

# Misuse of Stimulant Medication Among College Students: A Comprehensive Review and Meta-analysis

Kari Benson · Kate Flory · Kathryn L. Humphreys ·  
Steve S. Lee

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**Abstract** The misuse of stimulant medication among college students is a prevalent and growing problem. The purpose of this review and meta-analysis is to summarize the current research on rates and demographic and psychosocial correlates of stimulant medication misuse among college students, to provide methodological guidance and other ideas for future research, and to provide some preliminary suggestions for preventing and reducing misuse on college campuses. Random-effects meta-analysis found that the rate of stimulant medication misuse among college students was estimated at 17 % (95 % CI [0.13, 0.23],  $p < .001$ ) and identified several psychological variables that differentiated misusers and nonusers, including symptoms of attention-deficit/hyperactivity disorder, problems associated with alcohol use, and marijuana use. A qualitative review of the literature also revealed that Greek organization membership, academic performance, and other substance use were associated with misuse. Students are misusing primarily for academic reasons, and the most common source for obtaining stimulant medication is peers with prescriptions. Interpretation of findings is complicated by the lack of a standard misuse definition as well as validated tools for measuring stimulant misuse. The relation between stimulant medication misuse and extra curricular participation, academic outcomes, depression, and eating

disorders requires further investigation, as do the reasons why students divert or misuse and whether policies on college campuses contribute to the high rates of misuse among students. Future research should also work to develop and implement effective prevention strategies for reducing the diversion and misuse of stimulant medication on college campuses.

**Keywords** Stimulant medication · Misuse · College students · Motives · Psychological correlates

## Introduction

Stimulant medications are typically used for the treatment of attention-deficit/hyperactivity disorder (ADHD) to alleviate symptoms associated with difficulty focusing and lack of impulse control. These medications, such as Adderall (i.e., amphetamine and dextroamphetamine) and Ritalin (i.e., methylphenidate), require a prescription from a physician, ideally after a diagnosis of ADHD has been confirmed (Barkley 2006). Prescriptions for stimulant medications are on the rise; between 2002 and 2010, the number of prescriptions for ADHD medications for youth under 18 increased 46 % (Chai et al. 2012).

A recent review of the literature estimates the prevalence rate of ADHD to be about 2–8 % among college students (DuPaul et al. 2009). More individuals with ADHD are matriculating to college than in the past (DuPaul et al. 2001; Wolf 2001), as more supports have been put in place for college students diagnosed with ADHD, including improved pharmacological and educational/organizational treatments and accommodations (DuPaul et al. 2009). Many college students with ADHD utilize prescription stimulant medications as part of their

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K. Benson · K. Flory (✉)  
Department of Psychology, Barnwell College, University of  
South Carolina, Columbia, SC 29208, USA  
e-mail: floryk@mailbox.sc.edu

K. L. Humphreys  
Tulane University School of Medicine, New Orleans, LA, USA

S. S. Lee  
University of California Los Angeles, Los Angeles, CA, USA

treatment plan. McCabe et al. reported that 2 % of college students had prescriptions for stimulant medications annually (2006a), whereas Rozenbroek and Rothstein (2011) found that 7 % of college students had prescriptions for stimulant medications since entering high school. As the prevalence of stimulant medication prescriptions increases, individuals without prescriptions are increasingly gaining access to stimulant medications. In a survey of college students with medication prescriptions, stimulants were the most commonly diverted medication, with 62 % of students with stimulant prescriptions reporting having shared or sold their medication at least once (Garnier et al. 2010). Studies report that as many as 43 % of college students have misused stimulant medication in their lifetime (Advokat et al. 2008). Throughout this review, “misuse of stimulant medication” refers to using prescription stimulant medications without a prescription or using more stimulant medication than prescribed (i.e., a higher or more frequent dosage). “Diversion” refers to a prescription holder sharing, selling, or otherwise distributing stimulant medication.

When taken as prescribed, stimulants are highly effective at reducing ADHD symptomatology and generally have very few adverse effects (Findling and Dogin 1998; Morton and Stockton 2000). However, in rare cases, stimulant medications have caused cardiac problems and death, but only among individuals with preexisting cardiac conditions, such as structural cardiac abnormalities (Vetter et al. 2008). Those who are prescribed stimulant medications by a physician are generally screened for preexisting cardiac conditions and are monitored accordingly throughout their time on the medication (Vetter et al. 2008). Individuals who misuse stimulant medications are at increased risk for these adverse cardiac effects. Of note, DeSantis et al. (2008) found that none of the 175 undergraduates they interviewed who reported misusing stimulant medication sought out information from health professionals, medical reference guides, or even internet guides before taking their first dose.

There are a number of additional health risks associated with misusing stimulant medication. Stimulant medications, especially quick release formulations, have the potential for abuse similar to illicit central nervous system stimulants, such as amphetamine and cocaine (Volkow et al. 1995). The potential for abuse of stimulant medications is greater when the medication is taken intranasally; Volkow et al. (1995) found that individuals experienced a high similar to that of cocaine use when snorting methylphenidate. Overdose on stimulant medications is also possible; when an individual overdoses on stimulant medication, symptoms similar to acute amphetamine intoxication occur, such as delirium, euphoria, confusion, toxic psychosis, aggressiveness, and hallucinations (Rappley

1997). Finally, college students and other young adults sometimes report misusing stimulant medications to ingest more alcohol over a longer period of time (Graff Low and Gendaszek 2002). In this context, simultaneous use of stimulant medication and alcohol can increase the likelihood of adverse outcomes related to heavy alcohol use, such as driving while intoxicated, blacking out, missing class or work due to drinking, or having unprotected or unplanned sexual intercourse (McCabe et al. 2006).

Given the convenient access to stimulant medications among college student, the prevalence of stimulant medication misuse among this population, and the potentially serious health risks associated with misuse of stimulant medication (especially when combined with other substances, such as alcohol, that are commonly used by college students), there is a pressing need to better understand and characterize the misuse of stimulant medication among college students. Thus, the purpose of this review is to provide a comprehensive summary of the existing research literature on the characteristics of college students (e.g., demographic variables, motives, academic outcomes, psychological symptoms, other substance use) who report misusing stimulant medication. We also address rates of stimulant medication misuse and diversion among college students. A unique and important feature of this review is that we present meta-analytic results for rates of stimulant medication misuse among college students, the association between ADHD diagnosis and misuse, as well as the associations between both problematic alcohol use and marijuana use with misuse. In addition, we explored whether potentially important methodological factors (e.g., study design, sample size, percent of sample with ADHD diagnosis) predicted heterogeneity of effect sizes across the studies included in the meta-analyses. Although it would have been preferable to examine all factors included in this review using meta-analytic techniques, we were limited to factors that were examined in at least three studies that used consistent measurement techniques (Borenstein et al. 2009). Inconsistent measurement of both stimulant medication misuse and factors associated with misuse is a significant limitation of the existing literature and will be covered in the “Discussion.”

Weyandt et al. (2013) recently published a review of the literature on prescription stimulant misuse among college students. The present review differs from Weyandt et al. (2013) in several important ways. First, there are several variations in inclusion criteria (e.g., we did not set a date restriction, whereas studies published before 2003 were excluded in the Weyandt et al. review; we excluded studies that focused only on one type of ADHD medication, such as Ritalin), which resulted in a greater number of studies identified in our review of the literature than in Weyandt et al. (2013) (30 vs. 22). Second, this review covers many

additional factors potentially related to stimulant misuse among college students than were addressed in the Weyandt et al. (2013) review, including: rate of stimulant medication diversion among college students; the demographic factors of race; socioeconomic status; religion, and year in college; perceived availability of stimulant medications; perceived consequences of misuse of stimulant medication; academic outcomes associated with misuse; depression and eating disorder symptomatology and sensation seeking as related to misuse of stimulant medications; and other substance use associated with stimulant medication misuse. Finally, as mentioned above, our review includes a meta-analytic component. There have been other recent articles addressing the problem of stimulant medication misuse among college students and offering suggestions for prevention (e.g., Arria and Dupont 2010), but to our knowledge, no other comprehensive literature reviews have been published.

## Method

### Search Procedure

To identify empirical studies for this comprehensive review and meta-analysis, the following databases were used: PsycInfo, PsycArticles, Psychology and Behavioral Science Collection, Pub Med, SAGE journals, Science Direct, and Taylor & Francis. Key search phrases used included “abuse of ADHD medication,” “abuse of stimulant medication,” and “college students.” Initial searches (Fall 2013) using all of the databases resulted in a total of 727 articles, though many articles were repeated across databases. Article titles were initially scanned for relevancy, which resulted in 81 articles whose abstracts were then carefully read to determine inclusion in this review. An article was deemed appropriate for inclusion if: (1) the main focus of the article included the illicit use of ADHD medication, (2) it was a peer-reviewed, empirical article using quantitative data analytic techniques, (3) it was written in English, (4) it used only undergraduate students in the sample, (5) it did not focus on only one type of ADHD medication (e.g., Ritalin only), and (6) if the article discussed multiple prescription drug categories (e.g., stimulants, opiates), the data must have been analyzed separately for each drug category. Articles that focused only on one type of ADHD medication were excluded because they are likely to under represent misuse of stimulant medications. Articles that did not separately analyze misuse of stimulant medication may overestimate misuse by including other medications (e.g., opiates). Thus, these articles were also excluded.

After evaluation of inclusion criteria, 30 articles were included in this review. Of the 51 articles that were excluded after reviewing their abstracts, 21 were excluded primarily

because they did not address the misuse of stimulant medications; 13 were excluded primarily because they included a non-undergraduate sample; 11 were excluded for not being empirical articles; five were excluded because they focused on only one or two kinds of stimulant medication; and one was excluded for not analyzing prescription medications separately by category. In the remaining 30 articles included in this review, there were 21 unique samples, meaning that some articles utilized the same sample (or a subset of a sample used in another study) for their data analyses. Table 1 presents a detailed summary of the 30 studies included in this review with results.

### Procedures Used in Meta-analyses

#### *Data Extraction*

Two intensively trained raters coded individual studies for data used in the meta-analyses (i.e., examining rates of stimulant misuse among college students, ADHD diagnosis, problematic alcohol use, and marijuana use and risk for misuse, and potential moderators related to the heterogeneity of effect sizes). Rater agreement for extracted data was 93 %. When raters provided contradictory judgments, disagreements were discussed until the raters agreed on how to code the data.

#### *Calculation of Effect Sizes*

We calculated the effect size of the proportion of the sample misusing stimulant medications by calculating a ratio of the number of misusers over the total sample size. Proportions could range from 0 (indicating that no participant misused stimulants) to 1 (indicating that all participants reported stimulant misuse). Odds ratio (OR) was used to estimate the effect size of the association between stimulant misuse (yes/no) and three separate dichotomous risk outcomes: (a) ADHD (yes/no), (b) problematic alcohol use (yes/no), and (c) marijuana use (yes/no), where in each case yes represented hypothesized greater risk. An OR of 1 indicated that the misuse outcome was equivalent based on that risk factor, whereas an OR greater than 1 or less than 1 indicated that stimulant misuse was more or less likely, respectively, to occur in the risk group. The 95 % confidence interval (CI) represents the relative precision of the measurement (i.e., wider ranges are less precise). For each study, an effect size was separately calculated for each available analysis. Thus, the same study could yield as many as four effect sizes. These procedures produced 29 total effect sizes estimated from 23 unique studies. Given that moderator analyses require a minimum of three studies (Borenstein et al. 2009), follow-up moderator analyses were conducted for all misuse variables.

