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Misuse of methamphetamine and prescription stimulants among youths and young adults in the community

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Abstract

Background: Gender differences in the prevalence and characteristics of misuse of methamphetamine (meth) and prescription stimulants were examined in a representative US sample of youths and young adults aged 16–25 ($N = 24{,}409$).
Methods: Stimulant misusers were categorized into three mutually exclusive subgroups: meth users only, meth and prescription stimulant users, and prescription stimulant users only (e.g., Benzedrine®, Ritalin®, or Dexedrine®). Multinominal logistic regression analyses identified the characteristics associated with misuse of meth and prescription stimulants.
Results: About 1 in 10 youths reported any misuse of stimulants in their lifetime. Prescription stimulant misuse occurred earlier and was more frequent than meth misuse. About 47% of meth misusers also reported prescription stimulant misuse. Among misusers of meth and prescription stimulants, males were more likely than females to misuse methylphenidate (82% versus 65%) but were less likely to misuse diet pills or amphetamines (37% versus 49%). Multinominal logistic regression analyses indicated that all subgroups of lifetime stimulant misuse were associated with past year substance abuse. The characteristics of meth misusers differed slightly from prescription stimulants misusers.
Conclusions: Multidrug use is common among stimulant misusers. Parents should be informed about the risk of prescription stimulant misuse by their youths.

Keywords: Gender differences; Methamphetamine; Methylphenidate; Prescription stimulants; Substance use disorders

1. Introduction

Illicit methamphetamine (meth) use is increasingly prevalent worldwide, and meth misusers tend to use other illicit drugs (Meredith et al., 2005; United Nations Office on Drugs and Crime, 2003). This study examines gender differences in the prevalence and correlates of misuse of meth and prescription stimulants, as well as patterns of misuse of multiple stimulants. The term "misuse" in this paper refers to nonmedical or illicit use of these substances. The findings from this study may contribute to the identification of demographic and other characteristics of youths at risk for misusing stimulants and to the design of prevention programs and the selection of their target populations.

Meth ("speed," "ice," "crystal," "crank," or "glass") is a stimulant that can be easily made in clandestine laboratories from readily available, inexpensive ingredients (National Institute on Drug Abuse [NIDA], 1999). Meth misuse is a major concern in the United States as well as in many other countries because it has become the most widely available and misused amphetamine-type stimulant worldwide (Meredith et al., 2005; United Nations Office on Drugs and Crime, 2003). Compared with cocaine users, meth users have been found to experience a shorter period of time from first use to regular use and to entering substance abuse treatment (Gonzalez Castro et al., 2000).

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Cross-national comparisons of drug use in 36 countries have shown that, after marijuana, amphetamines/meth are the illicit drugs most likely to be used by high school students (Smart and Ogborne, 2000). Data from emergency department visits (documented via the Drug Abuse Warning Network [DAWN]) and from publicly funded substance abuse treatment facilities (documented in the Treatment Episode Data Set [TEDS]) in the United States have indicated that meth-related treatment admissions have risen dramatically since the early 1990s (Substance Abuse and Mental Health Services Administration [SAMHSA], 2001, 2002). Meth is the primary form of amphetamine used illicitly in the United States, and it accounted for 94% of all amphetamine treatment admissions to facilities reporting to TEDS in 1999 (SAMHSA, 2001).

Meth misuse is associated with frequent episodes of alcohol intoxication (Furr et al., 2000), high-risk sexual behaviors related to the human immunodeficiency virus (HIV) infection (Semple et al., 2004), psychiatric morbidity (Copeland and Sorensen, 2001; Meredith et al., 2005; Zweben et al., 2004), and significant medical problems (Ohta et al., 2005; Perez et al., 1999; Yu et al., 2003).

The medical use (Robison et al., 1999; Safer et al., 1996) and perhaps the misuse (Babcock and Byrne, 2000; McCabe et al., 2004) of prescription stimulants have increased over the past decade. Methylphenidate (Ritalin®) is the most commonly prescribed stimulant for managing attention deficit hyperactivity disorder (ADHD) (Safer and Malever, 2000). The overall use of psychotropic medication by children increased from 1.4 per 100 persons in 1987 to 3.9 in 1996; moreover, the use of stimulants experienced a four-fold increase (from 0.6 to 2.4 per 100 persons) during the same time interval (Olfson et al., 2002). The increased availability of prescription stimulants appears to be associated with prescription stimulant misuse. In a study of middle and high school students, McCabe et al. (2004) found that 4.5% of the study sample reported misuse of stimulant medications, and close to one fourth (23%) of the students who received prescription stimulants reported being approached to divert (i.e., to sell, give, or trade) their stimulant medications. Babcock and Byrne (2000) found that more than 16% of students attending a public college had misused methylphenidate.

To date, gender differences in the patterns and correlates of misuse of meth and prescription stimulants have been understudied. Studies have typically focused exclusively either on meth misuse or on prescription stimulant misuse. Little is known about gender-specific patterns of misuse of multiple stimulants. Our prior study found that female stimulant misusers were significantly more likely than male stimulant misusers to meet the criteria for stimulant dependence, indicating possible gender differences in the pattern of stimulant misuse (Wu and Schlenger, 2003). Determining the extent and correlates of misuse of meth and prescription stimulants in a large representative sample is timely and important, given the increased prevalence of the use and nonmedical use of stimulants.

