

Concurrent use of methamphetamine, MDMA, LSD, ketamine, GHB, and flunitrazepam among American youths

Li-Tzy Wu^{a,*}, William E. Schlenger^{a,b}, Deborah M. Galvin^c

^a Duke University School of Medicine, Department of Psychiatry and Behavioral Sciences, DUMC, P.O. Box 17969, Durham, NC 27715, USA

^b RTI International, Behavioral Health Research Division, 3040 Cornwallis Road, RTP, NC 27709, USA

^c Center for Substance Abuse Prevention, Division of Workplace Programs, Substance Abuse and Mental Health Services Administration, DHHS, Room # 2-1035, 1 Choke Cherry Road, Rockville, MD 20850, USA

Received 3 June 2005; received in revised form 19 December 2005; accepted 4 January 2006

Abstract

Background: The magnitude and the characteristics of the use of methamphetamine, MDMA (Ecstasy), LSD (D-lysergic acid diethylamide), ketamine, GHB (gamma-hydroxybutyrate), and flunitrazepam (Rohypnol) were examined in a probability sample of the U.S. civilian population that included multiethnic urban, suburban, and rural youths aged 16–23 ($N = 19,084$).

Methods: Data were drawn from the National Survey on Drug Use and Health (NSDUH). Logistic regression analyses were conducted to identify the characteristics associated with the use of each of these drugs and of multiple drugs.

Results: Approximately 20% of youths aged 16–23 reported having ever used one or more of these drugs. Less than 1% of club drug users used club drugs only, and 82% of them had ever used three or more drug classes. Females were more likely than males to report using multiple club drugs. Recent users of methamphetamine were most likely to be females and adolescents aged 16 or 17. Recent users of MDMA tended to be young adults aged 18–21 and residents of metropolitan areas. Most recent users of LSD were adolescents aged 16–19 and those in low-income families. Ketamine users were primarily employed youths. Staying in school and getting married were associated with decreased odds of club drug use. Club drug use was highly associated with the presence of criminal behaviors and recent alcohol abuse or dependence.

Conclusions: Adolescents are more likely than young adults to use multiple drugs. The clustering of multidrug use and alcohol use disorder is a cause of concern.

© 2006 Elsevier Ireland Ltd. All rights reserved.

Keywords: Adolescents; GHB; Ketamine; LSD; Methamphetamine; MDMA; Rohypnol

1. Introduction

In the United States, methamphetamine, 3,4-methylenedioxyamphetamine (MDMA or Ecstasy), LSD (D-lysergic acid diethylamide), GHB (gamma-hydroxybutyrate), ketamine, and flunitrazepam (Rohypnol) have been labeled “club drugs” by the National Institute on Drug Abuse (NIDA, 2005). These drugs are typically used by teenagers and young adults at bars, clubs, concerts, and parties, and the use of these drugs is reported to help maintain energy levels for dancing or to enhance an altered state of consciousness (Koesters et al., 2002). As stressed by the Director of the NIDA, several national monitoring mechanisms have suggested an emerging use of these club drugs (Volkow,

2004). In an attempt to combat the increasing use of club drugs in the community, NIDA has established a website to provide scientific information about them—<http://www.clubdrugs.org> (Volkow, 2004). Similarly, many investigators in other countries have suggested that the use of such drugs has increased (Gross et al., 2002; Joe Laidler, 2005; Lua et al., 2003; Schuster et al., 1998), and that party attendees typically use multiple drugs (Barrett et al., 2005; Boys et al., 1997). To better gauge the extent of this drug use, we examine the prevalence rates, patterns, and correlates of club drug use among youths aged 16–23 in the United States. Our study is based on a national household survey sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA).

