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Major Article

Frequent Nonprescription Stimulant Use and Risky Behaviors in College Students: The Role of Effortful Control

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Abstract. **Objective**: The goal of this study was to (a) investigate the association between nonprescription stimulant use (NPSU) and risky behaviors, including risky sex, driving, financial behaviors, and drug use and (b) collect preliminary evidence on mechanisms that may link NPSU to risky behaviors. **Participants**: A sample of 555 college students was collected between August 2010 and February 2012. **Methods**: Students completed several self-report measures assessing their drug use history, attention-deficit and hyperactivity symptoms, temperament, and risky behaviors beyond drug use. **Results**: Those who reported more frequent NPSU were more likely to engage in high-risk behavior across all 4 domains studied. Further, effortful control abilities partially mediated the link between NPSU and risky behaviors. **Conclusions**: These results highlight the associated risks of frequent NPSU for college students as well as provide future directions for examining effortful control as a potentially important mechanism linking NPSU to other risky behaviors.

Keywords: clinical medicine, community health, drugs, health education, mental health

Nonprescription stimulant use (NPSU) is characterized by the use of prescription stimulant medication (eg, Ritalin, Adderall, Vyvanse, Concerta, Focalin) either without a valid prescription or at levels in excess of the prescribed amount. United States–based national prevalence estimates suggest a 7.9% lifetime prevalence of NPSU in persons over age 12 and that students' willingness to engage in the diversion (outgoing and/or incoming movement of prescription medication to someone it is not intended for) of prescription stimulant medications appears to develop before students enter college, with the highest diversion rates in 16–18-year-olds.[1,2] In undergraduate students, most recent estimates indicate that 8.5% have engaged in NPSU in the last year.[3] In an effort to curtail this public health problem, the American College Health Association (ACHA) Healthy Campus 2020 initiative has set a nationwide precedence to reduce NPSU in the coming years.[4] Despite college students commonly expecting academic benefits,[5] findings from a recent meta-analysis support that these expectancies are not supported by empirical data.[6] More so, frequent NPSU is associated with serious medical side effects,[7] decreased effortful control (eg, increased inattention),[8,9] and risky behaviors (see below).

In previous studies, NPSU has been reliably associated with the use of other substances, including alcohol, marijuana, ecstasy, and cocaine.[10] Polydrug use involving NPSU is common; about half of college students who engage in NPSU simultaneously consume alcohol when taking the stimulants.[11] Although more theoretical research is needed explaining the link between NPSU and drug use, it is plausible that traditional predictors of drug use also lead to NPSU. For example, higher sensation seeking[12,13] and lower effortful control[12] have been linked to both NPSU and drug use. Effortful control, a top-down process, represents effortful behavioral and cognitive regulation that

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is thought to rely heavily on prefrontal circuitry.[14] Experimental literature suggests that aspects of effortful control, specifically impulsivity, are hindered as a result of nonprescription stimulant abuse.[8,9] For example, higher doses of D-amphetamine have been associated with impulsivity errors in healthy adults, especially in environmental contexts where there is a strong response tendency.[8]

Although NPSU appears to be associated with other drug use in young adults, little research has investigated other risky behaviors besides drug use. This would be a logical progression, since those who engage in other drug use also have higher rates of other risky behaviors, such as risky sex,[15] risky financial behavior,[16] and risky driving.[17] Indeed, some preliminary literature suggests that prescription stimulant misuse may be associated with similar negative outcomes. A recent study by Boyd and colleagues[12] found evidence that middle- or high-school–aged adolescents who engage in NPSU were more sexually active and engaged in more gambling behaviors. To the best of the authors' knowledge, these associations have not been further investigated or replicated in a young adult sample. Additionally, research linking NPSU to risky driving has also not been investigated, although deficits in effortful control could explain why these 2 risky behaviors would be associated.[18]

Less is known about the implications of NPSU on public health. For an accurate sense of the societal burden of NPSU, it is critical to examine potentially co-occurring risky behaviors.[19] More so, including information on potential negative outcomes such as these could help make campus awareness campaigns and educational programs more informative and effective. Clinically, these risky behaviors could be an indicator to practitioners of stimulant abuse in their college student patients. Finally, if underlying mechanisms linking frequent NPSU to risky behaviors could be identified, clinical or public health interventions could be developed to target such mechanisms that would lessen the impact of these associated risky behaviors. For example, if effortful control is a mechanism of this nature, then clinicians working with students currently abusing stimulants could advise them to minimize driving, limit other drug abuse that may amplify effortful control deficits, avoid certain social situations (eg, parties), etc.