**Table 1** Summary of Studies Included in the Review

Citation	Sample	Method	Rates of misuse	Findings associated with demographics	Findings associated with psychological variables or drug use	Findings associated with motives or consequences	Findings associated with sources or diversion
Advokat et al. (2008) <sup>1</sup>	1,550 students at a large public Southern university with and without ADHD	One-time survey	43 % of those without ADHD misused in their lifetime	More males misused than females, no significant difference found for year in school. GPA was not related to misuse	Misusers used tobacco, alcohol, and marijuana significantly more than nonusers	Misusers used more often to study or stay awake than for recreational use (to get high)	A large proportion of the ADHD group had been asked to give their medications to a non-diagnosed student
Arria et al. (2008) <sup>1</sup>	1,253 students at a public university in the mid-Atlantic region with and without ADHD	Longitudinal surveys and interviews	13 % in their lifetime, 11 % in the past year	N/A	A significant interaction between perceived harmfulness of misuse and sensation seeking in relation to misuse	N/A	N/A
Arria et al. (2011) <sup>1</sup>	470 students from a public university in the mid-Atlantic region without ADHD	Longitudinal surveys and interviews	N/A	Caucasians and males were significantly more likely to misuse	Persistent stimulant medication misusers reported more symptoms of ADHD and used more drugs than persistent users of marijuana and non-drug users	N/A	N/A
Arria et al. (2008b) <sup>1</sup>	1,253 students at a public university in the mid-Atlantic region with and without ADHD	Two-time survey and interview	13 % misused in their lifetime, 11 % in the past year	More Caucasians used than other races, but no difference found for gender, Greek status, or SES. Misusers had lower high school and college GPAs than nonusers	N/A	N/A	N/A
Arria et al. (2013) <sup>1</sup>	984 students at a public university in the mid-Atlantic region with and without ADHD	Longitudinal surveys and interviews	By the fourth/last year, 38 % had misused	Higher family income, being male, being white, having a lower GPA, and skipping class were all associated with misuse	Significantly more misusers met criteria for cannabis use disorder and alcohol use disorder than nonusers; misusers were more likely to self-report ADHD diagnosis	N/A	N/A
DeSantis et al. (2008)	1,811 students at a large southeastern university without ADHD	One-time survey and interview	34 % misused in their lifetime	Significantly more Caucasians, males, Greek members, and upperclassman misused	N/A	The majority of misusers did so for academic reasons, such as to stay awake to study longer or to help them concentrate	The vast majority of misusers got the medication from friends

Table 1 continued

Citation	Sample	Method	Rates of misuse	Findings associated with demographics	Findings associated with psychological variables or drug use	Findings associated with motives or consequences	Findings associated with sources or diversion
Dussault and Weyandt (2013)	1,033 students from five universities in the northeastern, southeastern, northwestern, southwestern, and midwestern USA	One-time survey	20 % misused in their lifetime	More males misused than females; more social fraternity or sorority members misused than academic fraternity or sorority members and nonmembers	Depression was not associated with misuse; impulsivity was associated with misuse	Academic reasons including test performance and focusing better in class were top motives for misuse across groups	N/A
Garnier-Dykstra et al. (2012) <sup>1</sup>	1,253 students at a public university in the mid-Atlantic region with and without ADHD	Longitudinal surveys and interviews	13 % misused in their lifetime, 11 % in the past year	The greater rate of misuse among males appeared to be accounted for by exposure opportunity; no difference in misuse found for SES, race, Greek status, or religion. Misusers had a lower GPA	The magnitude of the significant association between cannabis use disorder and misuse increased over time	Curiosity was more likely to be endorsed as a motive for misuse early in college as compared to later years. Studying was the most commonly endorsed motive every year	A friend with a prescription was the most common source every year; however, overusing one's own prescription increased over time
Hall et al. (2005)	381 students at a Midwestern university with and without ADHD	One-time survey	14 % misused in their lifetime	Significantly more males misused than females	N/A	Less than a fifth of misusers agreed that misuse had a positive effect on their academic performance	N/A
Graff Low and Gendaszek (2002)	150 students at a small competitive college in the US with and without ADHD	One-time survey	35 % misused in the past year	Significantly more males misused than females	The interaction between sensation seeking and perfectionism was significantly associated with misuse. Cocaine and MDMA use were significantly associated with misuse	Academic motives for misuse, such as to improve intellectual performance, were more common than recreational motives, such as using in combination with alcohol	N/A
Jeffers et al. (2013)	705 students at an eastern university with and without ADHD	One-time survey	N/A	No difference was found for gender, age, or body mass index between users and nonusers. Caucasians were more likely to misuse for weight loss than other races	Misusers were significantly more likely to report utilizing a fad diet, using diet pills, smoking cigarettes, vomiting, using laxatives, and fasting than nonusers	A small portion of the sample reported ever having used a prescription stimulant for weight loss	N/A
Judson and Langdon (2009)	333 students from two small New England colleges with and without ADHD	One-time survey	20 % misused in their lifetime	N/A	ADHD "self-diagnosers" without prescriptions were significantly more likely to misuse than non-diagnosers	Academic motives were endorsed more often than recreational or weight loss motives	N/A

**Table 1** continued

Citation	Sample	Method	Rates of misuse	Findings associated with demographics	Findings associated with psychological variables or drug use	Findings associated with motives or consequences	Findings associated with sources or diversion
Kayloyanides et al. (2007)	4,580 students with and without ADHD	One-time survey	2 % of those without prescription misused in the past month	N/A	Starting a prescription in college greatly increased the odds of using these substances together	N/A	N/A
Lookatch et al. (2012)	206 students at Towson University with and without ADHD	One-time survey	26 % misused in the past year	N/A	Sensation seeking and problematic alcohol consumption were both significantly associated with misuse	Academic motives were endorsed more often than recreational or weight loss motives	N/A
McCabe (2008) <sup>2</sup>	3,639 students at one university with and without ADHD	One-time survey	6 % misused in the past year	Misusers and nonusers did not significantly differ by gender, but Greek members misused significantly more than non-members	N/A	N/A	N/A
McCabe and Boyd (2005) <sup>3</sup>	9,161 students at a large public Midwestern university with and without ADHD	One-time survey	5 % misused in the past year	N/A	Those who got stimulant medication from peers were more likely to smoke cigarettes, drink heavily, endorse 2 + items of alcohol abuse, use marijuana, use illicit drugs, or use prescription drugs compared to those who obtained it from family	N/A	The most frequently reported source was peers; only a few reported family or drug dealers as a source
McCabe et al. (2006a) <sup>3</sup>	9,161 students at a large public Midwestern university with and without ADHD	One-time survey	5 % misused in the past year	Men reported significantly more misuse than women; Asians reported significantly less use	N/A	N/A	N/A
McCabe et al. (2006b) <sup>3</sup>	9,161 students at a large public Midwestern university with and without ADHD	One-time survey	5 % misused in the past year; 8 % misused in their lifetime.	Misuse in the past year was associated with being male, Caucasian, upper-class, a Greek member, Jewish or no religious affiliation, and lower cumulative GPA	A greater percentage of misusers of prescription stimulants in the past year reported binge drinking, marijuana use, cocaine use, ecstasy use, and use of hallucinogens compared to nonusers	N/A	The most frequently reported source was peers; only a few reported family or drug dealers as a source

Table 1 continued

Citation	Sample	Method	Rates of misuse	Findings associated with demographics	Findings associated with psychological variables or drug use	Findings associated with motives or consequences	Findings associated with sources or diversion
Peterkin et al. (2011)	184 students from George Mason University without ADHD	One-time survey	27 % misused in their lifetime	Difference in misuse between men and women did not reach significance	Significantly more misusers than nonusers screened positive for ADHD	The most common reason for misuse was "to improve study skills." Almost all misusers had academic reasons for misuse; only two misusers gave nonacademic reasons	N/A
Rabiner et al. (2009a) <sup>4</sup>	115 students from one public and one private university in the southeastern USA with ADHD and prescriptions for stimulant medication	One-time survey	31 % misused since the beginning of college, 24 % in the last 6 months	Race, Greek status, and GPA did not reach significance	Misusers had higher levels of hyperactive-impulsive symptoms, but not inattentive. Misusers were more likely to have consumed alcohol and used marijuana, but not used cigarettes or cocaine, than nonusers	Of the 27 misusers, 14 misused for only academic reasons and 13 misused for both academic and nonacademic reasons	Those who had misused were significantly more likely to divert
Rabiner et al. (2009b) <sup>4</sup>	3,407 students from one public and one private university located in the southeastern USA with and without ADHD	One-time survey	9 % since starting college, 5 % in last sixth months	Significantly more misuse was reported by males, Caucasians, and Greek members; misusers had significantly lower GPAs	Misusers were significantly more likely have used alcohol, cigarettes, marijuana, cocaine, and inhalants in the previous six months. Misusers had higher inattentive and hyperactive-impulsive symptoms than nonusers, but the groups did not differ on depressive symptoms	The majority of misusers used for academic motives only, some misused for academic and nonacademic motives, and a small portion of the sample misused for only academic motives. Those with academic motives felt they got the desired outcome more often than those with nonacademic motives	The majority of misusers bought or were given the medication by a prescription holder
Rabiner et al. (2010)	777 students at one public and one private university in the southeast without ADHD	Survey at beginning and end of academic year	5 % initiated use between first and second survey	No significant difference found for gender, race, or site (the two schools). Greeks were 2.32 times more likely to initiate use than non-Greeks	The odds of becoming a misuser increased by 1.78 times for each standard deviation increase in attention problems and by 3.81 times for each standard deviation increase in substance use	N/A	N/A
Rozenbroek and Rothstein (2011)	428 undergraduates from a medium sized mid-Atlantic college with and without ADHD	One-time survey	8 % misused since entering high school	N/A	Misusers were less likely than medical users to use only one drug	The majority used for academic reasons, followed by "just to try it," and "makes me feel good"	"Friend or acquaintance" was listed as one source by practically all stimulant misusers

**Table 1** continued

Citation	Sample	Method	Rates of misuse	Findings associated with demographics	Findings associated with psychological variables or drug use	Findings associated with motives or consequences	Findings associated with sources or diversion
Septúlveda et al. (2011)	55 students at Northwestern University with ADHD and prescriptions for stimulant medication	One-time survey	36 % reported using too much, 9 % to get high, 40 % misused in some way	Differences for gender, race, and year in school did not reach significance	No significant difference in symptoms of ADHD between misusers and non-misusers. Cigarette smoking, higher rates of binge drinking, and adverse consequences of alcohol use, marijuana use, illicit drug use, and drug use dependence were more prevalent among misusers	N/A	A little more than third of the sample diverted stimulants in the last year; misusers were more likely to divert. Adderall was the most frequently diverted
Sharp and Rosen (2007)	448 students at a large public university in the western US with and without ADHD	One-time survey	18 % misused in their lifetime	Differences for gender and race did not reach significance	N/A	The majority of misusers did so to focus and study or to stay up later, some indicated that they did so to prolong nights of partying or hanging out with friends	Only a small portion of participants had sold or given away stimulant medication
Teter et al. (2005) <sup>3</sup>	9,161 students at a large public Midwestern university with and without ADHD	One-time survey	8 % misused in their lifetime; 5 % in the past year	Men reported significantly more misuse than women and Caucasians and Hispanics misused significantly more than African-American and Asians	Misusers were significantly more likely to use cocaine, cigarettes, alcohol, ecstasy, and amphetamines and binge drink than nonusers	The most commonly endorsed motive was to concentrate, followed by to increase alertness and to get high	N/A
Teter et al. (2010) <sup>2</sup>	3,639 students at one university with and without ADHD	One-time survey	6 % misused in the past year	N/A	More frequent misuse and non-oral routes of administration were significantly associated with depressed mood; about half of those frequent misusers experienced past-month depressed mood	N/A	N/A
Weyandt et al. (2009)	390 undergraduates at a large northeast university without ADHD	One-time survey	8 % misused in past month, 18 % in last year, 27 % in their lifetime	Gender and year in school did not significantly differ between misusers and nonusers. Greek members were significantly more likely to misuse. GPA was negatively associated with misuse	Sensation seeking, somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychosis were strongly correlated with prescription stimulant misuse	The highest rated motives for misuse were to (a) perform better on schoolwork, (b) perform better on tests, and (c) focus better in class	A very small portion of the sample had sold stimulant medication to other students