In this study, we examined the prevalence, patterns, and correlates of misuse of meth and prescription stimulants among American youths and young adults aged 16–25 who participated in the 2003 National Survey on Drug Use and Health (NSDUH). Prior to 2002, NSDUH was called the National Household Survey on Drug Abuse (NHSDA). We focused on a crucial developmental period when adolescents transition into young adulthood, with special attention to gender differences. This transitional period involves major role changes in many life domains, such as leaving school, going to college, or entering the job market, and it represents an important risk period for the onset of illicit drug use (Kandel and Logan, 1984; Substance Abuse and Mental Health Services Administration, 2004). Past month illicit drug use typically increases in mid-to-late adolescence, reaches a peak at age 18–20, and decreases thereafter (Compton et al., 2005; Substance Abuse and Mental Health Services Administration, 2004). We sought to determine whether stimulant misuse follows an age-related pattern of use.

Additionally, we examined key sociodemographic characteristics of youths (i.e., race/ethnicity, school status, employment, marital status, family income, and population density), criminality, and mental health treatment that have been found to be associated with illicit drug use and/or multidrug use (Wu et al., 2003, 2006). For example, youths who reside in metropolitan areas, engage in criminal activities, or dropped out of school have an increased likelihood of using multiple illicit drugs, including meth (Wu et al., 2003, 2006). Racial/ethnic variations in stimulant misuse also have been documented (McCabe et al., 2004; Wu et al., 2006). Particularly, there is an increasingly recognized need to determine Hispanics' illicit drug use given that Hispanics now comprise the largest minority group in the United States and that 33.9% of Hispanics are under age 18 making them vulnerable to illicit drug use (US Census Bureau, 2006; Volkow, 2006). Finally, we determined whether a particular subgroup(s) of stimulant misuse is associated with increased odds of past year substance use disorder that would indicate a need for early intervention or treatment.

We hypothesized that (1) there would be gender variations in the pattern of stimulant misuse with females more likely than males to report prescription stimulant misuse; (2) prescription stimulant misuse would be more likely than meth misuse to be associated with the use of mental health treatment and with white ethnicity; (3) meth misuse would tend to be associated with criminal behaviors and a nonstudent status; (4) stimulant misuse overall would be associated with alcohol and drug use disorders.

2. Method

2.1. Data source

Statistical analyses were based on data from the public use file of the 2003 NSDUH, an annual survey of the use of licit and illicit substances by noninstitutionalized, household Americans aged 12 or older (Substance Abuse and Mental Health Services Administration, 2004; Substance Abuse and Mental Health Data Archive, 2006). This survey uses multistage area probability sampling methods (Bowman et al., 2005) to select survey respondents, including residents of noninstitutional group quarters (shelters, rooming houses, dormitories, and group homes), residents of all 50 states and the District of Columbia, and civilians residing on military bases.

Respondents were interviewed at their place of residence for about an hour. To increase respondents' willingness to report socially stigmatizing behaviors, such as illicit drug use (Turner et al., 1998), the survey used a combination of

computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI) methodologies. Assessments of substance use and misuse were conducted via ACASI techniques. By using ACASI, respondents could either read the questions silently on a computer screen, or listen to the questions read aloud by the computer through headphones, and then enter their responses directly into the computer.

A total of 67,784 individuals aged 12 or older participated in the 2003 survey. A weighted household screening response rate of 91% was achieved. The weighted interview response rate was 77%. To produce prevalence estimates that are representative of the US general population aged 12 or older, analysis weights were developed to adjust for variations in household selection, nonresponse, and poststratification of the selected NSDUH sample to the US census. NSDUH design and data collection procedures have been reported in detail elsewhere (Substance Abuse and Mental Health Services Administration, 2004).

2.2. Study variables

2.2.1. Misuse of meth and prescription stimulants. NSDUH assessed respondents' illicit use of cocaine, inhalants, marijuana/hashish, heroin, and hallucinogens, as well as misuse of prescription-type drugs (i.e., nonmedical use of stimulants, sedatives, tranquilizers, and pain relievers). In NSDUH, misuse of a prescription drug was defined broadly as the use of any form of prescription drugs that were not prescribed for the respondent, or that the respondent took only for the experience or feeling they caused. The use of over-the-counter drugs was explicitly excluded from the definition of misuse.

The survey used separate questions to assess misuse of any prescription-type stimulants in the lifetime. The following stimulants were listed on a pill card shown to respondents: (1) meth (crank, crystal, ice, or speed), Desoxyn®, or methedrine; (2) amphetamines, Benzedrine®, Biphetamine®, Fastin®, or phentermine; (3) Ritalin® or methylphenidate; (4) Cylert®; (5) Dexedrine®; (6) dextroamphetamine; (7) Didrex®; (8) Eskatrol®; (9) Ionamin®; (10) Mazanor®; (11) Obedrin-LA®; (12) Plegine®; (13) Preludin®; (14) Sanorex®; (15) Tenuate®. The survey asked the respondent, "Have you ever, even once, used meth, Desoxyn, or Methedrine that was not prescribed for you or that you took only for the experience or feeling it caused?" It also asked respondents to look at all the categories of stimulants shown on the pill card and to identify the stimulant drug(s) that they had ever used nonmedically. Any stimulant misuse referred to the nonmedical use of any type of stimulants in the lifetime and nonstimulant misuse referred to not having a lifetime history of using any type of stimulants for nonmedical purposes.

We also examined any past year misuse, age at first misuse, and misuse of multiple stimulants. We summed the number of stimulants misused in the lifetime and created a categorical variable reflecting multistimulant misuse (0, 1, 2, and 3 or more stimulants misused). We created a categorical variable to differentiate misusers of meth only, misusers of meth and prescription stimulants, and misusers of prescription stimulants only. For the analysis of stimulant misuse in the past year, only two subgroups of stimulant misusers were defined (misusers of meth regardless of prescription stimulant misuse versus misusers of prescription stimulants only) because the survey did not ask about each specific stimulant misused in the past year. Illicit use of multiple drugs was defined by summing the number of illicit drug classes ever used in a respondent's lifetime (cocaine/crack, inhalants, marijuana/hashish, heroin, hallucinogens, sedatives, tranquilizers, pain relievers, and stimulants) and grouping them into three categories (1, 2, and 3 or more drug classes).