Thus, the purpose of this study was to investigate to what degree and why frequent NPSU is associated with risky behaviors. The first aim of the current study was to investigate if NPSU is associated not only with illicit drug use but also other risky behaviors such as risky sexual behavior, risky driving, and risky financial behaviors. We hypothesized that NPSU would be associated with all 4 behaviors due to the traditionally postulated reasons reviewed above, such as NPSU occurring in those who have higher sensation seeking or worse effortful control. Experimental research reviewed above has found support that stimulant abuse may have direct harmful effects on various aspects of effortful control. Since effortful control is associated with risky behaviors, it could be proposed that frequent NPSU may relate to higher risky behavior due to decreased effortful control. Therefore, the second aim of the study was to investigate if the association between NPSU and risky behavior is mediated by effortful control abilities. Due to the literature supporting the possibility of a link between these variables, we hypothesized evidence supporting a mediation will be observed in our college sample. All analyses controlled for demographic variables identified below and attention- and hyperactivity-related difficulties.

Attention-deficit/hyperactivity disorder (ADHD) is an important factor to consider when reviewing the literature on NPSU and risky behavior, since self-medication is a documented predictor of NPSU[20] and attention-deficit/hyperactivity symptom severity is proposed to increase risky behavior.[21,22] In fact, NPSU occurs in approximately 31% of college students diagnosed with ADHD, with 8% reporting intranasal use in the last 6 months.[23] Consistent with the literature reviewed above, misuse was associated with higher impulsivity and other substance use.[23] Thus, ADHD is a covariate to be considered in the study of NPSU and risky behavior and often was not included in the analyses of the studies reviewed above.

METHODS

Participants

Participants for this study included 555 college students, mostly female (66%). The mean age of the participating students was 20 years (range = 18–24), with the vast majority being single, never married (98%). In terms of ethnicity, the sample was diverse, with 49% of participants identifying themselves as white/Caucasian, 20% Asian, 19% Hispanic/Latino, 8% black/African American, and 4% as biracial or "other." The median family income was between $95,000 and $110,000 per year (range = less than $20,000 to more than $110,000). Approximately three-fourths of our sample was unemployed, and one-fourth was employed part time.

Thirty-two (6%) individuals in our sample reported a history of an ADHD diagnosis, with 12 (2%) of those individuals reporting psychopharmacological therapy for their ADHD. Using the established Conners Adult ADHD Rating Scale (CAARS), 60 (11%) participants were at or above a *T*-score of 65 on the ADHD Index score, suggesting clinical attention-deficit/hyperactivity symptom severity in a portion of the sample.[24]

Procedure

This study was approved by the university Institutional Review Board. Participants were recruited from psychology or premedical undergraduate classes at a southeastern university. After being consented, they were given a participant number and instructions to access the survey online. The questionnaires were administered using a secure survey system, and the order of questionnaire administration was randomized. In order to verify the identification of the individual completing the surveys, participants were prompted

to call into the research office following survey completion to give their participant number and answer questions about the consenting procedure (eg, to identify if they were physically present). A strength of collecting data online is increased honesty in response, vital for sensitive questionnaires like the ones in this study that asked about illicit substance use or risky sexual behaviors.[25–27]

Measures

NPSU and Substance Use

Our drug use survey was adapted from the National Survey on Drug Use and Health questionnaire[28] and assessed frequency of drug use over the past month, year, and lifetime for alcohol, marijuana, cocaine, hallucinogens, stimulants, and sedatives. The reliability and validity of using frequency rates to assess severity of substance use is well established.[29,30] For alcohol and marijuana use, the number of days in the previous month participants endorsed using either substance as well as how many days of binge drinking (ie, >5 drinks on the same occasion) were examined. To reduce the number of analyses, these 3 items were standardized and averaged into a single substance use factor ($\alpha = .74$). In terms of NPSU, students were asked, "How long has it been since you LAST used any prescription stimulants, in any form, that were NOT prescribed for you or that you took only for the experience or feeling they caused?" Students answered on a 4-point Likert scale: 0 (*within the past 30 days*), 1 (*more than 30 days but within the last year*), 2 (*more than 12 months ago*), 3 (*never*). For all NPSU questions, students were reminded that using stimulants at a dose higher than what is prescribed should be considered nonprescription use.