Table 1 continued

Citation	Sample	Method	Rates of misuse	Findings associated with demographics	Findings associated with psychological variables or drug use	Findings associated with motives or consequences	Findings associated with sources or diversion
Van Eck et al. (2012)	660 students at the University of South Carolina with and without ADHD	One-time survey	23 % misused in their lifetime	N/A	Symptoms of ADHD and CD were both individually significantly associated with misuse, and there was an interaction between the variables	N/A	N/A
Zullig and Divin (2012)	22,783 students from 40 campuses with and without ADHD	One-time survey	6 % misused in the past year	N/A	Participants who misused in the last year were significantly more likely to feel very sad, feel depressed, and consider suicide	N/A	N/A

Citations marked with the same superscript used the same sample or a subset of the same sample for data analyses

### Moderator Variables

We tested whether potentially important methodological factors across the studies predicted heterogeneity of effect sizes in estimates of stimulant medication misuse, ADHD associated with misuse, and problematic alcohol use and marijuana use associated with misuse. The following study characteristics were coded: (a) year published, (b) total sample size, (c) mean age of participants, (d) mean years in college, (e) sex (percent male), (f) race (percent Caucasian), (g) percent in Greek organizations, (h) mean grade point average (GPA), (i) time frame of misuse assessment (lifetime, more than 1 year, past year, or less than 1 year), (j) sample source (public or private college), (k) design (cross-sectional or longitudinal), (l) definition of misuse used in the study (definition of misuse only included “using when you don’t have a prescription,” definition of misuse only included “using a stimulant medication you don’t have a prescription for”—could have another prescription, or definition of misuse include “using medication you do not have a prescription for, using too much of your own medication, or using your medication incorrectly”), (m) whether the study included individuals with ADHD (yes or no), (n) whether the study included those with prescription stimulant medication (yes or no), (o) percent participants with prescriptions, and (p) percent participants with an ADHD diagnosis.

### Statistical Analysis

Random-effects models were conducted with the effect size for each outcome. Heterogeneity of effect sizes was estimated using the standard Cochran’s  $Q$  Test, which approximates a Chi-square distribution with  $k - 1$  degrees of freedom, where  $k$  is the number of effect sizes, and indicates the degree of consistency of findings across studies (Hedges and Olkin 1985). A nonsignificant  $Q$  test statistic suggests that the pooled OR represents a unitary effect. When the  $p$  value associated with the  $Q$  statistic was equal or less than .10, random-effects meta-regression analyses were conducted to determine whether the study characteristics described above could explain variability across studies. The meta-analysis statistical analyses were performed using STATA 12.

### Results

#### Overview of Studies Included in this Review

The 30 articles/studies that met inclusion criteria for this review used a variety of research designs (see Table 1). Twenty-three studies were cross-sectional surveys of college students; one study used a short longitudinal design with surveys administered at the beginning and end of an

academic year; one study used mixed methods including a cross-sectional survey and an interview; and five studies used mixed methods including an initial cross-sectional survey followed by four prospective interviews (i.e., one interview per year for 4 years) with a selected subsample. These five studies used data from the College Life Study in which a screener survey was administered to 3,401 first-time students and annual interviews were administered to 1,253 of these students.

### Prevalence of Stimulant Medication Misuse Among College Students

Twenty-six of the studies reviewed reported rates of misuse of stimulant medication among college students in general; two reported only on misuse among those with stimulant prescriptions; and two studies did not report rates of misuse because one focused only on the differences between misusers and nonusers (Arria et al. 2011), and one focused only on misuse for weight loss (Jeffers et al. 2013). Lifetime rates of stimulant medication misuse were the most frequently reported prevalence rates, with 15 studies reporting lifetime rates with a range of 8 % (McCabe et al. 2006b) to 43 % (Advokat et al. 2008). Among these 15 studies, six reported a lifetime prevalence rate between 5 and 15 %, four reported a lifetime rate between 15 and 25 %, four reported

a rate between 25 and 35 %, and only one reported a lifetime prevalence rate of misuse of stimulant medication above 35 %. Fourteen studies reported misuse of stimulant medications within the last year with a range of 5 % (Rabiner et al. 2010) to 35 % (Graff Low and Gendaszek 2002). Eleven of these 14 studies reported a prevalence rate of annual misuse between 5 and 11 %. Only three studies reported how many participants had misused stimulant medications in the last month, ranging from 2 % (Kaylonides et al. 2007) to 8 % (Weyandt et al. 2009).

Students involved in these stimulant misuse studies reported misusing a wide range of prescription stimulant medications, including short- and longer-acting formulations of Adderall, Ritalin, Concerta, Dexedrine, Desoxyn, Metadate, Cylert, Focalin, and others, although multiple studies (e.g., Advokat et al. 2008; Lookatch et al. 2012) suggest that Adderall may be the most commonly misused medication. A recent report (Austerman and Muzina, 2014) indicated that the most prescribed ADHD medication in 2012 was Adderall with 34 % of the market share.

### Meta-analysis Results

Twenty studies provided rates of stimulant medication misuse in their sample that were appropriate for meta-analysis, with proportions ranging from 0.02 to 0.43 (see

**Fig. 1** Meta-analysis results for rates of stimulant medication misuse

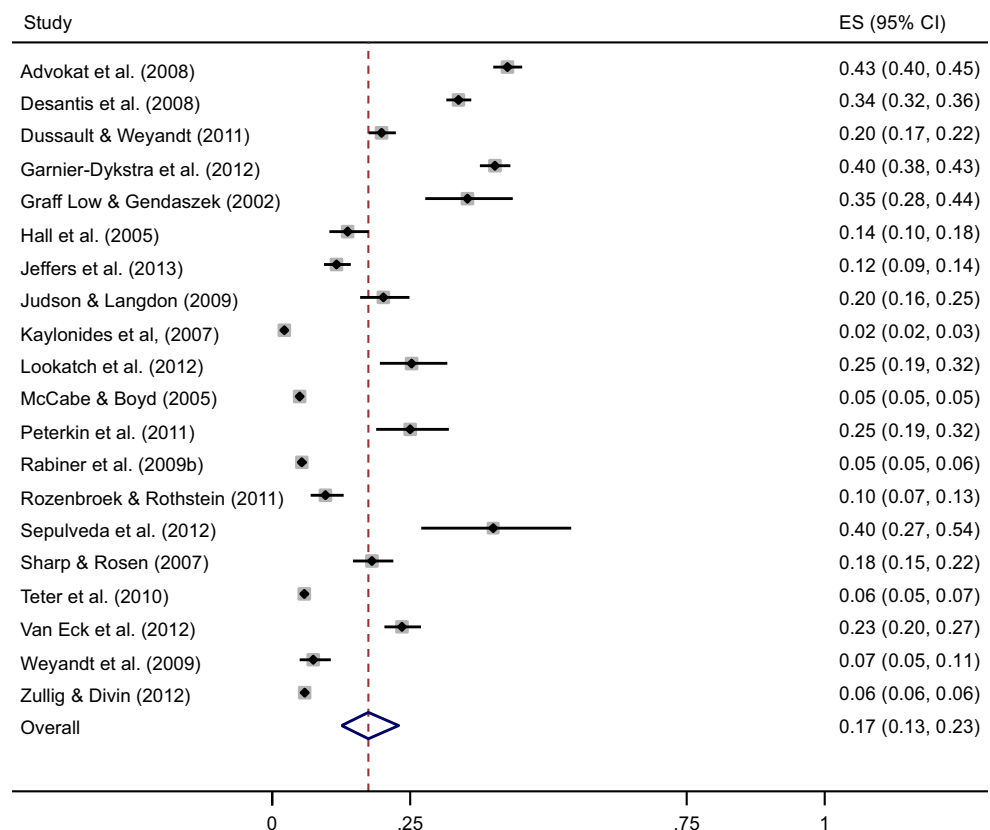


Fig. 1). The 95 % CIs varied widely. The random-effects meta-analysis estimated the rate of misuse at 17 % (Proportion = 0.17; 95 % CI [0.13, 0.23],  $p < .001$ ) with significant heterogeneity observed across studies ( $Q(19) = 2,825.88$ ,  $p < .001$ ).

Three moderator variables significantly predicted heterogeneity in effect size in rates of misuse, whereas an additional moderator did so marginally. First, longitudinal studies yielded higher rates of misuse than cross-sectional studies ( $t = 2.26$ ,  $p = .036$ ; Adj.  $R^2 = 20.07$ ). Second, the time frame in which the study obtained information about the rates of misuse was significantly associated with rates of misuse. Analyses of the length of time for assessment periods were conducted as an ordinal variable (0 = lifetime, 1 = more than 1 year, 2 = past year, 3 = less than 1 year) and as a linear variable. Findings were quite consistent such that longer periods of time were associated with higher rates of reported misuse ( $t = -2.42$ ,  $p = .026$ ; Adj.  $R^2 = 24.28$ ). Third, the percentage of the sample with a diagnosis of ADHD also significantly predicted rates of misuse in the studies ( $t = 2.93$ ,  $p = .043$ ; Adj.  $R^2 = 67.72$ ). That is, increased rates of stimulant medication misuse were observed in samples that included a greater percentage of individuals with ADHD. Finally, the marginally significant moderator variable was the size of the study; total sample size was negatively associated with effect size ( $t = -1.91$ ,  $p = .072$ ; Adj.  $R^2 = 12.37$ ). Thus, larger studies demonstrated marginally lower rates of stimulant medication misuse.

### Summary

The range of prevalence rates of misuse of stimulant medication among college students is quite wide and variable, with lifetime rates ranging from 8 % (McCabe et al. 2006b) to 43 % (Advokat et al. 2008), and is due, at least in part, to important methodological differences between existing studies. The variability in methodologies utilized to study stimulant medication misuse, along with the wide range of misuse rates reported, suggests that more research in this area is warranted. It may be the case that rates vary, in part, because of distinct geographical, demographic, academic, or other features of the colleges and universities where these data have been collected; this is a theory that we explored with our moderator analyses, but it should be further investigated through population-based approaches and/or qualitative studies to understand how different environments may predict risk for misuse. Although misuse rates vary widely across studies, it is clear from our meta-analytic summary that a substantial number of college students are misusing stimulant medication (17 %), which supports the need for identifying current users and those at-risk and developing effective intervention/

prevention programs that can be administered on college campuses.

### Sources, Perceived Availability, and Diversion of Stimulant Medications Among College Students

Six of the studies reviewed asked students how they obtained stimulant medications for misuse. Five of these studies found that peers were the most common source for obtaining the medications. The remaining study did not ask whom students had obtained the medications from, but rather, if they had bought, received for free, or stolen the stimulant medication. This study reported that 39 % of students bought stimulant medications from a prescription holder, 36 % were given the medications from a prescription holder, 12 % bought stimulant medications from a nonprescription holder, and one participant stole medications from a prescription holder (Rabiner et al. 2009a, b). DeSantis et al. (2008) found that 91 % of the undergraduates who were interviewed obtained stimulant medications from friends or significant others; however, McCabe and Boyd (2005) found that the number who obtained stimulant medications from peers was around 68 %. In a longitudinal study, peers were the most common source of stimulant medications every year of data collection; however, overusing one's own prescription grew over time (Garnier-Dykstra et al. 2012).