2.2.2. Alcohol use and other drug misuse variables. We defined both lifetime (ever use) and past year use of alcohol and each of the other illicit drug classes (illicit use of cocaine, inhalants, marijuana/hashish, heroin, hallucinogens, as well as misuse of prescription-type sedatives, tranquilizers, and pain relievers). Past year alcohol and drug use disorders were defined using the criteria specified in the 4th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) (American Psychiatric Association [APA], 1994; Substance Abuse and Mental Health Services Administration, 2004). Lifetime diagnoses were not assessed. Because prior studies suggest that females may be more likely than males to meet the criteria for prescription drug use disorder (Simoni-Wastila and Strickler, 2004; Wu and Schlenger, 2003), we classified drug use disorders into prescription drug use disorder (any drug use disorder of prescription stimulants, sedatives, tranquilizers, and pain relievers) and nonprescription drug use disorder (any drug use disorder of cocaine, inhalants, marijuana/hashish, heroin, and hallucinogens) (Wu and Ringwalt, 2004).

2.2.3. Mental health and criminality variables. Mental health treatment referred to the receipt of any inpatient or outpatient treatment or counseling in the past year for emotional or behavioral problems; such treatment or counseling has been found to be a significant correlate of drug abuse (Wu et al., 2004a, 2005). The wording of the mental health treatment variable for young adults aged 18 or older was constructed somewhat differently in that it referred to the receipt of any inpatient or outpatient treatment or counseling in the past year for problems with emotions, nerves, or mental health. NSDUH explicitly asked the respondents not to include treatment for alcohol or drug use. Criminal activity (being arrested or booked) was defined as respondents' self-reported experience of having been arrested and booked for breaking the law in the past year, and it was grouped into three categories (none, once, and twice or more times) (Wu et al., 2006).

2.2.4. Social and demographic variables. We also examined the following potential correlates of stimulant misuse: age group, gender, race/ethnicity, employment status, school status (students versus nonstudents), marital status, total family income, and population density where the respondents reside (large metropolitan areas with a population $\geq$1 million, small metropolitan areas with a population <1 million, and nonmetropolitan areas). Employment status was categorized into full-time employment (working $\geq$35 h weekly), part-time employment (working <35 h weekly), unemployed (laid off), and not employed (not in the labor force) (Wu et al., 2003).

2.3. Data analysis

Data were weighted to reflect the complex design of the NSDUH sample and were analyzed by SUDAAN® software (Research Triangle Institute, 2002), which applies a Taylor series linearization method to account for the effects of the complex NSDUH design (e.g., weighting).

We first determined the overall prevalence of any stimulant misuse and conducted binary logistic regression procedures (Hosmer and Lemeshow, 2000) to identify correlates of any stimulant misuse. We then investigated gender differences in the prevalence and patterns of stimulant misuse, alcohol use, and other illicit drug use for each subgroup of stimulant misusers (i.e., meth only, meth and prescription stimulants, and prescription stimulants only). To control for the potential confounding influence of demographics, we conducted multinominal logistic regression procedures to examine the correlates of meth misuse and of prescription stimulant misuse. We reported odds ratios (ORs) from the logistic regression models that reflect estimated associations between stimulant misuse and its correlates.

3. Results

3.1. Demographic characteristics of the study sample

Secondary data analyses were conducted on youths and young adults aged 16–25 from the public use data file of the 2003 NSDUH (N = 24,409). There was an equal proportion of males (50%) and females (50%). Of this sample, 38% were members of nonwhite minority groups, mostly African Americans (14%) and Hispanics (18%). More than one half (55%) were students, 30% reported an annual family income of less than $20,000, and 14% had ever been married.

3.2. Prevalence and characteristics of any stimulant misuse

We first report the overall prevalence and characteristics of those who had greater odds of any stimulant misuse. One in 10

Table 1
Lifetime prevalence and odds ratios (ORs) of misuse of any stimulants among youths aged 16–25 in the 2003 NSDUH (unweighted $N = 24,409$)