ADHD Symptoms

The CAARS[24] is a 68-item measure used to capture the severity of attention-deficit/hyperactivity symptoms in adults. The ADHD Index score provides a sensitive dimensional measure of clinical ADHD symptoms[24] and was utilized in this study ($\alpha = .81$).

Risky Driving

To assess students' risky driving, the Driving Behavior Questionnaire (DBQ)[31] was administered. The DBQ is a widely used measure of risky driving with excellent reliability and validity.[31] Supported from research by Lajunen et al[32] the DBQ consists of 40 items and uses a 7-point Likert scale yielding 4 subscales measuring Aggressive Traffic Violations (eg, using horn to indicate annoyance), Ordinary Traffic Violations (eg, speeding), Driving Errors (eg, braking too quickly on a slippery road), and Driving Lapses (eg, accidently hit something while reversing). To reduce the number of analyses, these 4 subscales were standardized and combined into a single risky driving factor to minimize the number of analyses ($\alpha = .79$).

Risky Sexual Activity

To assess students' risky sexual activity, students completed the Sexual Risk Survey (SRS).[33] The self-report version contains 23 items, which yield 5 nonoverlapping but correlated scales that capture risky sexual behavior (sex with uncommitted partners, risky sex acts such as unprotected sex, impulsive sexual behavior such as unexpected sexual encounters, risky anal sex acts such as unprotected anal sex, and intent for sexual acts) as well as an overall risky sex scale. Students report the number of times they engaged in the various sexual activities over the past 6 months, with higher scores indicate riskier sexual activities. The SRS has strong psychometric properties.[33,34] For the purpose of the present study and to reduce the number of analyses, the overall risky sex score was used ($\alpha = .86$).

Risky Financial Behaviors

To assess students' risky financial behaviors, the Compulsive Buying Scale (CBS)[35] and Credit Card Misuse Scale (CCMS)[36] were administered. The CBS is an 1-dimensional, 7-item screening measure developed by extensive qualitative and quantitative analysis that that assesses feelings, thoughts, and behaviors associated with compulsive purchasing of items, with higher scores reflecting higher frequency of compulsive buying tendencies. The CCMS is a 12-item scale that measures one's propensity for credit card misuse, with higher scores reflecting irresponsible use of credit cards (eg, having credit cards at their maximum limit, taking cash advances on credit cards). Both measures ask respondents to answer questions in general, rather than in a specific time period, and have good psychometrics.[35–37] For the purpose of the present study, the total score of the CBS ($\alpha = .77$) and CCMS ($\alpha = .81$) were used as our measures of risky financial behaviors.

Effortful Control

The Adult Temperament Questionnaire (ATQ)[38,39] is a widely used self-report temperament measure that consists of 77 items on a 7-point Likert scale. The Effortful Control index score, which is composed of the Inhibitory Control (eg, resist talking at inappropriate times), Attentional Control (eg, alternate attention between tasks), and Activation Control (eg, making appointments on time) subscales, was utilized in this study. The ATQ has well-established psychometric properties.[40] Higher scores on the ATQ reflect better abilities in effortful control, and strong internal consistency was observed for this index score in this sample ($\alpha = .79$).

Data Analytic Strategy

Missing data were calculated, Little's missing completely at random (MCAR) test was used to test for patterns of missing data, and then multiple imputation was conducted to address the missing data.[41] Descriptive

statistics and preliminary analyses were conducted to examine the normative distribution of each variable and to examine whether there were any statistically significant associations between demographic variables (eg, sex, age, race, family income, grade point average [GPA]) and our study variables. A Blom transformation[42] was utilized to address any significant skewness or kurtosis in the study variables. To reduce the number of analyses, a factor analysis was conducted to test the hypothesis that all the risky behavior variables capture a similar construct. For Aim 1, a partial correlation was conducted and the *c* paths of the 2 mediation models described below were used to provide a path analysis of NPSU regressed on the measures of risky behavior.