Perceived availability of stimulant medications was discussed in three articles. In two studies, participants, including stimulant misusers and nonusers, were asked how easy they believed it was to obtain stimulant medication. DeSantis et al. (2008) found that 82 % of students thought it was somewhat or very easy to obtain stimulant medication; however, Sharp and Rosén (2007) found that only 55 % of students thought it was somewhat or very easy to obtain stimulant medication. In the third study that examined perceived availability, 37 % of men and 29 % of women agreed that they know students who would provide them with stimulant medications (Hall et al. 2005).

Two of the studies included in this review provided rates of the diversion (i.e., giving away, selling, or otherwise distributing one's own medication) of stimulant medications by college student prescription holders. In the year prior to measurement, 36 % of stimulant prescription holders reported diverting their medication and Adderall was most the most frequently diverted of these medications (Sepúlveda et al. 2011). The other study reported that 56 % of prescription holders had been approached to divert their medication in the last 6 months and 13 % had been approached more than six times. Of the 115 participants who reported diverting their medication, 20 diverted 1–2 times, five diverted 3–5 times, three diverted 6–9 times, and two diverted 10–19 times for a total of 16 % who

diverted in the last 6 months (Rabiner et al. 2009a). Interestingly, the greatest predictor of diverting stimulant medication was misusing stimulant medication (i.e., taking more medication than prescribed): 57 % of misusers diverted their medication compared to 21 % those who used stimulant medications as prescribed ( $p < .01$ ; Sepúlveda et al. 2011); Rabiner et al. (2009a) found similar results, with 59 % of misusers reporting diversion compared to 22 % of those who used stimulant medications as prescribed ( $p < .001$ ). An additional study reported that 5 % of students with ADHD had been “occasionally pressured into giving someone else their prescription stimulants,” though this study did not provide a general rate of diversion among students with ADHD (Weyandt et al. 2009).

### Summary

Existing studies reveal that the most common source of obtaining stimulant medications among college students is from their peers and that the majority of college students believe that stimulant medication is somewhat easy or very easy to obtain. Estimates of stimulant medication diversion are consistent with these conclusions. Based on these findings, policies and interventions specifically targeting college students and other young adults with prescriptions for stimulant medication could play a critical role in reducing the diversion of stimulant medication to college students who do not have prescriptions.

### Demographic Characteristics Related to Stimulant Medication Misuse Among College Students

Many of the studies reviewed examined the relations between particular demographic characteristics (e.g., gender, race, socioeconomic status, religion, year in college, sorority or fraternity membership) and misuse of stimulant medication among college students. Nineteen studies reported on gender differences in misuse of stimulant medication and 13 of these studies found that significantly more males misused stimulant medication than females. For example, one study found that 26 % of males and 17 % of females reported misusing stimulant medication ( $p < .001$ ; Dussault and Weyandt 2013); another study found that 39 % of males and 30 % of females reported misuse ( $p < .001$ ; DeSantis et al. 2008). The other six studies found no significant difference in stimulant medication misuse based on gender. However, one of these studies used a  $p$  value of  $< .001$  as the cutoff for significance. In this study, the difference between males and females in stimulant medication misuse resulted in a significance level of  $p = .0031$  (Peterkin et al. 2011), which would typically be considered statistically significant. The remaining five studies that did not report a statistically

significant difference between males and females in stimulant medication misuse generally still found a higher percentage of males misusing than females (McCabe 2008; Sharp and Rosén 2007). One study evaluated how often students reported having the opportunity to engage in stimulant medication misuse, measured by how many days they were offered stimulant medication in the last year. Males had significantly more opportunities for misusing stimulant medications than females and this difference appeared to account for most of the variability between males and females in terms of rates of misuse (Garnier-Dykstra et al. 2012).

Findings linking racial background to misuse of stimulant medication were less conclusive than results related to gender; 12 studies reported on misuse of stimulant medication as related to racial group and seven of these studies found that Caucasian students reported greater stimulant medication misuse than students of other racial backgrounds. The other five studies found no significant difference between racial groups in terms of stimulant medication misuse. Most studies examining race used the categories of Caucasian and non-Caucasian for data analytic purposes. For example, one study found that 35 % of Caucasian students misused, while 25 % of other ethnicities misused ( $p < .05$ ; DeSantis et al. 2008). Another study reported that 7 % of Caucasian students misused stimulant medications in the last 6 months, while only 2 % of non-Caucasian students, including African-American, Asian, and Hispanic students, had misused in that same time period (Rabiner et al. 2009b). However, another study that examined race by specific categories found that Caucasian and Hispanic students had similar rates of lifetime stimulant medication misuse, 10 and 9 % respectively, though they both significantly differed from African-American and Asian students, with 3 and 5 %, respectively ( $p < .001$ ; Teter et al. 2005).

Four studies reported on the association between socioeconomic status (SES) and stimulant medication misuse and only one of these studies found a significant association (i.e., higher SES was related to a greater rate of misuse; Arria et al. 2013). Two of these four studies used self-reported family income to measure SES. One study found that participants with an annual family income greater than \$250,000 were 2.24 times ( $p < .05$ ) more likely to use stimulant medication as prescribed than those with an annual family income under \$50,000, but the difference did not reach significance for misuse (McCabe et al. 2006b). The other study that measured self-reported family income found that the average family income significantly differed for those who misused stimulant medications compared to those who did not misuse: \$78,000 compared to \$71,400, respectively (Arria et al. 2013). It is important to note that the remaining two studies, which did

not find a significant difference, used the participants' mother's highest degree achieved (Arria et al. 2008b) and average SES reported by zip code (Garnier-Dykstra et al. 2012) as a proxy for SES.

Religious affiliation and stimulant medication misuse were evaluated in only two studies. One study found that Jewish students were 2.02 times ( $p < .001$ ) more likely and nonaffiliated students were 1.69 times ( $p < .001$ ) more likely to misuse when compared to Christian, Muslim, and other denominations of students (McCabe et al. 2006b). The other study found no significant difference in stimulant medication misuse among students from different religious affiliations (Garnier-Dykstra et al. 2012).

Five studies examined the association of misuse of stimulant medication with year in college (e.g., Freshman, Sophomore) and two of these studies found a significant difference in stimulant medication misuse for students of different years, with upperclassmen using more than Freshmen (DeSantis et al. 2008; McCabe et al. 2006b). For instance, one study reported that 18 % of Freshmen, 31 % of Sophomores, 49 % of Juniors, and 55 % of Seniors had misused stimulant medication ( $p < .001$ ; DeSantis et al. 2008). These differences by year in college may be due to the fact that upperclassmen have been in college longer and have therefore had more time and perhaps more opportunities to misuse stimulant medications; however, misuse of stimulant medications has also been linked to other difficulties, such as academic problems and drug use, that may make it more difficult for students to remain in college.

Members of fraternities and sororities appear to be more at-risk for misuse of stimulant medication than non-Greek students. Ten studies measured stimulant medication misuse among Greek and non-Greek students, and seven found a significant difference between these groups. In fact, in multiple studies, Greek students had rates of misuse twice that of non-Greeks. For example, 48 % of Greeks misused in their lifetime compared to 22 % of non-Greeks (DeSantis et al. 2008); 12 % of Greeks misused in the past year compared to 5 % of non-Greeks ( $p < .01$ ; McCabe 2008); and Greeks were 2.32 times more likely to initiate use than non-Greeks ( $p < .05$ ; Rabiner et al. 2010).

One study delved further into the relation between Greek organization membership and misuse of stimulant medications. Dussault and Weyandt (2013) studied the difference between social fraternities and sororities and academic fraternities and sororities. They found that the social organization members had a significantly higher rate of lifetime stimulant medication misuse, 36 %, compared to both academic fraternity/sorority members and nonmembers, 20 and 16 %, respectively. This study also reported that social fraternity/sorority members differed significantly from nonmembers on perception of stimulant medication safety and perceived rate of peer

misuse of stimulant medication, such that social sorority/fraternity members thought that stimulant medications were safer and that more sorority/fraternity members were misusing than did nonmembers (Dussault and Weyandt 2013). One of the studies that found no significant difference between Greeks and non-Greeks in stimulant medication misuse also measured participation in sports and volunteering but found no significant difference in rates of stimulant medication misuse based on involvement in these activities. This was the only study to evaluate other campus activities besides Greek life (Garnier-Dykstra et al. 2012).

### Summary

Being male and/or a member of a college fraternity/sorority, particularly social organizations, are both strongly associated with the misuse of stimulant medication. This is consistent with past research findings that men are more frequent users of alcohol and most illicit drugs (Dennhardt and Murphy 2013). Greek membership has also been demonstrated to be related to greater substance use in general (Dennhardt and Murphy 2013). Results were less conclusive for racial background and year in college, but some studies examining these factors did find that Caucasian students and college upperclassmen are more likely to misuse stimulant medication than non-Caucasian students and college underclassmen. The association of SES, religion, and extracurricular involvement on stimulant medication misuse requires further research to draw firm conclusions.

### Motives for and Perceived Consequences of Misuse of Stimulant Medication Among College Students

Researchers have also evaluated college students' motives for misusing stimulant medication and the risks and benefits they associate with misuse. Fifteen studies asked misusing participants about their motives for misuse. All of these studies reported that the most commonly endorsed motives were related to academics. "To concentrate better while studying" (Rabiner et al. 2009b), "to improve study skills" (Peterkin et al. 2011), "to stay awake to study longer" (DeSantis et al. 2008), and "to improve concentration" (Judson and Langdon 2009) were some of the most commonly endorsed motives in these studies. Nonacademic reasons, such as to get high, to prolong effects of alcohol and other drugs, and to lose weight, were less commonly endorsed (Sharp and Rosén 2007; Lookatch et al. 2012; Advokat et al. 2008). In studies where participants were able to indicate multiple motives for misuse, very few students misused for only nonacademic reasons. For example, 54 % misused for only academic reasons, 6 % used for only for nonacademic reasons, and 40 %

misused for both purposes (Rabiner et al. 2009b). Peterkin et al. reported similar findings: 87 % of respondents reported academic reasons for misuse and 4 % reported nonacademic reasons for misuse (2011). Curiosity was more likely to be endorsed as a motive earlier in college compared to later (Garnier-Dykstra et al. 2012). One study found that a disproportionate number of women indicated misusing stimulant medication for weight loss compared to men (DeSantis et al. 2008), though, in general, motives for stimulant medication misuse do not seem to differ significantly by gender (Graff Low and Gendaszek 2002).

Four studies measured the relation between misuse of stimulant medication and perceived risk associated with misuse. Perceived risk was conceptualized as perceived harmfulness (Arria et al. 2008a), perception of safety (Dussault and Weyandt 2013), concern with health risk (Judson and Langdon, 2009), and positive outcome expectancies (Lookatch et al. 2012), though it is important to note that positive expectancies is the inverse of perceived risk. These articles found that when college students perceive more risk or have less positive expectancies about stimulant medication misuse, they are less likely to misuse stimulant medication. Similarly, those who associated stimulant medication misuse with low perceived harmfulness were over 10 times more likely to use in the last year than those who associated misuse with high perceived harmfulness (Arria et al. 2008a).