Lifetime prevalence and ORs	Males unweighted $N = 11,921$		Females unweighted $N = 12,488$	
	Adjusted[a]		Adjusted[a]	
	Row (%)	OR (95% CI)	Row (%)	OR (95% CI)
Age group in years				
16–17	7.0	1.0	7.5	1.0
18–19	9.9	**1.4 (1.07–1.90)***	8.7	1.2 (0.87–1.52)
20–21	10.6	**1.6 (1.15–2.07)****	10.0	**1.5 (1.10–1.97)****
22–23	12.9	**2.3 (1.68–3.07)*****	11.6	**1.8 (1.36–2.48)*****
24–25	12.4	**2.3 (1.68–3.04)*****	10.2	**1.7 (1.13–2.40)****
Race/ethnicity				
White, non-Hispanic	13.9	**2.7 (2.07–3.54)*****	12.7	**2.4 (1.76–3.30)*****
African American, non-Hispanic	2.3	**0.4 (0.23–0.58)*****	2.2	**0.4 (0.23–0.67)*****
American Indian or Alaska native	16.7	**2.9 (1.55–5.42)*****	17.7	**2.8 (1.42–5.44)****
Asian, Pacific Islander, native Hawaiian	3.9	0.8 (0.42–1.39)	4.5	0.9 (0.47–2.17)
More than one race	13.9	**2.1 (1.05–4.23)***	7.5	1.0 (0.47–2.17)
Hispanic	6.1	1.0	5.8	1.0
Student				
No	12.0	1.1 (0.90-1.44)	10.5	1.2 (0.93–1.44)
Yes	9.2	1.0	8.9	1.0
Employment status				
Full time	10.5	0.8 (0.64–1.09)	10.1	1.0 (0.76–1.24)
Part time	10.8	1.1 (0.87–1.44)	10.0	1.1 (0.84–1.32)
Unemployed	13.6	**1.4 (1.02–1.97)***	11.6	1.2 (0.88–1.76)
Not employed	8.6	1.0	7.9	1.0
Marital status				
Single	10.5	1.0 (0.78–1.37)	9.7	1.2 (0.93–1.53)
Ever married	10.3	1.0	8.8	1.0
Family income				
$0–$19,999	10.4	1.1 (0.87–1.50)	10.5	1.3 (0.98–1.79)
$20,000–$39,999	10.5	1.1 (0.89–1.46)	9.1	1.2 (0.88–1.57)
$40,000–$74,999	10.5	1.1 (0.85–1.43)	9.5	1.2 (0.87–1.57)
$75,000+	10.5	1.0	8.6	1.0
Population density				
Large metro areas	9.6	1.1 (0.89–1.37)	9.1	1.1 (0.88–1.42)
Small metro areas	11.4	**1.2 (1.00–1.46)***	9.8	1.0 (0.82–1.26)
Nonmetro areas	10.8	1.0	10.2	1.0
Mental health treatment, past year				
Yes	18.1	1.3 (0.99–1.61)	16.8	**1.4 (1.14–1.77)****
No	9.8	1.0	8.3	1.0
Booked or arrested, past year				
Two or more	27.8	**2.0 (1.50–2.55)*****	39.5	**2.8 (1.46–5.46)****
Once	21.7	**2.0 (1.42–2.94)*****	20.5	**1.7 (1.15–2.57)****
None	9.0	1.0	9.0	1.0
Alcohol use disorder, past year				
Yes	23.5	**2.4 (1.97–2.81)*****	26.3	**2.6 (2.06–3.28)*****
No	7.2	1.0	7.3	1.0
Nonprescription drug use disorder, past year				
Yes	31.7	**3.0 (2.35–3.75)*****	36.4	**3.3 (2.47–4.53)*****
No	8.4	1.0	8.1	1.0
Prescription drug use disorder, past year				
Yes	52.3	**4.0 (2.51–6.22)*****	54.1	**5.7 (3.66–8.86)*****
No	9.7	1.0	8.8	1.0

The sample size is unweighted; all the other figures are weighted estimates.
[a] Each gender-specific adjusted logistic regression model includes all variables listed in the first column.
* $p \leq 0.05$.
** $p \leq 0.01$.
*** $p \leq 0.001$.

youths and young adults aged 16–25 ($N = 24,409$) reported any misuse of a stimulant in their lifetime (10.5% among males and 9.6% among females). As shown in Table 1, greater stimulant misuse was found among young adults, whites, American Indians/Alaska Natives, and those reporting more than one race. A very high prevalence of any stimulant misuse was also observed among those who had been arrested twice or more in the past year (28% among males and 40% among females) or who met the criteria for an alcohol or drug use disorder in the past year (ranging from 24% to 54%). There were few gender differences in the correlates of any stimulant misuse. The receipt of mental health treatment services was associated with greater odds of any stimulant misuse among females only.

3.3. Prevalence of misuse of meth and prescription stimulants

We then determined the prevalence and characteristics of three mutually exclusive subgroups of stimulant misusers. Overall, prescription stimulant misuse (7.6%) was more prevalent than meth misuse (4.6%). Close to one half of meth misusers also reported prescription stimulant misuse (46% in males and 47% in females). More than one half of all stimulant misusers reported prescription stimulant misuse only (52% in males and 57% in females).

We report in Table 2 gender-specific prevalences of stimulant misuse for each subgroup. About 5% of males (2.7% misused meth only; 2.4% misused meth and prescription stimulants) and 4% of females (2.2% misused meth only; 1.9% misused meth and prescription stimulants) had misused meth in their lifetime. The salient findings were as follows: (1) prescription stimulant misuse occurred at an earlier age than meth misuse; (2) whites had a higher prevalence of prescription stimulant misuse only than other racial/ethnic groups; (3) nonstudents had a high prevalence of meth misuse only; (4) students had a high prevalence of past year misuse of prescription stimulants only.

3.4. Patterns of misuse of stimulants and other substances among stimulant misusers

We summarize in Table 3 gender-specific prevalences of misuse of various types of prescription stimulants for each subgroup of stimulant misusers.

3.4.1. Patterns of stimulant misuse. Methylphenidate, amphetamines or diet pills, and Dexedrine® were the prescription stimulants most likely to be misused, and there were gender differences in the stimulants of choice. Compared with female misusers of meth and prescription stimulants, male misusers of such stimulants were more likely to misuse methylphenidate (82% versus 65%), but were less likely to misuse diet pills or amphetamines (37% versus 49%). Likewise, male misusers of prescription stimulants only were more likely than their female counterparts to misuse methylphenidate (78% versus 58%), but were less likely to misuse diet pills or amphetamines (14% versus 38%).

There were also some interesting variations in the patterns of misuse of multiple stimulants and the age of first stimulant misuse by subgroup of stimulant misusers. Approximately 50% of misusers of meth and prescription stimulants had used three or more different categories of stimulants. By comparison, the vast majority (74–76%) of misusers of prescription stimulants only had misused a single type of stimulants. Misusers of meth and prescription stimulants also were most likely to initiate their stimulant misuse before age 15 (25% in male users; 29% in female users).

