other race/ethnicity group reported higher rates of depressed mood in our study even after controlling for other study variables. It is also unclear why reporting a higher family income appeared to confer a protective effect against depressed mood. These race/ethnicity and family income findings need to be investigated more thoroughly before any definitive statements can be made. Lastly, our lack of gender differences in rates of depressed mood among college students is consistent with other recent college-based studies that have not found elevated rates of depressed mood among female students (Grant et al., 2002). Perhaps college student samples are unique as compared to the general population in which there is a well-accepted higher prevalence rate of depression found among women.

4.2. Limitations

The most important limitation in this study that should be considered when interpreting our results is the inability to identify causation due to the cross-sectional nature of the data collection. For example, we are unable to answer two very important and related questions: “Did depressed mood lead to more drug involvement?” or “Did more drug involvement cause or exacerbate depressed mood?” Regardless of the direction of these relationships, our findings highlight the importance of subgroups of students that may be particularly at risk for co-occurring substance use and depressed mood. Another limitation is the administration of the PHQ-2 via the Web. This instrument has not been thoroughly tested for psychometric properties using this method. In addition, we used a past-month time frame to assess depressed mood, which is longer than the past 2 weeks approach used in the original PHQ-2 (Kroenke et al., 2003) and the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (*DSM-IV-TR*; American Psychiatric Association [APA], 2000). In an effort to offset these limitations, we used a conservative analytic approach and only considered depressed mood present if both of the items on the PHQ-2 were endorsed. This is a very important distinction because these are two “core” symptoms that must be present to make an official diagnosis of major depressive episode using the *DSM-IV-TR* (APA, 2000). However, we were not able to diagnose major depressive episodes in our sample and were solely interested in identifying the presence of depressed mood. Although we achieved an adequate response rate, nonresponse may have introduced bias in our study. However, concerns regarding nonresponse were lessened because the demographic characteristics of the sample closely resembled those of the overall student population. In addition, we assessed the potential impact of nonresponse by administering a brief telephone survey to 159 nonrespondents and found no significant differences in alcohol and other drug use between respondents and nonrespondents. This should provide some assurance that nonresponse was unlikely to significantly impact our results.

4.3. Practical and clinical implications

Despite limitations present in this study, several notable relationships were found between depressed mood and demographic characteristics and substance use behaviors. In particular, we were able to confirm our hypotheses and identify subgroups of nonmedical users of prescription stimulants (i.e., past-month frequent users and nonoral routes of prescription stimulant administration) that were strongly related to the presence of depressed mood. Results indicate that nonmedical users of prescription stimulants should be screened for depressed mood; especially those who report frequent nonmedical use or nonoral routes of administration. This greater need for comprehensive screening may extend to the nonmedical use of other prescription medications classes as well (please see Fig. 1), and the implications of these findings deserve more attention in future work. Finally, in a broader context, this study provides additional evidence that NMUPS cannot be considered a benign behavior that is unrelated to negative adverse consequences such as depressed mood.

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Appendix 1

Figure.

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Fig. 1. Depressed mood (shown as percentages) was measured using modified version of the two-item PHQ-2.

Table 1

Bivariate correlates of depressed mood among college students

Characteristics	Past-month depressed mood (%)	χ^2 (df)
Overall student sample (<i>N</i> = 3,546)	26.2	
Gender		
Female (<i>n</i> = 1,900)	27.1	1.5 (1)
Male (<i>n</i> = 1,646)	25.2	
Race		
White (<i>n</i> = 2,405)	23.9	25.5 (4) **
African American (<i>n</i> = 211)	28.0	
Hispanic (<i>n</i> = 147)	25.2	
Asian (<i>n</i> = 423)	33.3	
Other (<i>n</i> = 360)	32.5	
Class year		
Freshmen (<i>n</i> = 1,059)	26.3	3.7 (3)
Sophomore (<i>n</i> = 794)	28.2	
Junior (<i>n</i> = 790)	26.2	
Senior (<i>n</i> = 876)	24.1	
Living arrangements		
Residence hall (<i>n</i> = 1,649)	27.3	3.6 (3)
Greek housing (<i>n</i> = 154)	23.4	
House/Apartment (<i>n</i> = 1,551)	25.0	
Other living (<i>n</i> = 192)	28.6	
Annual household income		
<50,000 (<i>n</i> = 439)	29.8	8.4 (5)
50,000–99,999 (<i>n</i> = 814)	27.6	
100,000–149,999 (<i>n</i> = 638)	26.6	
150,000–249,999 (<i>n</i> = 420)	22.1	
>250,000 (<i>n</i> = 322)	24.5	
Social fraternity/Sorority membership		
Nonmember (<i>n</i> = 3,053)	26.8	4.5 (1) *
Member (<i>n</i> = 460)	22.2	
Past-year route of NMUPS administration		
Nonuser (<i>n</i> = 3,324)	25.6	21.8 (2) **
Oral only route (<i>n</i> = 123)	25.2	
Nonoral route (<i>n</i> = 88)	47.7	
Past-month frequency of NMUPS		
Nonuser (<i>n</i> = 3,459)	25.8	12.0 (2) **
1–2 times (<i>n</i> = 41)	29.3	
3+ times (<i>n</i> = 35)	51.4	
Past-year prescribed antidepressants		

Characteristics	Past-month depressed mood (%)	χ^2 (df)
Nonuser ($n = 3,326$)	24.6	76.0 (1) **
Prescribed user ($n = 200$)	52.5	

*
 $p < .05$.

**
 $p < .01$.

Table 2Multivariate correlates of depressed mood among college students ^a

Characteristics	Past-month depressed mood	
	AORs	95% CI
Race		
White	REF	
African American	1.3	0.9–1.8
Hispanic	1.1	0.7
Asian	1.7 **	1.3
Other	1.6 **	1.3–2.1
Annual household income		
<50,000	REF	
50,000–99,999	0.9	0.7
100,000–149,999	0.9	0.7
150,000–249,999	0.7 *	0.5–0.9
>250,000	0.7	0.5–1.0
Route of NMUPS administration		
Nonuser	REF	
Oral only route	0.9	0.5–1.5
Nonoral route	2.2 **	1.4–3.7
Monthly frequency of NMUPS		
Nonuser	REF	
1–2 times (past month)	1.3	0.6–3.0
3+ times (past month)	2.3 *	1.01–5.2
Past-year prescribed use of antidepressants		
Nonuser	REF	
Prescribed user	3.4 **	2.5–4.7

Note. REF = reference group.

^a Odds ratios adjusted for all correlates in the model (e.g., gender, race, class year, living arrangements, family income, social fraternity/sorority membership, route of NMUPS administration, frequency of NMUPS, and prescribed use of antidepressants). The AORs for nonsignificant correlates are not shown.

* $p < .05$.

** $p < .01$.