The perceived consequences of stimulant medication misuse have been measured less often than motives. Perceived consequences refer to desired outcomes and adverse effects that students perceive have resulted from their misuse of stimulant medication. Three studies reviewed the desired outcomes of misuse, with researchers asking participants how often the desired effect was achieved based on the motives they endorsed. In a general college student sample, effects were experienced “often” or “always” for 74 % or higher for all academic motives, 59 % for getting high, but only 39 % for losing weight (Rabiner et al. 2009b). An ADHD-only sample appeared to experience desired outcomes less often, with desired academic effects ranging from 47 to 73 % (Rabiner et al. 2009a). However, the third study, which used a general college student sample, reported that only 14 % of misusers believed that the medication had a positive effect on their academic outcomes in the long run (Hall et al. 2005).

Three studies assessed the adverse effects associated with misuse of stimulant medication. In one study, 74 % of misusing students experienced decreased appetite, 71 % experienced insomnia, 29 % experienced irritability, 27 % experienced headaches, and 23 % experienced stomachaches (Advokat et al. 2008). The other two studies described the same sample, though one specifically examined only those who were prescribed stimulant

medication. These studies reported similar results as the first study; however, they also found that 16 % of the general population of college student misusers felt sad and 7 % of the general population and 15 % of the ADHD population of misusers experienced social difficulties as a result of misuse (Rabiner et al. 2009a, b).

### Summary

Existing research on motives for and consequences of stimulant medication misuse among college students indicates that students misuse for mostly academic reasons, though there are some who misuse to lose weight or get high. Interestingly, students who misuse for academic reasons believe they achieve their desired outcomes more often than those who misuse for nonacademic reasons. Perceived risk of misusing stimulant medication appears to be a protective factor against misuse, which corresponds with past research findings that fewer positive outcome expectancies and more negative outcome expectancies have been shown to predict alcohol and other types of substance use (Brown et al. 1985). Students reported adverse effects associated with stimulant medication misuse relatively often, most commonly decreased appetite and insomnia. However, it is unclear whether these adverse effects deter students from misuse, as they may in fact be desired effects for some or many students. Thoroughly understanding students’ motives for stimulant medication misuse is a critical first step in preventing misuse. Since perceived risk of misusing stimulant medication is a protective factor against misuse, universities could provide information to students about the harms of misuse in order to increase students’ perceived risk and thereby decrease their misuse. Also, because students are primarily misusing for academic reasons and they believe the medication to be effective, providing students with academic interventions, such as instruction in study skills and academic goal setting, could reduce their desire to misuse stimulant medication.

### Academic Outcomes Associated with Misuse of Stimulant Medication Among College Students

Eight studies reviewed the relation between academic outcomes and misuse of stimulant medication; and six of these demonstrated a significant difference between misusers and nonusers. For example, Advokat et al. (2008) found that there was not a significant difference for nonusers compared to misusers (3.19 vs. 3.15 respectively) while in another study nonusers reported an average GPA of 3.28 compared to 3.16 for misusers ( $p < .001$ ; Rabiner et al. 2009b). Other research demonstrates that the lower the student’s GPA is, the greater the odds are of the student

misusing stimulant medication (McCabe et al. 2006b). Misuse is also significantly related to other detrimental academic behaviors, like skipping class and less studying (Arria et al. 2008b, 2013). Weekly, misusers spend less time studying, 19.7 h compared to 17.2 h for nonusers, and skipped a greater percentage of classes, 16 % compared to 9 % for nonusers (Arria et al. 2008b).

### Summary

Interestingly, although misusers report most often taking stimulant medication to improve academic outcomes, nonusers appear to actually be more successful in academics. This suggests that: (1) misuse of stimulant medication is not actually an effective strategy for improving academic functioning (i.e., students may inaccurately perceive that misuse of stimulant medication helps with their academic functioning), (2) students who are doing more poorly in school may turn to stimulant medication misuse in an attempt to improve their academic outcomes, and/or (3) other psychological factors, such as ADHD symptoms, may relate to both poorer academic performance as well as attempts to self-medicate symptoms by misusing stimulant medications.

### ADHD as a Correlate of Stimulant Medication Misuse Among College Students

Researchers have evaluated the relation between a variety of different psychological variables and misuse of stimulant medication. The clearest association is between symptoms of ADHD and stimulant medication misuse. All eight studies that collected data on symptoms of ADHD in a general college student population reported a significant association between greater symptoms of ADHD and higher rates of misuse or a significant difference in rates of misuse between those reporting clinically significant symptoms of ADHD and those who did not. One study found that 71 % of stimulant medication misusers screened positive for adult ADHD symptoms (Peterkin et al. 2011). Another study found that for every standard deviation increase in attention problems, the odds of becoming a misuser increased by 1.78 (Rabiner et al. 2010). Two studies asked participants if they believed they had ADHD. Advokat et al. (2008) found that 12 % of misusers believed they had ADHD. Twenty-nine percent of individuals with “self-diagnosed” ADHD reported misusing, compared to 11 % of “nondiagnosed” ( $p < 0.001$ ) (Judson and Langdon 2009). While there is meta-analytic evidence that stimulant medication in itself does not increase risk for substance use disorders (Humphreys et al. 2013) and the use of stimulant medication to treat ADHD may even reduce drug use (Schoenfelder et al. 2014), a

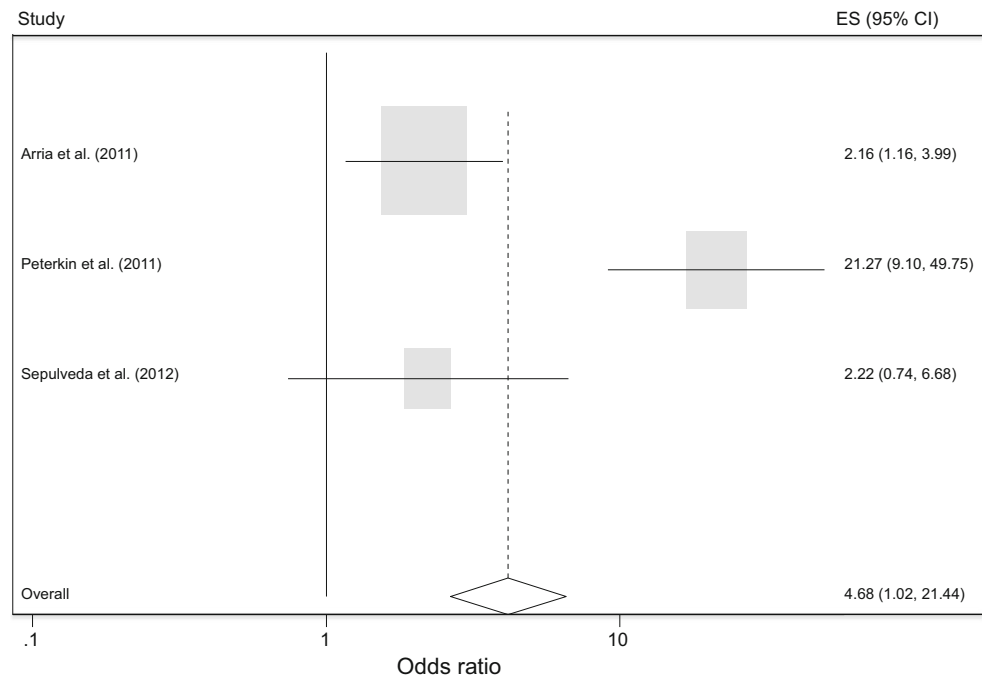
preponderance of existing research suggests that ADHD is a risk factor for substance use in general (Gudjonsson et al. 2012; Lee et al. 2011). Thus, the findings relating ADHD symptoms/diagnosis to greater misuse of stimulant medications may not be unique to stimulant medications. However, a recent longitudinal study evaluated a sample of college students over 4 years and analyzed three groups: “persistent misusers” who misused stimulant medication at least once during each year of data collection, “persistent marijuana users” who used marijuana at least once during each year of data collection, and “consistent nonusers” who did not use any drug besides alcohol or tobacco at any point. The stimulant misuse group contained a much higher percentage of students with a high risk for ADHD than both the marijuana group and nonusers group (17 % vs. 9 % vs. 8 %;  $p < .05$ ), suggesting a specific association of ADHD symptoms with misuse of stimulant medication relative to other substances (Arria et al. 2011). More studies are needed that examine the potential unique relation between ADHD symptoms and misuse of stimulant medication.

### Meta-analysis Results

Three studies evaluated the association of ADHD diagnosis and stimulant misuse (Fig. 2). ORs ranged from 2.16 to 21.27, and one of the three studies’ 95 % CIs included 1. The random-effects model estimated that individuals with ADHD were significantly more likely to misuse stimulant medication compared to individuals without ADHD (OR 4.68, 95 % CI [1.02, 21.44],  $p = .047$ ). Given evidence of significant heterogeneity in ORs ( $Q = 19.81$ ,  $p < .001$ ), moderators were examined as potential explanatory factors of this heterogeneity. However, we were limited in the number of moderators that could be examined given considerable missing data among the studies and the small number of studies that provided information for this outcome. For risk of stimulant medication misuse among those with and without ADHD, all moderator variables were examined (i.e., publication year, total sample size, definition of misuse, and study design), but they were unrelated to variance in the OR.

### Summary

Although symptoms of ADHD were significantly associated with misuse of stimulant medication among college students, additional research is necessary to determine whether ADHD symptoms/diagnosis among college students confers a greater risk for misuse of stimulant medications than for use of other substances, such as cigarettes, alcohol, or illicit drugs. It may be that a general propensity for substance use/misuse related to ADHD symptoms is driving the link between ADHD and stimulant medication

**Fig. 2** Meta-analysis results for ADHD diagnosis related to stimulant medication misuse

misuse among college students. Alternatively, it may be that students with ADHD symptoms selectively choose to misuse stimulant medications in order to ameliorate symptoms or impairment associated with ADHD (i.e., a self-medication hypothesis).

#### Other Psychological Correlates of Stimulant Medication Misuse Among College Students

Five studies reviewed the relation between symptoms of depression and misuse of stimulant medication and three of these indicated a significant difference in symptoms of depression between misusers and nonusers. Zullig and Divin (2012) found that misusers were significantly more likely to feel very sad, feel depressed, and consider suicide than nonusers. More frequent misuse was also significantly associated with depressed mood (Teter et al. 2010). It is important to note, however, that the directional relation between depression symptoms and misuse of stimulant medication remains unclear from these findings. It may be that students who are depressed misuse stimulant medications to improve their mood or to improve other difficulties (e.g., academic problems) that may be negatively impacting their mood. It is also possible that frequent misuse of stimulant medication (especially if desired motives are not achieved) may result in increased symptoms of depression. There were two articles that reported no significant differences between misusers and nonusers on depression symptoms (Rabiner et al. 2009b; Dussault and Weyandt 2013).

The relation between symptoms of eating disorders and misuse of stimulant medication was only evaluated in one study. Jeffers et al. (2013) found that 12 % of students reported misusing stimulant medication specifically for weight loss. However, this may have been an overestimation since the survey was advertised as a survey about weight loss behavior and therefore those who engage in this behavior may have been more likely to respond. The results from this study also indicated that students who reported misusing stimulant medication for weight loss were significantly more likely to utilize a fad diet, use diet pills, vomit, use laxatives or diuretics, and fast ( $p < .001$ ) as well as engage in compensatory exercise ( $p < .01$ ). Students who reported misusing stimulant medications for weight loss also had significantly worse scores for emotional and stress eating, appraisal of ability and resources to cope with emotions and stress, and appraisal of outside stressors/influences ( $p < .001$ ; Jeffers et al. 2013). More research is certainly needed to clarify and substantiate the potential relation between symptoms of eating disorders and misuse of stimulant medication.