3.4.2. Patterns of alcohol use and other drug misuse. As shown in Table 3, almost all stimulant misusers had used alcohol, and the vast majority also had used multiple illicit drugs, such as marijuana, hallucinogens, cocaine/crack, inhalants, pain relievers, and tranquilizers, with the prevalences ranging from 34% to 99%. Meth misuers generally were more likely than misusers of prescription stimulants only to have ever used three or more illicit drug classes. There were also gender differences in the types of illicit drugs used, with males having a higher prevalence of illicit use of several drugs. For instance, among misusers of meth only, males were more likely than females to use cocaine/crack (71% versus 59%). Among misusers of prescription stimulants only, males also were more likely than females to use inhalants (49% versus 34%), hallucinogens (62% versus 53%), cocaine/crack (41% versus 34%), and pain relievers (71% versus 60%). However, like male meth misusers, female meth misusers reported a very high prevalence of having ever used three or more illicit drug classes (89% in misusers of meth only and 98% in misusers of meth and prescription stimulants).

3.5. Correlates of meth misuse and of prescription stimulant misuse

Before examining gender-specific correlates of stimulant misuse, we determined whether gender was associated with the subgroup of stimulants misused. Controlling for age group, race/ethnicity, student status, employment status, marital status, family income, population density, past year use of mental health treatment, past year criminal activity, past year alcohol use disorder, and past year drug use disorder in the multinomial logistic regression model, we found that males were 20% less likely than females to report the misuse of prescription stimulants only compared with nonstimulant misuse (adjusted OR [AOR] = 0.8, 95% confidence interval [CI] = 0.72–0.97; data not shown in a table). There was no gender difference in the other two subgroups of meth misuse.

We summarize the findings of gender-specific multinomial logistic regression analyses of lifetime stimulant misuse in Table 4. Here, our categorical dependent variable is lifetime stimulant misuse, and each subgroup of stimulant misuse was compared with a group comprised of all individuals without a lifetime history of using stimulants for nonmedical purposes (nonmisusers). Because the correlates of the two subgroups of meth misuse were similar, they were combined together as one subgroup.

Table 2
Prevalence of methamphetamine (meth) and other prescription stimulants among youths aged 16–25 in the 2003 NSDUH (unweighted $N = 24{,}409$)

	Lifetime misuse						Past year misuse[a]			
	Males			Females			Males		Females	
	Meth only	Meth and other stimulants	Other[b] stimulants only	Meth only	Meth and other stimulants	Other[b] stimulants only	Any meth, regardless of other stimulants misused	Other[b] stimulants only	Any meth, regardless of other stimulants misused	Other[b] stimulants only
Overall prevalence	2.7	2.4	5.4	2.2	1.9	5.5	1.7	2.2	1.3	2.1
Age group										
16–17	1.3	1.5	5.4***	0.9	1.2	5.5***	1.5	2.5	1.0	3.1**
18–19	2.3	2.0	5.7	1.4	1.7	6.6	1.9	2.7	1.3	2.3
20–21	2.7	2.1	5.7	2.5	1.9	5.6	1.4	2.2	1.5	2.4
22–23	3.1	3.6	6.2	3.2	2.6	5.9	1.8	2.0	1.3	1.6
24–25	4.4	2.7	5.3	2.9	2.4	4.9	1.7	1.3	1.4	1.0
Race/ethnicity										
White, non-Hispanic	2.9	3.5	7.5***	2.5	2.6	7.5***	2.3	3.0***	1.5	2.7***
African American, non-Hispanic	0.7	0.1	1.5	0.3	0.1	1.8	0.1	0.6	0.1	1.2
Hispanic	3.3	0.5	2.3	2.4	1.0	2.3	0.9	1.0	1.3	0.9
American Indian or Alaska Native	6.4	5.9	4.5	8.4	6.1	3.3	4.1	1.1	9.5	0.8
Asian, Pacific Islander, or Native Hawaiian	2.4	0.2	1.0	0.5	1.3	2.7	0.5	0.8	1.0	1.0
More than one race	4.2	4.2	5.5	3.7	2.4	1.5	2.8	2.6	1.8	0.7
Student										
Yes	1.4	1.6	6.2***	1.4	1.7	5.8***	1.0	2.8***	1.0	2.8***
No	4.3	3.2	4.5	3.2	2.2	5.1	2.5	1.4	1.7	1.2

The sample size is unweighted; all the other figures are weighted estimates. The χ^2-test for the stimulant misuse variable (with either two or three mutually exclusive categories) and the demographic variable (age group, race/ethnicity, or student status).

[a] The data do not provide enough information to separate past year meth misusers who misused meth only from past year meth misusers who also misused other prescription stimulants in the past year.

[b] Other stimulants refer to prescription stimulants.

** $p \leq 0.01$

*** $p \leq 0.001$.

Table 3
Lifetime prevalence of prescription stimulant misuse and other substance use among three categories of stimulant misusers aged 16–25 in the 2003 NSDUH