Methamphetamine (“speed”, “ice”, “crystal”, “crank”, and “glass”) is a powerful addictive stimulant that has high potential for widespread abuse because it is inexpensive, available in many different forms, and can be easily made in clandestine

* Corresponding author. Tel.: +1 919 668 8576; fax: +1 919 668 7107.
E-mail address: litzylwu@yahoo.com (L.-T. Wu).

laboratories from relatively inexpensive, over-the-counter ingredients (NIDA, 1999). MDMA, an hallucinogenic stimulant, is a synthetic, psychoactive drug with a chemical structure similar to methamphetamine and mescaline (Freese et al., 2002). LSD is the most potent mood- and perception-altering drug known, and it is the most widely used hallucinogen among adolescents (Golub et al., 2001; NIDA, 2001). Ketamine and GHB are anesthetic agents. Ketamine produces effects similar to those of phencyclidine but with a much shorter duration of effect (Jansen, 1993). GHB (liquid X, liquid ecstasy) has been used as a sleep aid, an intoxicant (producing a pleasurable intoxication or enhancing social activity), and a growth promoter (Nicholson and Balster, 2001; Zacny and Galinkin, 1999). Flunitrazepam is a benzodiazepine sedative/hypnotic (NIDA, 2000). GHB and flunitrazepam have been reported to be associated with drug-facilitated sexual assaults, such as “date rape” (NIDA, 2000; Nicholson and Balster, 2001).

Of these drugs, illicit use of methamphetamine and MDMA has been suggested to become a new epidemic worldwide (Koesters et al., 2002; United Nations, 2003). There has been a substantial global increase in the supply and use of methamphetamine and MDMA (United Nations, 2003). Data from emergency department (ED) visits in the United States suggest that the prevalence of the NIDA-defined set of club drugs rose dramatically among patients receiving care at EDs during the mid-to-late 1990s (OAS, 2002). Globally, methamphetamine is the most widely available and used club drug (United Nations, 2003). Investigators in many different countries also have reported an increase in MDMA use, as well as MDMA-related deaths, particularly among young people (Cregg and Tracey, 1993; Landry, 2002; Raikos et al., 2002; Schifano et al., 2003; Schuster et al., 1998; Wilkins et al., 2003). In the United States, Patel et al. (2004) reported a 400% relative increase in MDMA-related fatalities between 1999 and 2001.

To date, most studies of club drug use in the United States and elsewhere have focused on adults and specific population subgroups (e.g., drug users, gay/bisexual people, college students, and party or club participants), and the patterns and correlates of specific club drug use among youths in the community have been understudied. For instance, LSD is the hallucinogen most commonly used by adolescents (Golub et al., 2001), and its use is significantly associated with frequent risky sexual behaviors and frequent heavy drinking (Rickert et al., 2003). However, LSD has received relatively little recent research attention (Nichols, 2004), and therefore scarce data are available on the correlates of LSD use.

Research data on the use of GHB, ketamine, and flunitrazepam among the general population are especially scant (Maxwell, 2004; Nicholson and Balster, 2001). Current knowledge of the use of these drugs is based primarily on studies of gay or bisexual people as well as party or club participants, which tend to report a very high prevalence of GHB use (25–29%) and ketamine use (47–66%) and a significant association of using these drugs with risky sexual behaviors (Colfax et al., 2001; Lua et al., 2003; Mansergh et al., 2001; Mattison et al., 2001; Romanelli et al., 2003; Rusch et al., 2004).

The recent rise in the prevalence of the use of these drugs is of particular concern. Regardless of the sample characteristics, studies have consistently suggested that some club drug users typically use multiple drugs, engage in risky sexual behaviors, and are at high risk for substance addiction and HIV transmission (Boyd et al., 2003; Frosch et al., 1996; Klitzman et al., 2002; Molitor et al., 1998; Rickert et al., 2003; Romanelli et al., 2003; Rusch et al., 2004; Strote et al., 2002). In light of the emerging use of these drugs and associated adverse consequences, we examine the extent, patterns, and correlates of each specific drug use and of multidrug use among American youths aged 16–23.

We focus on a crucial developmental period from mid-adolescence to early adulthood during which time: (a) the onset of use of many drugs occurs (Kandel et al., 1992) and (b) older adolescents make the transition into their young adulthood. This transitional period typically involves major role changes in many domains of life (e.g., leaving high school, going to college or other postsecondary training, starting a career, becoming married, or having children), and it has been suggested to be a heightened risk period for the onset of club drug use and heavy drinking (Chilcoat and Schütz, 1996; Cuomo et al., 1994; Schulenberg and Maggs, 2002; von Sydow et al., 2002). Hence, it provides an illustration of variations in drug use through different developmental stages.