Sensation seeking was evaluated in four of the studies and all four described a significant relation between sensation seeking and misuse of stimulant medication. These results are consistent with the well-documented relation between sensation seeking and substance use (Pedersen 1991; Jaffe and Archer 1987; Martins et al. 2008). One study found a significant interaction between sensation seeking and perfectionism in relation to stimulant medication misuse; specifically, those that were considered high in



sensation seeking and high in perfectionism were the most likely to misuse stimulant medication ( $p = .012$ ; Graff Low and Gendaszek 2002). Another study found a significant interaction between sensation seeking and perceived harmfulness of misusing stimulant medication such that those with high sensation seeking and low perceived harmfulness were most likely to misuse (Arria et al. 2008a).

### Summary

Symptoms of depression are related to misuse of stimulant medication among college students; however, directional effects have not been adequately examined and require prospective longitudinal study designs, which have generally not been utilized. It is also important to recognize that there is substantial overlap between symptoms of ADHD and depression; for example, a review of studies using community samples reported that the rate of major depressive disorder among youth with ADHD is 5.5 times higher than among youth without ADHD, with rates ranging from 12 to 50 % (Angold et al. 1999). Therefore, questions remain as to whether depression is linked with misuse of stimulant medication due to its overlap with ADHD or whether there is an independent association between depression and misuse of stimulant medications. Indeed, although stimulant medications are typically thought of as medications to improve attention, concentration, and impulse control, these medications do increase the level of dopamine in the brain, which may also result in a sense of euphoria, increased energy levels, enhanced self-esteem, and elevated mood (e.g., Caplan et al. 2007; Khantzian 1997) and are sometimes used to treat cases of depression that are resistant to antidepressant therapy (Caplan et al. 2007). Thus, it is quite possible that individuals who are depressed are misusing stimulant medications specifically to improve their symptoms of depression.

Additional research is also necessary to draw firm conclusions about whether misuse of stimulant medications is related to symptoms of eating disorders among college students. Understanding the link between psychological correlates and misuse of stimulant medication among college students has important implications for the development of successful prevention/intervention programs on college campuses. For example, helping students with symptoms of depression or ADHD to obtain appropriate assessment/treatment may reduce the number of students with these difficulties who misuse stimulant medications.

### Other Substance Use Associated with Stimulant Medication Misuse Among College Students

Sixteen studies reported on the relation between stimulant misuse and other substance use and all found a positive

correlation or significant difference between stimulant misusers and nonusers in rates of other substance use. All nine of the studies that evaluated the association between misuse of stimulant medication and alcohol use found a significant relation. Six of these articles found significant associations between misuse of stimulant medication and specific alcohol-related constructs, such as binge drinking (Sepúlveda et al. 2011; Teter et al. 2005), problematic drinking behavior (Lookatch et al. 2012), or meeting the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association 2000) criteria for alcohol abuse (Arria et al. 2013). For example, McCabe et al. (2006b) found that a significantly greater percentage of misusers of stimulant medication reported binge drinking in the past 2 weeks compared to nonusers (88 vs. 49 %;  $p < .001$ ). Another study found that 40 % of misusers met *DSM-IV-TR* (2000) criteria for alcohol use disorder compared to 19 % of nonusers (Arria et al. 2013).

Marijuana use was also significantly associated with stimulant medication misuse, with all nine of the studies that examined marijuana use finding a significant association. For example, one study found that 74 % of stimulant medication misusers reported use of marijuana in the last 6 months compared to 18 % of nonusers (Rabiner et al. 2009b), while another study found that 93 % of misusers used marijuana in the last year compared to 34 % of nonusers (McCabe et al. 2006b). Stimulant medication misuse is also associated with cannabis use disorder; one study reported that 25 % of misusers met *DSM-IV-TR* (2000) criteria for cannabis use disorder compared to 7 % of nonusers (Arria et al. 2013). Another article using this same sample reported that the magnitude of the association between cannabis use disorder and misuse of stimulant medication increased over time (Garnier-Dykstra et al. 2012).

Five of the six studies that examined the relations between misuse of stimulant medication and tobacco or cigarette use found a significant association. The one article that did not find a significant association still demonstrated that misusers used cigarettes more often than nonusers, 46 % compared to 31 %, respectively, but the difference did not reach significance (Rabiner et al. 2009a). In one of the studies that did reach significance, the researchers found that 50 % of misusers smoked cigarettes in the last 6 months compared to 13 % of nonusers ( $p < .001$ ; Rabiner et al. 2009b). Furthermore, students who obtained stimulant medication from their peers were 7.68 times more likely to smoke cigarettes in the previous 30 days than those who did not misuse stimulant medication (McCabe and Boyd 2005).

Six studies reviewed the relation between illicit stimulants, such as ecstasy, cocaine, or amphetamines, and

stimulant medication misuse. Only one of these studies found that the difference in illicit stimulant use between stimulant medication misusers and nonusers did not reach significance with 9 % of misusers using cocaine compared to 7 % of nonusers (Rabiner et al. 2009a). Teter et al. (2005) reported that only 2 % of students who did not misuse stimulant medication had used cocaine in the past year, whereas students who misused stimulant medications to help them concentrate, increase alertness, or get high had past-year cocaine prevalence rates of 29, 31, and 35 %, respectively, all significant differences from those who do not misuse. In another study using the same sample, the researchers reported that 33 % of stimulant medication misusers also used cocaine in the last year compared to 2 % of stimulant nonusers ( $p < .001$ ; McCabe et al. 2006b).

Only one study examined the relation between misuse of stimulants medications and misuse of other prescription drugs and this study reported a significant association. The study found that those who misused stimulant medication in the past year were more than 12 times more likely to misuse other prescription drugs in the past year if the source was a peer or other source besides family ( $p < .001$ ); the association was not as strong for those who obtained prescription stimulants from family ( $p < .01$ ; McCabe and Boyd 2005).

Many of the studies reviewed examined the association between other substance use in general and stimulant medication misuse. Misusers of stimulant medication used significantly more types of substances than nonusers (Arria et al. 2011; Rozenbroek and Rothstein 2011; Arria et al.

2008b). The odds of becoming a stimulant medication misuser increased by 3.81 for each standard deviation increase in the amount of student substance use (Rabiner et al. 2010).

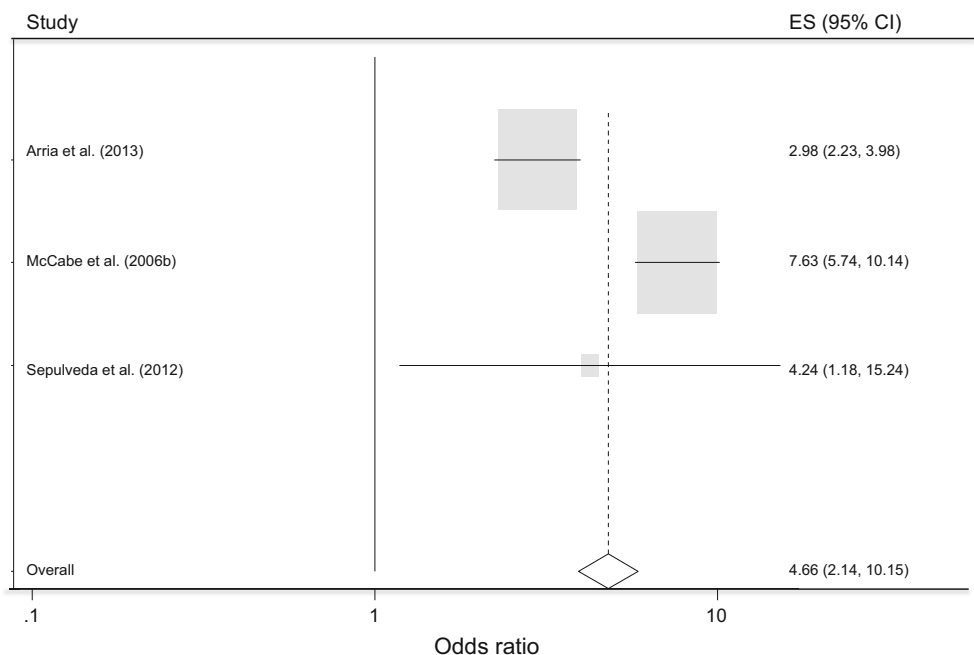
### Meta-analysis Results

Three studies evaluated the association of problematic alcohol use and stimulant medication misuse (Fig. 3). ORs ranged from 2.98 to 7.63 with all three reporting a significant association (95 % CIs did not include 1). Consistent with this, the overall random-effects model estimated that individuals with problematic alcohol use were significantly more likely to misuse stimulant medication than those who were not problematic alcohol users (OR 4.66, 95 % CI [2.14, 10.15],  $p < .001$ ). Again, significant heterogeneity was observed ( $Q = 20.57$ ,  $p < .001$ ).

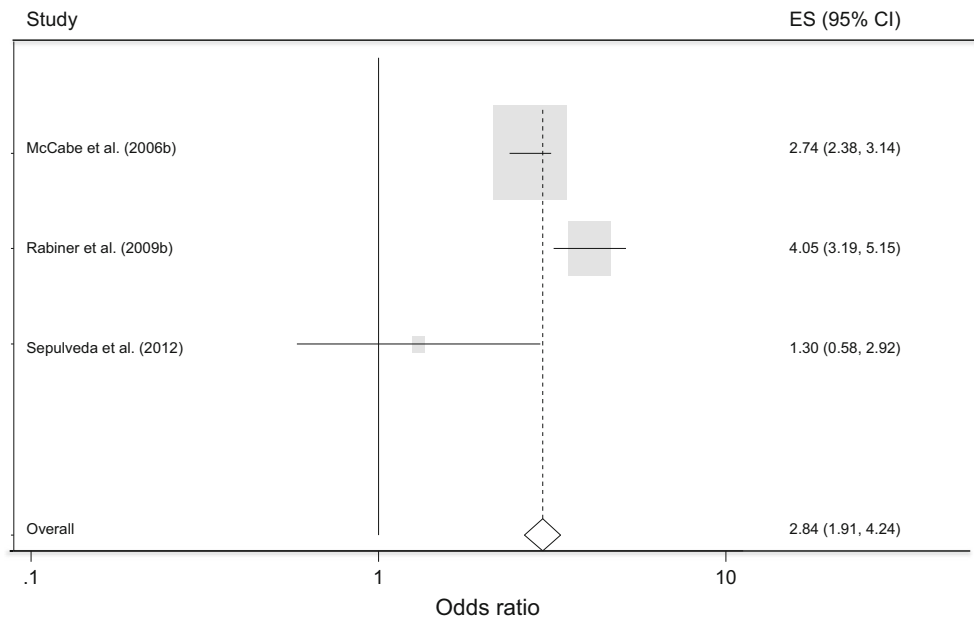
Three studies evaluated the association of marijuana use and stimulant medication misuse with ORs ranging from 1.30 to 4.05 (Fig. 4). One of these studies found no association, whereas two studies reported that marijuana use was significantly associated with increased the risk of stimulant misuse. The random-effects model estimated increased odds of stimulant misuse for those individuals who used marijuana compared to those who did not (OR 2.84, 95 % CI [1.91, 4.24,  $p < .001$ ); however, significant heterogeneity was observed across the studies ( $Q = 11.82$ ,  $p = .003$ ).

For risk of stimulant medication misuse among those with and without problematic alcohol use, none of the moderator variables examined (i.e., publication year, total

**Fig. 3** Meta-analysis results for problematic alcohol use related to stimulant medication misuse



**Fig. 4** Meta-analysis results for marijuana use related to stimulant medication misuse



sample size, definition of misuse, study design, and percent of participants with a prescription for stimulant medication) predicted significant variance in the OR. For risk of misuse among those with and without marijuana use, none of the moderator variables examined (i.e., publication year, total sample size, time frame assessed, sample source, definition of misuse, and mean year in college) predicted significant variance in the OR.