Prevalence of stimulant misuse, alcohol use, and other illicit drug use	Misusers of meth only		Misusers of meth and prescription stimulants		Misusers of prescription stimulants only	
	Males	Females	Males	Females	Males	Females
Sample size, unweighted *N*	326	252	310	236	704	695
Methylphenidate	–	–	**81.9**	**65.3****	**78.2**	**58.4*****
Diet pills or amphetamines	–	–	**37.3**	**48.6***	**13.7**	**37.5*****
Dexedrine®	–	–	18.4	19.0	8.4	8.7
Dextroamphetamine	–	–	11.1	7.2	1.8	1.0
Preludin®	–	–	4.3	3.7	1.4	0.4
Cylert®	–	–	2.9	2.7	0.9	0.6
Ionamin®	–	–	2.0	2.3	0.4	1.3
Didrex®	–	–	2.0	2.6	0.3	1.1
Mazanor®	–	–	1.8	0.8	0.1	0.6
Sanorex®	–	–	1.5	2.6	0.7	0.6
Obedrin-LA®	–	–	1.6	0.7	0.1	0.1
Tenuate®	–	–	1.4	1.6	0.4	0.3
Eskatrol®	–	–	1.0	0.6	0.09	0.04
Plegine®	–	–	0.6	0.1	0.3	0.0
Number of stimulants ever misused						
One	100	100	0.0	0.0	76.2	74.3
Two	–	–	49.8	51.3	14.6	16.5
Three or more	–	–	50.2	48.7	9.3	9.2
Age at first stimulant misuse						
14 or younger	10.1	16.3	25.3	28.8	18.6	15.2
15–17	50.9	44.3	51.1	44.4	42.6	42.5
18–25	39.0	39.5	23.6	26.8	38.8	42.3
Alcohol	99.9	99.3	99.4	99.3	96.8	97.5
Marijuana	97.7	97.0	98.9	99.2	88.0	84.7
Inhalant	50.4	44.3	**71.7**	**58.7***	**49.2**	**34.4*****
Hallucinogen	78.0	69.4	91.7	89.8	**62.4**	**52.5****
Cocaine/crack	**71.3**	**58.9***	85.2	81.5	**41.4**	**34.3***
Pain reliever	60.3	61.6	**91.7**	**74.2*****	**71.3**	**60.4****
Tranquilizer	37.1	40.7	**77.5**	**63.3****	43.1	40.1
Sedative	7.1	7.4	27.0	21.6	6.9	10.2
Heroin	9.2	7.8	22.8	18.4	6.2	3.3
Number of illicit drug classes used, lifetime						
One (stimulants only)	1.5	0.7	0.0	0.7	**4.3**	**8.0****
Two	4.9	10.2	1.0	1.6	**11.5**	**16.4**
Three or more	93.6	89.2	98.9	97.6	**84.2**	**75.6**
Number of illicit drug classes used, past year						
None	**19.4**	**21.9***	12.4	17.6	21.4	24.2
One (stimulants only)	**23.2**	**13.9**	11.2	12.0	19.9	19.3
Two	**37.7**	**35.2**	68.3	50.7	39.0	32.8
Three or more	**19.7**	**29.0**	8.1	19.8	19.7	23.8

The sample size is unweighted; all the other figures are weighted estimates. A total of four lifetime stimulant misusers with missing data on the specific stimulant misused were not included in the analysis. The χ^2-test for gender and the specific drug use variable.
* $p \leq 0.05$.
** $p \leq 0.01$.
*** $p \leq 0.001$.

3.5.1. Characteristics of meth misusers regardless of prescription stimulant misuse. Regardless of gender, increased odds of lifetime meth misuse were observed among nonstudents (relative to students), whites, and American Indians/Alaska Natives (relative to Hispanics). Meth misuse was significantly associated with past year multiple arrests and substance use disorders in both genders.

3.5.2. Characteristics of misusers of prescription stimulants only. Increased odds of misuse of prescription stimulants only were found among whites in both genders. Among males only, increased odds of misuse of prescription stimulants only were found among older youths, students, unemployed youths, and youths who had been arrested in the past year. Unlike lifetime meth misuse, which was associated with mental health treat-

Table 4
Adjusted odds ratios (AORs) of lifetime misuse of methamphetamine (meth) and prescription stimulants among youths aged 16–25