For Aim 2, the PROCESS macro[43] was implemented to test 2 independent mediation models. The significance of the indirect effects was tested via bootstrap analysis, which is advantageous due to its greater statistical power without assuming multivariate normality in the sampling distribution of indirect effects.[44–46]

RESULTS

Preliminary Analyses

Missing data were examined for all independent or dependent variables. Missing data averaged at 13.6% for all study variables and were determined to be missing completely at random by Little's MCAR test ($p = .241$), supporting the use of multiple imputation to handle missing data. In order to reduce the number of analyses, a principal axis factoring with a Promax rotation was utilized to test the acceptability of creating a risky behavior factor out of our 5 risky behavior dependent variables. Two factors emerged: a risky driving/financial behavior factor ($\lambda = 1.75$) that explained 35% of the variance and a risky health behavior factor ($\lambda = 1.17$) that explained 21% of the variance. The CCMS, CBS, and DBQ loaded on the risky driving/financial factor, whereas the drug use factor and SRS loaded on the risky health factor. All indicator variables were retained given their high loadings (>.70), and these 2 factor scores were used in subsequent analyses.

NPSU Descriptives

Overall, 16% of our sample reported a lifetime history of NPSU and 8% reported NPSU in the last year. Of these individuals, 82% reported a history of nonprescription use of Ritalin, Adderall, Vyvanse, Concerta, Focalin, methylphenidate, or any other ADHD stimulant medication, whereas the remaining 18% endorsed a history "other" prescription stimulant use. Average age of first NPSU was 18 years old ($SD = 1.36$), with the earliest use reported at age 14. In terms of duration since last NPSU in those who reported a history of use, 22% reported NPSU in the past 30 days, 38% reported NPSU between 31 days and 365 days ago, 28% reported NPSU over 365 days ago, and 12% did not answer this question. All descriptive information on NPSU in our sample is depicted in Table 1. History and recency of NPSU were highly correlated ($r = .801$, $p < .001$), and since stimulant abuse was hypothesized to drive the impact of NPSU on risky behavior, recency of NPSU was utilized for all analyses, as this captures more variability in the frequency of NPSU than a dichotomous history of use question. Age of first use and recency of NPSU were not significantly correlated ($r = -.057$, $p = .664$); therefore, age of first use was not entered as a covariate.

Demographic Profile of NPSU

Demographic and theoretical covariates were tested to identify their impact on recency of NPSU. Students who had lower GPA reported more recent use ($p < 05$). Ethnicity differences in recency of NPSU were also identified ($F[4, 536] = 6.901$, $p < .01$), and a Bonferroni-adjusted pairwise comparison found that Caucasian students had significantly more recent use than Asian students ($p < .001$). Attention-deficit/hyperactivity symptom severity was associated with recency of NPSU ($p < .01$), with college students reporting more symptoms of ADHD having more recent NPSU. All analyses controlled for GPA, ethnicity, and attention-deficit/hyperactivity symptom severity.

Recency of Nonprescription Stimulant Use and Risky Behaviors

Correlations depicting the associations between the duration since NPSU variable and the 2 risky behavior factors are depicted in Table 2. In general, more recent NPSU was significantly associated with increased risky behavior and worse effortful control, thus giving preliminary support to test a possible mediation model.

As depicted in Figure 1, the total effect of NPSU recency on both risky driving/financial ($c = -.15$, $p < .05$, overall model $R^2 = .17$) and risky health ($c = -.48$, $p < .001$, overall model $R^2 = .13$) factors was significant. More recent NPSU consistently predicted higher risky behavior, although duration since last NPSU was a stronger predictor of risky health behaviors than risky driving/financial behavior. More recent NPSU significantly predicted worse effortful control ($a = .19$, $p < .01$). Worse effortful control predicted higher risky driving/financial behaviors ($b = -.33$, $p < .001$) and higher risky health behaviors ($b = -.13$, $p < .05$), although effortful control was a stronger predictor of risky driving/financial behavior than risky health behavior.

Preliminary Support for Effortful Control Mediation Model

When the *a*, *b*, and *c* paths were run simultaneously to test for evidence of mediation, significant indirect effects emerged for the risky driving/financial model and the risky

TABLE 1. Descriptives of Those Reporting Any Lifetime NPSU ($n = 89/555$)

Descriptive	%	*M*	*SD*	Min.	Max.
"Have you ever, even once, used Ritalin, Adderall, Vyvanse, Concerta, Focalin, methylphenidate or any other ADHD or ADD stimulant medication that was NOT prescribed for you or that you took only for the experience or feeling it caused?"	82%				
"Have you ever, even once, used any OTHER prescriptions when they were NOT prescribed for you or that you took only for the experience or feeling they caused?"	18%				
"How old were you the FIRST TIME you used any prescription stimulant, in any form, that was NOT prescribed for you or that you took only for the experience or feeling they caused?"		18	1.36	14	22
"How long has it been since you LAST used any prescription stimulants, in any form, that were NOT prescribed for you or that you took only for the experience or feeling they caused?"	NA = 12% 0 = 22% 1 = 38% 2 = 28%				