We first determine the prevalence of lifetime (ever) and past year (recent or active) use of each different type of drug use and examine the extent of multidrug use among each subgroup of drug users. Using advanced statistical procedures to adjust for demographic variations, we then examine potential correlates of use of each of the specific drugs and of multidrug use. Findings from these analyses could help to identify demographic subgroups for targeting prevention programs to reduce the frequency and adverse consequences of this emerging club drug use among adolescents and young adults.

2. Method

2.1. Data source

Statistical analyses were based on data from the public use file of the 2002 National Survey on Drug Use and Health (NSDUH), an annual survey of the use of licit and illicit substances by non-institutionalized, household Americans aged 12 or older (OAS, 2003). We used the 2002 public use file because it was the most recent NSDUH available for public use at the time we conducted the analyses. This study was declared exempt from the RTI International institutional review board because it used an existing public use data file. No information or identifiers on the data file can be associated with any survey respondent.

Prior to 2002, NSDUH was called the National Household Survey on Drug Abuse (NHSDA). This survey uses multistage area probability sampling methods (Bowman et al., 2003) 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' cooperation and willingness to report substance use behaviors honestly (Turner et al., 1998), the survey used a combination of computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI) methodologies. ACASI was used for sensitive survey items, for which respondents either read the questions silently on a computer screen, or listened to the questions read aloud by the computer through headphones, and then entered their responses directly into the computer.

A total of 68,126 individuals aged 12 or older participated in the 2002 survey. A weighted screening response rate of 91% was achieved. The weighted interview response rate was 79% (90% for youths aged 12–17, 85% for young adults aged 18–25, 80% for females, 81% for Hispanics, and 82% for blacks). To ensure that the annual NSDUH sample was representative of the U.S. general population aged 12 or older, analysis weights were developed to adjust for variation in household selection, nonresponse, and poststratification of the selected sample to census. NSDUH design and data collection procedures have been reported in detail elsewhere (OAS, 2003).

2.2. Study sample

Secondary data analyses were conducted on youths aged 16–23 ($N = 19,084$). There was about an equal proportion of youths in each age and gender group. Of this sample, 37% were members of nonwhite minority groups (14% African Americans, 17% Hispanics, 5% Asians or Pacific Islanders, 1% American Indians or Alaska Natives, and 1% persons reporting more than one race), 31% reported an annual family income of less than \$ 20,000, 9% had ever been married, and 21% resided in non-metropolitan areas.

2.3. Study variables

2.3.1. Drug use variables. NSDUH assessments of alcohol and illicit drug use were conducted via ACASI and included a detailed description of each drug group and lists of qualifying drugs, including a colored pill card with pictures of different pharmaceutical products. The survey assessed respondents' use of the following classes of illicit drugs: cocaine (including crack), inhalants, marijuana (including hashish), heroin, hallucinogens (e.g., LSD and MDMA), and the nonmedical use of prescription drugs, including sedatives, tranquilizers, pain relievers, and stimulants (e.g., methamphetamine). Data on the context or specific situations or locations where the drug or drugs were used are not collected in NSDUH.

Consistent with the literature, club drug use was defined to include any illicit use of methamphetamines, MDMA, LSD, GHB, ketamine, or flunitrazepam (Bialer, 2002; NIDA, 2000). For each drug, we examined lifetime use (ever use in a respondent's lifetime) and past year use (any use in the past 12 months preceding the interview). Lifetime use is a measure of the cumulative probability of club drug use, whereas past year use is more reflective of current or active drug use. We summed the number of club drugs used and created a categorical variable reflect-

ing multidrug use of club drugs (0, 1, and 2 or more club drugs used). Other multidrug use was assessed by summing the number of drug classes 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).

2.3.2. Alcohol use and criminality variables. We defined both lifetime (yes versus no) and past year alcohol use. Past year alcohol use diagnoses (abuse or dependence) were specified by the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) (American Psychiatric Association [APA], 1994). Past year alcohol use was categorized into four mutually exclusive groups: no use, use without meeting DSM-IV criteria for an alcohol diagnosis, alcohol abuse, and alcohol dependence (Wu et al., 2004, 2005). Lifetime criminal activity was assessed by the following question: "Not counting minor traffic violations, have you ever been arrested and booked for breaking the law?" The survey explicitly defined "being booked" as ever been taken into custody and processed by the police or by someone connected with the courts, even if the respondents were then released. Among the respondents who gave a positive response to this question, the survey then asked the number of times during the past 12 months that they had been arrested and booked (0, 1, and 2 or more times).