Gender-specific adjusted multinominal logistic regression model[a]	Males, unweighted $N = 11,921$		Females, unweighted $N = 12,488$	
	Any meth misuse regardless of prescription stimulant misuse[b] AOR (95% CI)	Prescription stimulant misuse only[b] AOR (95% CI)	Any meth misuse regardless of prescription stimulant misuse[b] AOR (95% CI)	Prescription stimulant misuse only[b] AOR (95% CI)
Age group, in year				
18–19 vs. 16–17	1.3 (0.84–1.99)	**1.5 (1.09–2.13)b**	1.5 (0.97–2.29)	1.1 (0.75–1.47)
20–21 vs. 16–17	1.3 (0.82–2.11)	**1.7 (1.21–2.35)b**	**2.3 (1.45–3.54)c**	1.2 (0.83–1.67)
22–23 vs. 16–17	**2.1 (1.32–3.35)b**	**2.4 (1.67–3.36)c**	**3.3 (2.12–5.04)c**	1.3 (0.91–1.99)
24–25 vs. 16–17	**2.1 (1.34–3.28)c**	**2.4 (1.66–3.55)c**	**3.0 (1.74–5.21)c**	1.2 (0.75–1.77)
Race/ethnicity[c]				
White vs. Hispanic	**2.4 (1.66–3.58)c**	**3.4 (2.28–4.98)c**	**1.6 (1.05–2.55)a**	**3.4 (2.21–5.14)c**
African American vs. Hispanic	**0.2 (0.10–0.53)c**	0.6 (0.33–1.07)	**0.1 (0.05–0.33)c**	0.8 (0.41–1.48)
Native American vs. Hispanic	**3.4 (1.49–7.82)b**	2.1 (0.87–5.26)	**3.2 (1.46–6.93)b**	1.5 (0.52–4.07)
Asian vs. Hispanic	1.1 (0.49–2.56)	0.5 (0.22–1.22)	0.6 (0.20–1.85)	1.2 (0.57–2.57)
More one race vs. Hispanic	**2.5 (1.06–5.70)a**	1.9 (0.77–4.85)	1.3 (0.50–3.45)	0.5 (0.22–1.06)
Student status				
Nonstudent vs. student	**2.2 (1.59–3.12)c**	**0.7 (0.48–0.87)b**	**1.4 (1.06–1.97)a**	1.0 (0.75–1.30)
Employment status				
Full-time vs. not employed	0.8 (0.51–1.09)	0.9 (0.64–1.28)	0.9 (0.62–1.26)	1.1 (0.79–1.41)
Part-time vs. not employed	1.1 (0.76–1.66)	1.1 (0.82–1.53)	1.2 (0.86–1.73)	1.0 (0.73–1.23)
Unemployed vs. not employed	1.2 (0.77–1.90)	**1.6 (1.05–2.40)a**	1.4 (0.92–2.23)	1.2 (0.73–1.80)
Marital status				
Single vs. ever married	0.8 (0.56–1.11)	**1.7 (1.09–2.53)a**	1.0 (0.72–1.43)	**1.4 (1.00–1.91)a**
Family income				
$0 - $19,999 vs. $75 K+	1.1 (0.76–1.70)	1.2 (0.84–1.58)	1.3 (0.83–2.18)	1.3 (0.93–1.82)
$20 K–$39,999 vs. $75 K+	1.3 (0.92–1.93)	1.0 (0.70–1.31)	1.2 (0.75–1.88)	1.2 (0.81–1.63)
$40 K–$74,999 vs. $75 K+	1.2 (0.80–1.72)	1.1 (0.79–1.44)	1.1 (0.67–1.70)	1.2 (0.88–1.73)
Population density				
Large metro vs. nonmetro	1.0 (0.70–1.29)	1.3 (0.97–1.68)	0.8 (0.58–1.21)	**1.4 (1.05–1.87)a**
Small metro vs. nonmetro	1.0 (0.79–1.35)	**1.4 (1.09–1.79)b**	0.8 (0.59–1.09)	1.2 (0.92–1.58)
Mental health treatment, past year				
Yes vs. no	1.2 (0.85–1.66)	**1.4 (1.00–1.82)a**	**1.5 (1.08–2.00)a**	**1.4 (1.06–1.81)a**
Booked/arrested, past year				
Once vs. no	**2.0 (1.44–2.85)c**	**1.9 (1.33–2.62)c**	**2.2 (1.23–3.75)b**	1.4 (0.87–2.30)
Two or more vs. no	**2.3 (1.49–3.66)c**	**1.8 (1.07–2.88)a**	**4.1 (1.84–8.92)c**	1.9 (0.92–4.10)
Alcohol use disorder, past year				
Yes vs. no	**2.3 (1.82–2.95)c**	**2.4 (1.90–3.02)c**	**2.4 (1.71–3.34)c**	**2.8 (2.11–3.61)c**
Nonprescription drug use disorder				
Yes vs. no	**3.7 (2.67–5.23)c**	**2.4 (1.82–3.09)c**	**4.4 (3.00–6.34)c**	**2.7 (1.85–3.97)c**
Prescription drug use disorder				
Yes vs. no	**4.6 (2.72–7.63)c**	**3.4 (1.97–5.91)c**	**7.3 (4.34–12.17)c**	**4.8 (2.87–8.02)c**

The sample size is unweighted; all the other figures are weighted estimates. 95% CI: 95% confidence intervals. (a) $p \leq 0.05$; (b) $p \leq 0.01$; (c) $p \leq 0.001$.

[a] Each gender-specific adjusted multinominal logistic regression model includes all variables listed in the first column.

[b] The comparison group (OR = 1.0) consists of individuals without a lifetime history of using stimulants for nonmedical purposes.

[c] Native Americans include American Indians and Alaska Natives; Asians include Asians, other Pacific Islanders, and Native Hawaiians.

ment only among females, misuse of prescription stimulants only was associated with the receipt of mental health treatment for both genders. Prescription stimulant misuse in both genders was highly associated with having an alcohol or drug use disorder in the past year.

3.6. Correlates of past year meth misuse and of prescription stimulant misuse

Our multinomial logistic regression analyses of past year stimulant misuse identified a pattern of associations similar to lifetime associations (data not shown). Past year stimulant misuse was highly associated with past year drug use disorders. We also found that greater odds of past year misuse of prescription stimulants only were observed in students, whereas greater odds of past year meth misuse were found in those who had been arrested for criminal activities.

4. Discussion

Findings from this study provide empirical documentation of gender-specific patterns and characteristics of misuse of meth

and prescription stimulants based on a large, representative sample. Approximately 1 in 10 American youths and young adults aged 16–25 years reported misuse of stimulants in their lifetime. Prescription stimulant misuse (e.g., Ritalin®) was more frequent and tended to occur earlier than meth misuse. Among all lifetime stimulant misusers, 54% had misused only prescription stimulants, and 22% had misused both meth and prescription stimulants.

The most salient finding from our study is an alarmingly high lifetime prevalence of other illicit drug use among all subgroups of stimulant misusers. Lifetime use of at least three illicit drug classes was highly common: approximately 90% or more in all meth misusers and more than 75% in misusers of prescription stimulants only. The lifetime prevalence of cocaine/crack and heroin use in all subgroups of our stimulant misusers was several times higher than the prevalence in the general population. For example, nationally, in 2003, lifetime prevalences of cocaine/crack use among American youths aged 12–17 and young adults aged 18–25 were 3% and 15%, respectively (Substance Abuse and Mental Health Services Administration, 2004), compared with our findings of 59% and 71% in female and male misusers of meth only, respectively. The corresponding national prevalences for heroin use were 0.3% and 1.6% compared with our findings of 8% and 9% in female and male misusers of meth only, respectively. Our prior study found that about one in seven lifetime misusers of stimulants reported lifetime injection drug use (injecting stimulants, cocaine, or heroin) and that adolescent-onset stimulant misusers had a high prevalence of injection drug use (22–35%) (Wu et al., 2004b). Hence, stimulant misuse in adolescence is a cause for concern.