### Summary

It is quite clear that students who misuse alcohol and use illicit drugs are also more likely to misuse stimulants. This points to the existence of a general, nonspecific propensity for drug use (Hakkarainen and Metso 2009), and likely suggests that students who are able to easily obtain other substances may also obtain stimulant medications from these same sources. This strong association also implies that the successful prevention or reduction of stimulant medication misuse may involve also targeting general substance use behaviors and risks.

### Discussion

Misuse of stimulant medication among college students is a significant concern as more students with ADHD are attending college (DuPaul et al. 2001) and prescriptions for stimulant medications are on the rise (Chai et al. 2012). The 30 studies described in this comprehensive review and meta-analysis demonstrated that multiple demographic, academic, and psychosocial factors are clearly associated

with misuse of stimulant medication among college students, including: sorority or fraternity membership, being male, lower GPA and other academic problems, ADHD symptoms, depression symptoms, high sensation seeking, and use/misuse of other substances, such as cigarettes, alcohol, marijuana, and illicit drugs. Further, college students who misuse stimulant medications most often obtain the medications from friends or peers with prescriptions. Academic motives for stimulant medication misuse are commonly endorsed, and perceived risk of stimulant medication misuse is a protective factor against misuse. Although several other factors potentially related to stimulant medication misuse among college students (e.g., racial and religious backgrounds, SES, year in college, eating disorder symptoms) were covered in this review, findings were not conclusive. Our findings are similar to those of a previous review (Arria and Dupont 2010) which also concluded that students who misuse stimulant medications have lower GPAs and are more likely to use illicit drugs. However, Arria and Dupont reported that many students use stimulant medication to enhance their experience partying and getting high on other substances (2010), but we found that this group of misusers is much smaller than those who report misusing for academic reasons.

### Methodological Considerations: Recommendations for Future Work

While conducting this review, we identified several methodological issues in the literature on stimulant medication misuse among college students that may impact the

interpretability of existing findings. First, there was a great deal of variability in the size of the samples utilized in the studies included in this review from 55 (Sepúlveda et al. 2012) to 22,783 (Zullig and Divin 2012). The smaller size of some of these samples limits how representative the data from these samples are, while the studies that attempted to survey the entire university population may be more representative. Future studies in this area should include large samples and survey entire campus populations when feasible.

Second, authors use different words/terms to describe stimulant medication misuse, such as “nonmedical use” (e.g., Arria et al. 2013), “illicit use” (e.g., Teter et al. 2005), “recreational use” (e.g., Sharp and Rosén 2007), and “misuse” (e.g., Peterkin et al. 2011; Rabiner et al. 2009a; Sepúlveda et al. 2011). Some even used “non-medical use” and “misuse” interchangeably in their studies (Dussault and Weyandt 2011; Jeffers et al. 2013; Weyandt et al. 2009). Related to this, a standard definition of misuse of stimulant medication was not utilized across all existing studies. For example, some studies defined misuse as an individual using medication that was not prescribed to him/her (McCabe 2008; Teter et al. 2005); some defined it as an individual taking medication not prescribed to him/her or that he/she only took for the experience or feeling it caused (Arria et al. 2013); and others included taking a prescribed medication in higher doses than prescribed, more often than prescribed, using someone else’s medication, using to get high, or using with alcohol or other drugs (Sepúlveda et al. 2011). The substantial variability among studies in misuse definitions and terminology may have contributed to differences across studies in prevalence rates and the demographic and psychological correlates of misuse of stimulant medication. Using different definitions for misuse of stimulant medication between similar studies can result in under- or overestimating prevalence rates of this behavior and therefore can cause confusion in understanding how many and which college students are at the greatest risk for misuse of stimulant medication.

We recommend the use of the term “misuse of stimulant medication” to facilitate the broader, more inclusive definition of this construct rather than narrowly to capture all related behaviors. We suggest that misuse of stimulant medication includes: (1) A prescription holder using his/her medication (or someone else’s) more frequently or at a higher dosage than prescribed or altering the route of delivery (e.g., crushing and taking the medication intranasally), (2) a prescription holder taking his/her medication (or someone else’s) for reasons other than those indicated in the prescribing literature, such as to get high or to prolong the effects of drinking alcohol, and (3) a nonprescription holder taking any stimulant medication via any

method of delivery for any reason. There appears to be no conclusive evidence that correlates of the groups defined above differ in any predictable way from one another; however, researchers are encouraged to further explore potential differences between these groups. For now, a broad, inclusive definition of misuse of stimulant medication used across future studies will allow for more accurate estimations of prevalence and correlates of stimulant medication misuse.

Third, since many existing studies have had different definitions of misuse of stimulant medication, their sample characteristics and the way the data were analyzed have differed substantially. For example, some studies excluded those with an ADHD diagnosis or a prescription for stimulant medication (Peterkin et al. 2011; Dussault and Weyandt, 2013). One study included prescription users in the sample, but automatically classified them as nonmisusers for data analysis (Graff Low and Gendaszek 2002). Other studies analyzed nonprescription misusers and prescription misusers separately (Hall et al. 2005; Judson and Langdon 2009), while others analyzed all misusers as one group (Van Eck et al. 2012; Arria et al. 2008b). Some of these strategies may result in underestimation of rates of stimulant medication misuse. Therefore, consistent with our recommendation to adopt a broad definition of stimulant medication misuse, we recommend that researchers assess general populations of individuals for stimulant medication misuse, when possible, to determine rates of misuse, correlates, and consequences. However, there is still a need for studies that investigate specific subgroups of stimulant medication misusers (e.g., stimulant prescription holders, students with an ADHD diagnosis), but researchers conducting these studies should carefully describe their sample inclusion criteria and not purport that their findings generalize to all stimulant medication misusers.

Fourth, given the broad array of definitions of stimulant medication misuse utilized across existing studies, researchers used a variety of assessment tools to measure this construct. Many studies developed their own questions to measure stimulant medication misuse (e.g., Lookatch et al. 2012; Rabiner et al. 2010; Weyandt et al. 2009; DeSantis et al. 2008), although Arria and colleagues’ series of studies utilized questions from the 2002 National Survey on Drug Use and Health (Arria et al. 2008a, b, 2011, 2013; Garnier-Dykstra et al. 2012). The wide range of survey and interview items used to assess stimulant medication misuse among college students, many of which do not appear to have been psychometrically validated, further complicates interpretation of the existing literature and the estimation of accurate prevalence rates for this behavior. This also made it difficult to conduct a meta-analysis of existing results. For future work in this area, we recommend that a standard measurement tool for stimulant medication misuse be

developed, validated psychometrically, and used consistently. This self-report tool should assess each of the behaviors that are subsumed under a broad definition of misuse (i.e., the behaviors detailed in points 1–3 above) and should include questions about motives, consequences, sources, and diversion of stimulant medications (for prescription holders). Weyandt et al. have developed the Stimulant Survey Questionnaire (SSQ; 2009), which has some published psychometric evidence and includes many of the components we have recommended. Our research team also developed a comprehensive survey assessing stimulant medication misuse based on the literature covered in this review, drawing questions from many of the existing studies. We have included this survey in Appendix as a reference to researchers in this area.

Finally, an additional, related methodological consideration within existing studies on misuse of stimulant medication among college students concerns the measurement of psychosocial constructs related to misuse. Many studies measured psychological symptoms in their surveys, such as symptoms of ADHD and depression, but they measured them using a variety of tools across studies, some of which did not appear to have been psychometrically validated. For instance, the Adult Symptoms Rating Scale for ADHD was most commonly used (e.g., Sepúlveda et al. 2011; Arria et al. 2011), but other studies used the Current Symptoms Scale (e.g., Van Eck et al. 2012) or developed their own tool to measure symptoms of ADHD among college students (Rabiner et al. 2010). Similar inconsistencies across studies were noted for the measurement of depression and other psychosocial variables. Using different tools to measure psychosocial constructs presumed to be related to misuse of stimulant medication among college students may account for some of the differences in findings across existing studies. Future studies in this area should select widely used, psychometrically valid measures to assess psychosocial constructs that may be related to misuse of stimulant medication.

#### Areas for Future Research

This comprehensive review of the literature on stimulant medication misuse among college students suggests a number of areas for future research. First, several of the demographic and psychosocial correlates covered in this review require further investigation. Involvement in extracurricular activities, such as sports teams or volunteer work, was only evaluated in one study, and no significant differences in rates of misuse were found based on involvement in these activities (Garnier-Dykstra et al. 2012). However, the strong relation between fraternity and sorority membership and misuse suggests that school activities can play a large role in stimulant medication

misuse; therefore, further investigation into the relation between non-Greek extracurricular activities and misuse is warranted (Dussault and Weyandt 2013). In addition, studies that measured the relation between depression symptoms and misuse of stimulant medication presented somewhat mixed results, and only one study was identified that examined the relation between symptoms of eating disorders and stimulant medication misuse. Additional research is needed to further investigate the relations between symptoms of depression and eating disorders and misuse of stimulant medication, especially longitudinal studies that have the capability to examine directional relations and theoretical explanations. There may also be symptoms of other psychological conditions, such as anxiety, that are significantly associated with stimulant medication misuse. Understanding the relation between symptoms of psychological disorders and stimulant medication misuse has important implications for understanding etiology and prevention.

Second, further investigation into *why* college students divert and/or misuse stimulant medication could also help to inform the development of effective prevention programs. We were able to identify only qualitative studies in the literature that have explored why students divert stimulant medication (e.g., DeSantis et al. 2010). From these studies, it appears that some students with stimulant prescriptions have a surplus of medication each month, and they see selling their leftovers as way to “look cool,” help out friends and make extra money. Studies that rigorously examine reasons for diversion using quantitative methods are needed. With respect to misuse, it would be informative to examine whether students who misuse stimulant medications are doing so, in part, because of social obligations. For example, students who are more socially oriented (e.g., those in the Greek system) may find it difficult to balance academic requirements with their social life, and see stimulant misuse as a short-cut (e.g., pulling an “all-nighter” to study right before an exam instead of spacing out studying to allow for attendance at more social events). In general, drawing from the more established literature on other substance abuse may help researchers to determine additional reasons why college students misuse stimulant medication.

Third, although our review of the literature indicates that college students misuse stimulant medications mostly for academic reasons and that most misusers believe that their desired outcome is achieved, stimulant misuse is associated with lower average GPAs and other broad negative academic outcomes. The potential mismatch between students’ motives, beliefs about consequences, and actual academic performance suggests that more research is needed to fully understand the academic outcomes associated with misuse of stimulant medication. Students who

misuse stimulant medications may be doing so *because* they are performing poorly in academics, resulting in a correlation between misuse and lower GPA. It is also possible that misusers' GPA would be even lower if they were not using stimulants (i.e., as would be expected from unmedicated individuals with ADHD). However, to truly understand this link, studies are needed that either use a tighter time frame or experimental manipulation to examine whether stimulant misuse leads to improvements in academic performance. For instance, studies might examine performance on an exam after taking an unprescribed stimulant the night before in order to study. Of course, it will be difficult to control for all potential confounds in studies of this nature. Experimental studies of cognitive performance following use of stimulant medication (among individuals without a prescription) using double-blind designs could provide additional insights.