2.3.3. Social and demographic variables. We also examined the following potential correlates of club drug use: age, gender, race/ethnicity, employment status, school (students versus non-students), marital status (ever been married versus never been married), total family income, and population density where the respondents reside. Self-reported race/ethnicity was grouped into nonHispanic white, nonHispanic black (African American), Hispanic (Latino), Asian (including Pacific Islander and Native Hawaiian), Native American (American Indian or Alaska Native), and more than one race. Employment status was categorized into full-time employment (working ≥ 35 h weekly), part-time employment (working < 35 h weekly), unemployed (laid off), and not employed (in school, disabled, keeping house full time, or not in the labor force) (Wu et al., 2003). NSDUH classified population density into large metropolitan (areas with a population ≥ 1 million), small metropolitan (areas with a population < 1 million), and nonmetropolitan areas (outside a metropolitan statistical area).

2.4. Data analysis

Data were weighted to reflect multistage probability 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 sample design (e.g., weighting). All percentages reported in this paper are weighted estimates, while the sample sizes are unweighted.

We first examined the prevalence of lifetime and past year use of each type of drug among youths aged 16–23. Because the literature suggests a high prevalence of multidrug use among these drug users, we then explored the pattern of alcohol and

other drug use among each group of drug user. To hold constant the variations in demographics, we conducted multiple logistic regression procedures (Hosmer and Lemeshow, 2000) to identify correlates of each club drug use. Multinomial logistic regression procedures were then conducted to examine the characteristics associated with multidrug use (one club drug used versus no use; two or more club drugs used versus no use). We report odds ratios (ORs) to estimate the strength of an association between the correlates and the drug use.

3. Results

3.1. Prevalence of club drug use: methamphetamine, MDMA, LSD, ketamine, GHB, and flunitrazepam

The prevalence of lifetime and past year drug use is summarized in Table 1. Among youths aged 16–23 ($N=19,084$), one in five (20%) reported having used at least one club drug

in their lifetime. MDMA (14%) and LSD (13%) were more likely to be used than the other drugs (methamphetamine, 5%; ketamine, 0.4%; flunitrazepam, 0.4%; GHB, 0.05%). Lifetime use increased with age and reached a peak at age 21 (28%). Overall, 8% of youths aged 16–23 used at least one of these drugs in the past year (40% of all lifetime drug users). MDMA (6%) was most likely to be used in the past year, followed by LSD (2%) and methamphetamine (2%). The prevalence of past year use generally increased at about age 18, then remained relatively constant up through age 21.

Club drug use varied by race/ethnicity. Youths who identified themselves as having more than one race/ethnicity, American Indians or Alaska Natives, and whites were more likely than other racial/ethnic groups to have ever used methamphetamine (11%, 10%, and 6%, respectively), MDMA (22%, 11%, and 17%, respectively), and LSD (17%, 20%, and 17%, respectively). African Americans generally had a very low prevalence of the use of these drugs, and Asians had a low prevalence of

Table 1
Prevalence of club drug use among youths aged 16–23 in the 2002 NSDUH (unweighted $N=19,084$)