Furthermore, regardless of gender and the types of stimulants misused, youths with a past year alcohol or drug use disorder had increased odds of misusing stimulants. Others have suggested similar findings. Teter et al. (2003) reported that college students who misused methylphenidate were also likely to engage in binge drinking (98%), marijuana use (100%), and MDMA (methylenedioxy-methamphetamine) use (58%) in the past year. Similarly, among treatment-seeking meth misusers (Brecht et al., 2006), multidrug use and early initiation of drug use were common, including illicit use of marijuana (99%), cocaine (87%), crack (71%), and heroin (37%).

The association between meth misuse and arrests is consistent with other studies. Researchers have noted that early aggression or defiance often precedes illicit drug use (Dawes et al., 2000; Neumark and Anthony, 1997). Assault weapon charges and delinquent acts have been reported among meth misusers in the United States (Zweben et al., 2004) and elsewhere (Yen et al., 2006). The high lifetime prevalence of stimulant misuse reported here is disturbing because of its negative medical consequences, associations with other drug use, and reported association with HIV-related risky sexual behaviors (Centers for Disease Control and Prevention, 2006; Semple et al., 2004; Yu et al., 2003). Furthermore, severe injuries have been reported among meth producers as a result of accidental fires and explosions that result from home meth-manufacturing by individuals without knowledge of safety measures when combining volatile chemicals (Lineberry and Bostwick, 2006).

Our data indicate that prescription stimulant misuse is more prevalent than meth misuse, particularly among young persons. The medical use of prescription stimulants for the treatment of ADHD has increased in recent years (McCabe et al., 2006; Safer et al., 1996), and our findings suggest that their misuse has increased. Although there is no evidence that the medical use of stimulants is associated with subsequent substance abuse (Wilens et al., 2003), diversion of prescription drugs has been reported among middle and high school students (McCabe et al., 2004; Musser et al., 1998), as well as college students (White et al., 2006).

Previous studies suggest that females are more likely than males to be prescribed psychotropic drugs and to misuse them (Cafferata and Meyers, 1990; Simoni-Wastila and Strickler, 2004). In our study, females were slightly more likely than males to report the misuse of prescription stimulants, and their misuse was associated with the receipt of mental health treatment. We also found that female stimulant misusers tended to misuse amphetamines/diet pills, whereas male stimulant misusers were likely to misuse Ritalin®. This difference in the drugs of choice may have resulted from the misuse of prescription stimulants by some females as appetite suppressants. For example, among high school seniors in the Monitoring the Future study, females were more likely than males to report amphetamine use for weight loss (Gritz and Crane, 1991). Nonetheless, there are studies indicating other motivations for stimulant misuse, including staying awake, improving grades, and enhancing sexual experience (Hall et al., 2005; Von et al., 2002).

4.1. Limitations and strengths

NSDUH is a cross-sectional study, so the associations reported here are not necessarily causal. Several limitations are noteworthy. First, our findings are based on self-reported drug use. Even though reports of illicit drug use are generally viewed as reliable, household interviews may yield lower estimates of illicit drug use than surveys in schools and other out-of-home settings (Gfroerer et al., 1997; Harrison et al., 1993). Second, NSDUH assessments of mental heath treatment and criminality are also based on self-report, and these reports lack some of the information needed to make important distinctions. For example, we do not know the exact extent of treatment received by those reporting the use of mental health treatment. Third, NSDUH does not include institutionalized (e.g., incarcerated persons and persons receiving inpatient treatment for psychiatric and drug use disorders) and homeless persons. Our findings do not apply to them. Fourth, prescription drug misuse is defined broadly in NSDUH. Components of nonmedical stimulant use covered by the NSDUH assessment may include very infrequent use of the drug for a medical need without a prescription (e.g., receiving the drug from fiends or family members) and deliberate misuse of the drug with or without a prescription (e.g., see Colliver et al., 2006).

Nevertheless, the use of NSDUH data has considerable advantages. NSDUH uses an advanced survey methodology to recruit a representative sample of noninstitutionalized US residents, and the use of computer-assisted survey technology may

facilitate the report of sensitive drug misuse (Turner et al., 1998). Previous NSDUH estimates were found to parallel estimates from other surveys of the general U.S. population (Anthony et al., 1994; Kandel et al., 1997). Additionally, although school dropouts are excluded from school-based surveys, the NSDUH sample covers both students and nonstudents (e.g., school dropouts). The latter group has a high prevalence of meth and other illicit drug use and appears to be at risk for injection drug use once they initiate drug use (Wu et al., 2004b, 2006).

4.2. Conclusion

Our findings have significant implications for clinicians and investigators. The robust associations between stimulant misuse and past year substance use disorders suggest that meth misusers and prescription stimulant misusers could benefit from substance abuse counseling or treatment. For a significant minority of misusers, initiation of prescription stimulant misuse occurs early in adolescence, and such misuse is more prevalent than meth misuse. Prevention programs of stimulant misuse need to target children in middle school, before the age of initiation of stimulant misuse. Finding ways of minimizing diversion of prescription stimulants without hampering the medical use of these medications is a public health challenge. Parents need to be aware of the potential for diversion when their children are prescribed stimulants for the treatment of ADHD. The potential for prescription stimulant misuse to be the first illicit drug use for some individuals deserves attention from investigators.

5. Human participant protection

This study was declared exempt by the institutional review board of RTI International (a trade name of Research Triangle Institute, Research Triangle Park, NC, USA) because the study used an existing public use data file. No information or identifiers on the data file can be associated with any survey respondent.

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