Fourth, since misuse of stimulant medication is prominent on college campuses, investigation into whether specific campus policies contribute to this misuse is warranted. For example, it may be that physicians in student health centers often diagnose college students with ADHD and prescribe stimulants without following the recommended diagnostic guidelines for adults, which include obtaining information from multiple sources about current and childhood symptoms of ADHD, ruling out other conditions that can manifest with symptoms similar to ADHD (e.g., depression, substance abuse, sleep deprivation, medical conditions), and including objective tests of ADHD symptoms (Barkley 2006). Poor diagnostic practices for ADHD among adults may exist off college campuses as well. Prescribing stimulant medications to college students and other young adults who do not actually meet diagnostic criteria for ADHD leads to more stimulant medications circulating among this population which are available for diversion and misuse by other students. Campus policies regarding consequences for students who are caught diverting or misusing stimulants should also be examined. It may be that some campuses are lenient toward students who are caught, leading to a general belief on campus that misuse is not serious. Student handbooks for some campuses may not include consequences related to diversion or misuse of prescription medications. These and other potential influences of campus policies on rates of stimulant medication diversion and misuse among college students should be explored.

Finally, although beyond the scope of this review, there is a need for research that explores stimulant medication misuse among middle and high school students. Our review of the existing literature suggests that very few studies of this behavior have included participants under the age of 18. With stimulant medication prescriptions for ADHD on the rise among individuals of all ages, and thus more

opportunities for medication diversion, it is important to explore whether middle and high school students are also reporting high rates of stimulant medication misuse. Understanding the developmental trajectories of this behavior can help to further inform prevention and intervention efforts as well as policy development.

#### Implications for Prevention/Intervention Programs and Policies

The findings summarized in this review have important implications for preventing and reducing the misuse of stimulant medication among college students. First, college students with a prescription for stimulant medication play a critical role. Not only do these students have a high rate of misuse themselves (Sepúlveda et al. 2011; Rabiner et al. 2009a), but they are also the most common source from which other students obtain stimulant medication to misuse (DeSantis et al. 2008; Garnier-Dykstra et al. 2012). It is therefore important for physicians who provide college students with prescriptions for stimulant medications to discuss the possible consequences of misusing or diverting medication, including potential negative health outcomes and legal consequences. They should also monitor their patients for signs of diversion, such as finishing a prescription early or frequently switching physicians or medications. Policy changes on college campuses could also help to reduce diversion of stimulant medications, such as dispensing only 1 week's worth of medication at a time, requiring attendance at an informational session on stimulant medication misuse before filling a prescription for the first time, and requiring that students sign an agreement that they will not divert their stimulant medication and that they understand the consequences of doing so if caught (e.g., probation from college, legal consequences) each time they fill a prescription for a stimulant medication. However, these policies could not be enforced if students obtain prescriptions for stimulant medications from physicians who are not affiliated with their college or university.

Perceived risk/harm associated with the use of stimulant medications was negatively related to misuse (Arria et al. 2008a; Judson and Langdon 2009). This suggests that if college students were more aware of the risks associated with stimulant medication misuse, with regard to both health and legal consequences, fewer students may choose to misuse stimulants. Education about the risks associated with stimulant medication misuse could be incorporated into other alcohol and drug education programs that are already in place at colleges and universities. For example, many colleges/universities require all first-year students to complete a substance use education/prevention module and/or online screening survey/educational tool. Some of

these, such as AlcoholEdu and The Alcohol eCHECKUP TO GO have demonstrated some success in reducing alcohol use in follow-up evaluations (Hustad et al. 2010). Information about misuse of stimulant medication could be included here. Moreover, members of certain organizations (e.g., fraternities or sororities) that are known for an increased risk of substance use/abuse among members are also sometimes required by their national chapters or host colleges/universities to complete a “risk management” class, which addresses behaviors such as binge drinking and drunk driving. Since one of the demographic factors that is most strongly related to stimulant medication misuse is Greek organization membership (Dussault and Weyandt 2013), presenting information about stimulant medication misuse to these groups during these classes could help to reduce this behavior on college campuses. Because being offered stimulant medication is related to misuse (Garnier-Dykstra et al. 2012), these presentations should discuss strategies for avoiding/resisting peer pressure. Additionally, Greek organizations could develop new policies that would help to reduce stimulant medication misuse among their members, such as strict punishments or probation for members who are caught diverting or misusing stimulant medications, and requiring new members to sign pledges stating that they will not misuse stimulant medications.

Misuse of stimulant medications among college students is often linked to symptoms of ADHD (Rabiner et al. 2010) and/or depression (Zullig and Divin 2012), and may also be linked to symptoms of eating disorders (Jeffers et al. 2013), though more research in this area is certainly needed. Therefore, when a student is found to be misusing stimulant medication, the student should be evaluated to determine whether he or she has significant symptoms of ADHD, depression, or eating disorders. Likewise, students who are determined by treatment providers to have ADHD, depression, or eating disorders symptoms should be closely monitored for stimulant medication misuse. Appropriate treatment (which may include pharmacological, psychological, or academic accommodation components) for students with these psychological symptoms may reduce the misuse of stimulant medications among this population, especially if

these students are misusing in order to reduce their symptoms (i.e., a self-medication hypothesis).

Finally, the most commonly reported motives for misuse of stimulant medications among college students are academic in nature (e.g., to study more, to concentrate better; e.g., Rabiner et al. 2009b) and many students who misuse for these reasons feel that their desired effect is achieved. This suggests that colleges and universities may need to improve their identification of students who are in need of academic assistance/supports and offer these interventions early in students’ college careers before they have the opportunity to begin misusing stimulant medications (especially since several studies indicate that college upper-classmen seem to be at greater risk for stimulant medication misuse than younger students). Such interventions may include teaching students skills such as note-taking and academic goal setting and educating students about the link between sleep deprivation and poor concentration (Pilcher and Walters 1997). Note-taking skill training has been shown to increase college students’ academic self-efficacy (Rahmati and Sharifi 2013). Setting, elaborating, and reflecting on goals also significantly improve academic performance among college students (Morisano et al. 2010).

There are certainly additional implications for prevention/intervention programs and policies that relate to the findings summarized in this review, but a thorough coverage of prevention is beyond the scope of this paper (see Arria and Dupont 2010). Existing prevalence estimates indicate that college/university administrators and health service providers need to address the misuse of stimulant medications on their campuses through developing new prevention/intervention strategies and/or making important policy changes. Researchers in the area of stimulant medication misuse are encouraged to share their findings with campus representatives and make related programming and policy suggestions.

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**Conflict of interest** None.

## Appendix

## Stimulant Medication Misuse Survey

1. Have you ever been diagnosed with ADHD?  
A. Yes B. No
  2. Who diagnosed you with ADHD? (if indicated yes to question above)  
A. Medical Doctor B. Psychiatrist C. Psychologist D. Other \_\_\_\_\_
  3. How old were you when you were diagnosed?  
\_\_\_\_\_
  4. Do you have a prescription for stimulant medication (generally used for the treatment of ADHD) such as Ritalin, Dexedrine, Adderall, or Vyvanse?  
A. Yes B. No
  5. What kind of stimulant medication do you have a prescription for? \_\_\_\_\_
- Questions for participants with a prescription for stimulant medication:**
6. In the past 12 months, what behaviors did you engage in related to stimulant medication? (choose all that apply)
    - A. Took too much of your medication (a greater dosage)
    - B. Took your medication more often than prescribed
    - C. Snorted stimulant medication
    - D. Took stimulant medication with other drugs
    - E. Took stimulant medication that you did not have a prescription for
  7. In the past 12 months, how often did you (behavior from question#6)? (The question will repeat for each behavior the participant indicated)
 

A. Not at all	G. Once a week
B. 1-3 times	H. 2-3 times a week
C. 4-7 times	I. 4-6 times a week
D. 8-11 times	J. Once a day
E. Once a month	K. Twice a day
F. 2-3 times a month	L. Several times a day
  8. Which drugs have you taken with stimulant medication? (Choose all that apply) (if participant indicates they have taken stimulant medication with another drug)
    - A. Alcohol
    - B. Marijuana
    - C. LSD or Mushrooms
    - D. Ecstasy, MDMA, or Molly
    - E. Cocaine
    - F. Heroin
    - G. Methamphetamine
    - H. Sedatives, barbiturates, or tranquilizers
    - I. Narcotics
    - J. Steroids
    - K. Other \_\_\_\_\_
  9. I have engaged in any of these behaviors from the question above (e.g., taking too much medication) at least once....
 

A. In the last month	B. In the last year	C. In my life
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  10. Have you ever sold or given away your prescription stimulant medication?
    - A) No
    - B) 1-2 times
    - C) 3-6 times
    - D) 7-12 times
    - E) 13-20 times
    - F) More than 20 times
  11. If you have sold or given away your prescription medication, what were your reason(s) for doing so? (Indicate all that apply)
    - A) To help a person who needed or wanted it
    - B) Pressure from a person who needed it or wanted it
    - C) To make money
    - D) Other \_\_\_\_\_
- Questions for participants without a prescription for stimulant medication:**
12. In the past 12 months, what behaviors did you engage in related to stimulant medication, such as Ritalin, Dexedrine, Adderall, or Vyvanse? (choose all that apply)
    - A. Took stimulant medication that you did not have a prescription for
    - B. Snorted stimulant medication
    - C. Took stimulant medication with other drugs
  13. In the past 12 months, how often did you (behavior from question#12)? (The question will repeat for each behavior the participant indicated)
 

A. Not at all	G. Once a week
B. 1-3 times	H. 2-3 times a week
C. 4-7 times	I. 4-6 times a week
D. 8-11 times	J. Once a day
E. Once a month	K. Twice a day
F. 2-3 times a month	L. Several times a day
  14. Which drugs have you taken with stimulant medication? (Choose all that apply) (if participant indicates they have taken stimulant medication with another drug)
    - A. Alcohol
    - B. Marijuana



- C. LSD or Mushrooms
- D. Ecstasy, MDMA, or Molly
- E. Cocaine
- F. Heroin
- G. Methamphetamine
- H. Sedatives, barbiturates, or tranquilizers
- I. Narcotics
- J. Steroids
- K. Other \_\_\_\_\_

15. I have engaged in any of these behaviors from the question above (e.g., taking too much medication) at least once....

- A. In the last month      B. In the last year      C. In my life

**Sources**

16. If you are using stimulant medication more than prescribed or that you do not have a prescription for, where do you most often get the stimulant medication?

- A. A college student
- B. A family member
- C. A friend who is not in college
- D. A drug dealer
- E. Other

17. Do they have a prescription for the stimulant medication?

- A. Yes      B. No

**Questions for all participants that indicate misuse in the last year:**

**Motives**

18. How often have you used stimulant medication that you did not have a prescription for or used more than prescribed for the following reasons <b>in the last year?</b>	Never	Rarely	Sometimes	Often	Always
To concentrate better while studying					
To be able to study longer					
To feel less restless while studying					
To concentrate better in class					
To feel less restless in class					
To keep better track of assignments					
To complete other tasks not related to school					
To stay awake longer					
To improve athletic performance					
To feel better					
To get high					
To prolong the intoxicating effects of alcohol or other substances					
To prevent other students from having an academic edge over me					
To lose weight					

**Outcomes**

If the participant indicates “sometimes, often, or always” for a motive in question 18, they will be asked to indicate how often the stimulant medication helped them achieve that motive.

19. When you used stimulant medication that you did not have a prescription for or used more than prescribed, how often did it actually help you...	Never	Rarely	Sometimes	Often	Always
To concentrate better while studying?					
To be able to study longer?					
To feel less restless while studying?					
To concentrate better in class?					
To feel less restless in class?					
To keep better track of assignments?					
To complete other tasks not related to school?					
To stay awake longer?					
To improve athletic performance?					
To feel better?					
To get high?					
To prolong the intoxicating effects of alcohol or other substances?					
To prevent other students from having an academic edge over me?					
To lose weight?					

20. Are there other reasons that you used stimulant medication that you did not have a prescription for or used more than prescribed besides the reasons already listed?

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