Weighted prevalence	Any club drug	Meth	MDMA	LSD	Ketamine	GHB	Flunitrazepam
Lifetime use (%)							
Overall	19.6	4.9	13.6	13.2	0.4	0.05	0.4
Age							
16	8.9***	2.2***	6.2***	4.9***	0.0	0.03	0.2
17	12.3	3.4	8.7	7.0	0.4	0.03	0.3
18	15.7	3.3	11.5	8.9	0.3	0.15	0.3
19	20.6	5.4	15.0	14.1	0.4	0.00	0.4
20	22.5	5.1	15.6	15.1	0.5	0.02	0.4
21	27.6	6.7	19.4	19.3	0.6	0.04	0.6
22–23	24.9	6.5	16.2	18.4	0.4	0.05	0.6
Race/ethnicity							
White	24.2***	6.1***	16.8***	17.3***	0.5	0.07	0.5
Black	5.2	0.5	4.2	1.6	0.0	0.00	0.1
Hispanic	14.6	3.4	8.9	8.8	0.2	0.00	0.6
Native American	24.1	10.4	11.1	19.8	0.3	0.00	0.0
Asian	14.6	3.7	13.0	5.3	0.3	0.00	0.0
More than one race	28.7	11.4	21.9	17.4	0.2	0.01	0.8
Past year use (%)							
Overall	7.8	1.8	6.0	2.3	NA	NA	NA
Age							
16	5.7***	1.6	4.1***	2.3***			
17	7.5	1.8	5.2	2.8			
18	9.0	1.9	7.4	3.0			
19	8.8	2.0	7.0	2.6			
20	9.0	1.6	7.2	2.5			
21	9.0	2.4	7.1	1.7			
22–23	6.4	1.6	5.0	1.6			
Race/ethnicity							
White	9.7***	2.2***	7.6***	3.1***	NA	NA	NA
Black	2.8	0.2	2.6	0.3			
Hispanic	4.9	1.5	3.2	1.2			
Native American	8.3	4.1	6.6	5.6			
Asian	5.4	0.5	4.8	0.6			
More than one race	12.3	6.2	8.8	2.3			

Note: all prevalence rates are weighted estimates. Meth, methamphetamine; MDMA, ecstasy; LSD, lysergic acid diethylamide; GHB, gamma hydroxybutyrate; flunitrazepam, rohypnol; NA, data not available.

*** χ^2 -test, $p \leq 0.001$. Because the sample is very large and many tests of significance were conducted, we report only p values ≤ 0.001 .

Table 2
Lifetime prevalence (%) of alcohol and drug use among club drug users aged 16–23 (unweighted $N=19,084$)

	Lifetime club drug users							Past year club drug users			
	Any club drug	Meth	MDMA	LSD	Ketamine	GHB	Flunitrazepam	Any club drug	Meth	MDMA	LSD
Unweighted N	3691	909	2500	2507	67	8	77	1458	348	1118	416
Number of club drugs used											
1	49.2	20.2	34.7	29.3	6.8	0.0	19.7	41.1	24.4	38.4	19.2
2	37.3	32.3	46.1	51.0	8.2	0.0	10.2	41.2	30.0	43.0	54.4
≥3 club drugs	13.5	47.5	19.3	19.8	85.0	100.0	70.2	17.7	45.7	18.6	26.5
Number of drug classes used											
1	1.4	0.4	1.5	0.7	0.0	0.0	0.8	0.8	0.4	0.9	0.4
2	16.5	3.6	15.8	11.2	1.6	0.0	3.6	14.2	3.4	16.5	4.3
≥3 drug classes	82.1	96.1	82.8	88.1	98.4	100.0	95.6	85.1	96.3	82.6	95.3

Note: All prevalence rates are weighted estimates. Meth, methamphetamine; MDMA, ecstasy; LSD, lysergic acid diethylamide; GHB, gamma hydroxybutyrate; flunitrazepam, Rohypnol.

club drug use except for MDMA use, which was reported by 13% of Asian youths.

3.2. Prevalence of other substance use among club drug users

Table 2 displays the prevalence of alcohol and drug use among youths aged 16–23 who used at least one club drug in their lifetime ($N=3691$) and in the past year ($N=1458$). Nearly all lifetime club drug users reported having ever used alcohol in their lifetime (more than 99% among users of methamphetamine, MDMA, and LSD; 100% among users of ketamine and GHB; 98% among flunitrazepam users).

Regardless of the type of drug used either in the lifetime or in the past year, 99% of club drug users also had used other drugs. Users of GHB, ketamine, flunitrazepam, and methamphetamine were most likely to have ever used three or more drug classes: 100%, 98%, 96%, and 96%, respectively. A very high proportion of users of LSD (88%) and MDMA (83%) also had ever used three or more drug classes.

Marijuana was the other drug most likely to be used by club drug users, used by 97–100% of lifetime club drug users, followed by pain relievers (63–87%) and cocaine/crack (35–79%). There was also a high prevalence of lifetime heroin use among users of ketamine (23%), GHB (20%), flunitrazepam (17%), and methamphetamine (14%).