Note. Information displayed for only those who endorsed any lifetime nonprescription stimulant use (NPSU). ADHD = attention-deficit/hyperactivity disorder; ADD = attention-deficit disorder; NA = participant did not answer question; 0 = less than 30 days ago; 1 = between 31 days and 365 days ago; 2 = 28% over 365 days ago.

health model (see Table 3). Significant direct effects remained for the association between duration since last NPSU and risky health behaviors ($c' = -.46$, $p < .001$), but not risky driving/financial behaviors ($c' = -.09$, $p = .219$). Effortful control explains a significant portion of shared variance between NPSU and risky behaviors in this study.

COMMENT

NPSU is a notable health issue in college students,[3,4] spurred by desires to self-medicate for attention-related difficulties, increase academic performance, and/or for recreational purposes.[47] Although NPSU has repeatedly been associated with drug use in college students,[48] to the best of our knowledge this study is the most comprehensive evaluation of NPSU and risky behaviors among college students, as this study investigated 4 distinct risky behaviors, controlled for attention-deficit and hyperactivity symptoms, and examined effortful control as a potential mechanism linking NPSU to other risky behaviors. Recency of NPSU predicted higher risky health and driving/financial behaviors, and preliminary evidence was observed that suggests that deficits in effortful control could be an underlying mechanism for the association between recency of NPSU and risky behaviors.

TABLE 2. Association Among Variables

Variable	1	2	3	4
1. Duration since NPSU	—			
2. Risky driving/Financial factor	$-.09^{*}$	—		
3. Risky health factor	$-.30^{***}$	$.18^{***}$	—	
4. Effortful control	$.12^{**}$	$-.32^{**}$	$-.16^{***}$	—

Note. All correlations controlled for students' grade point average and attention-deficit/hyperactivity symptom severity. NPSU = nonprescription stimulant use.
$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

NPSU may put young adults at risk for certain medical conditions,[7] and occasional NPSU can quickly lead to abuse, following the same addiction-related neural mechanisms as substances such as cocaine and other amphetamines.[49] The findings from this study are the first to suggest that NPSU is associated with multiple risky behaviors, such as risky sex or risky driving, that are both costly to the individual and society.[19,50,51] Furthermore, preliminary support indicates that effortful control may represent a potential underlying mechanism for why NPSU and other risky behaviors are associated. It will be important for future studies to examine effortful control, risky behaviors, and NPSU across several years in order to establish the directionality of these associations. As it stands, we cannot speak on whether effortful control deficits simply are a risk factor for both NPSU and associated risky behaviors and/or if they are a consequence or are further diminished as a result of engaging in either NPSU or other risky behaviors. For example, although deficits in effortful control can lead one to NPSU, abuse of prescription stimulants is posited to result in neurocognitive change related to decreases in inhibitory response control.[8,9,52,53]

Since frequent NPSU appears to be linked with risky behaviors that are harmful to society and the individual,[19,50,51] the ACHA initiative to reduce NPSU on college campuses by 2020 is a worthy goal that may have even broader health benefits. Perhaps informing students via campus awareness and educational programs of how

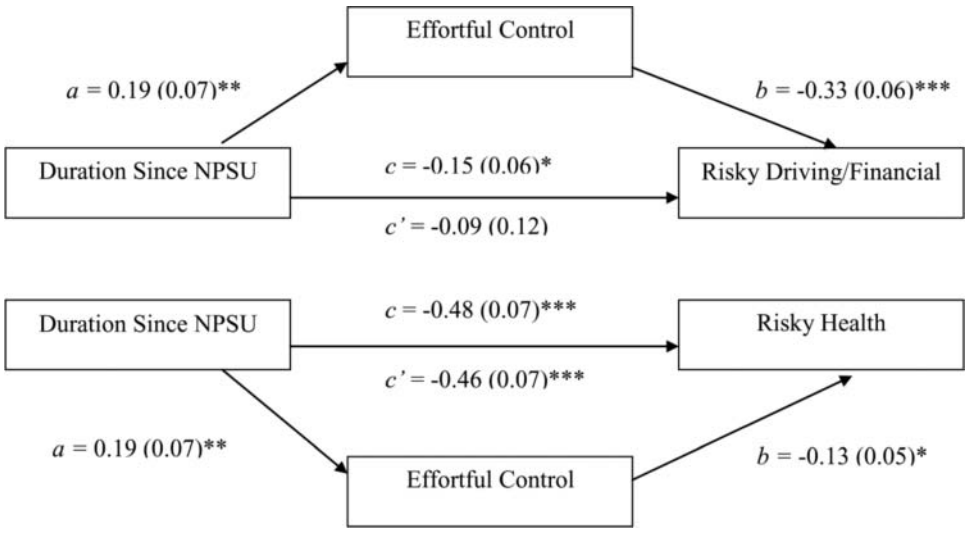

FIGURE 1. Two separate mediation models of the association between nonprescription stimulant use (NPSU) and risky driving/financial and risky health behaviors via effortful control. Standardized regression coefficients from a bootstrap procedure are provided along the paths with their respective standard error measures. Given the cross-sectional nature of this study, the direction of this model is based on past theoretical and empirical work. *$p < .05$; **$p < .01$; ***$p < .001$.

frequent NPSU is associated with other risky behavior will partially hinder use, as currently students' perceptions of NPSU appear misinformed, regardless of if they do or don't engage in NPSU.[54] Clinically, practitioners can integrate this information into their psychoeducation given to students who may be involved in NPSU and should monitor risky behavior in these patients. To further build upon this research, this study should be replicated in a longitudinal study. This replication should utilize a national sample and seek to provide empirical support for causality in order to increase confidence in the mediation analyses observed.[55] Research should also begin to investigate how to best integrate the growing literature on the consequences of frequent NPSU to campus awareness and educational programs.

Limitations

As with all research studies, there are some notable limitations of this study. Although the sample size of this study is a strength, the cross-sectional data prohibit any causality interpretations of the data. However, cross-sectional mediation studies can be conceptualized as identifying risk factors (ie, deficits in effortful control) that position them as likely mediators that should be further researched.[56] According to Mathieu and Taylor,[57] the likelihood that the identified risk factor is a true mediating factor is high if supported by previous experimental, temporal, and theoretical rational. Support for these 3 rationales was reviewed in this article. In this vein, the directionality of the association between NPSU and risky health behaviors cannot be confirmed by this cross-sectional study. Another notable limitation includes our convenience sample that only collected data from a few classes at one large university in the southeast and therefore limits the generalizability of these findings to university-wide or national NPSU. Indeed, the ethnic composition of our sample had a lower rate of respondents identifying themselves as Caucasians and a higher rate of respondents identifying themselves as Asians compared with that of the entire university, although it did match the university-wide percentage of African Americans

TABLE 3. Indirect Effects of Effortful Control

Model	Parameter estimate	*SE*	Lower 95% BC CI	Upper 95% BC CI
Driving/Financial	$-.06^{**}$	.02	−.11	−.03
Health	$-.03^{*}$	.01	−.05	−.01

Note. BC CI = bias-corrected confidence interval.
*$p < .05$; **$p < .01$; ***$p < .001$.

and Hispanics.[58] Importantly, the prevalence estimates in this study of lifetime NPSU and NPSU in the last year matched recent national data, including the spring 2013 ACHA–National College Health Assessment survey,[3,59] and the diversity of the sample is a notable strength.

Conclusions

Misuse of nonprescription stimulants is associated with multiple risky behaviors discussed in this study, supporting the need to increase campus awareness campaigns (eg, social marketing) and educational programs (eg, seminars).[60,61] These campaigns and programs should educate youth and young adults about the risks of occasional NPSU or combining stimulants with other substances,[11] the discrepancies between students' expectations and research on the actual benefits of NPSU,[5] the legal risks of distributing NPSU, and alternative coping skills to help students address some of the previously identified triggers to NPSU (eg, academic stress, depression).[59] Some have even argued that NPSU warrants increased regulation of NPSU in college students.[62] However, a better understanding of the detrimental effects of nonprescription stimulant abuse is required before accurate and effective intervention strategies can develop.

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CONFLICT OF INTEREST DISCLOSURE

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met the ethical guidelines, including adherence to the legal requirements, of the United States and received approval from the Institutional Review Board of the University of Florida.

NOTE

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