3.3. Odds ratios of club drug use

We conducted logistic regression analyses to identify the characteristics associated with the use of each club drug among

all respondents aged 16–23, while holding constant variations in demographic characteristics. Here, we focused on past year use because it reflected recent or active drug use by youths. For ketamine and flunitrazepam, logistic regression models of lifetime use were generated; data on their past year use were unavailable. The number of GHB users was too small to conduct the logistic regression analysis. The annual NSDUH does not assess whether the respondents use ketamine, flunitrazepam, or GHB in the past year.

Each logistic regression model includes age group, gender, race/ethnicity, student status, employment status, marital status, family income, population density, criminal activity, and alcohol use status. Because other drug use was highly correlated with club drug use, it was not included in the logistic regression model. ORs denoting the strength of an association between an explanatory variable and drug use are summarized in Table 3.

Past year any club drug use. Females were more likely than males to use at least one club drug in the past year. All three young age groups (16 or 17, 18 or 19, 20 or 21) were slightly more likely than those aged 22 or 23 to use a club drug in the past year. Youths reporting more than one race, whites, and Asians were about three times as likely as blacks to use a club drug recently. Native Americans and Hispanics were twice as likely to do so. Staying in school, being married, and residing in non-metropolitan areas were associated with decreased odds of club drug use. Increased odds of past year club drug use were positively associated with an increased level of criminal activity and of alcohol use. Alcohol dependents, abusers, and users without a diagnosis were 35, 27, and 11 times, respectively, as likely as nonusers of alcohol to use a club drug in the past year.

Table 3

Adjusted odds ratios (AORs) of the use of methamphetamine, MDMA, LSD, ketamine, GHB, and flunitrazepam among youths aged 16–23 (unweighted $N = 19,084$)

Adjusted logistic regression model	Any past year use of club drug AOR (95% CI)	Past year use of meth AOR (95% CI)	Past year use of MDMA AOR (95% CI)	Past year use of LSD AOR (95% CI)	Lifetime use of ketamine AOR (95% CI)	Lifetime use of flunitrazepam AOR (95% CI)
Age group						
16–17 vs. 22–23	1.6 (1.2–2.0) c	1.9 (1.2–3.1) b	1.3 (1.0–1.7)	2.6 (1.6–4.2) c	1.0 (0.3–3.1)	0.5 (0.2–1.3)
18–19 vs. 22–23	1.6 (1.3–2.0) c	1.4 (0.9–2.3)	1.6 (1.3–2.0) c	1.9 (1.3–2.9) b	1.4 (0.5–3.6)	0.7 (0.3–1.6)
20–21 vs. 22–23	1.4 (1.1–1.8) b	1.2 (0.8–1.9)	1.4 (1.1–1.8) b	1.2 (0.8–1.9)	1.7 (0.8–3.7)	0.9 (0.5–1.6)
Gender						
Male vs. female	0.9 (0.7–1.0) a	0.6 (0.5–0.8) c	0.9 (0.7–1.0)	1.3 (1.0–1.7)	1.0 (0.5–1.9)	1.6 (0.9–2.9)
Race/ethnicity^a						
White vs. black	3.3 (2.4–4.6) c	13.1 (5.1–34.2) c	2.7 (2.0–3.8) c	11.4 (5.0–26.0) c	NA ^b	7.9 (1.1–57.6) a
Hispanic vs. black	1.7 (1.2–2.5) b	10.5 (4.0–27.8) c	1.2 (0.8–1.7)	4.1 (1.6–10.6) b	0.3 (0.1–1.3)	9.9 (1.3–73.5) a
Native American vs. black	2.4 (1.1–5.1) a	17.0 (3.4–84.2) c	2.2 (0.9–5.3)	20.4 (5.0–83.1) c	0.8 (0.1–6.5)	NA
Asian vs. black	2.6 (1.6–4.2) c	4.3 (0.9–20.9)	2.4 (1.4–4.0) c	2.4 (0.6–10.1)	0.8 (1.2–3.7)	NA
More one race vs. black	3.6 (2.1–6.2) c	30.5 (9.6–97.6) c	2.6 (1.5–4.7) b	7.0 (1.8–26.9) a	0.2 (0.1–1.1)	10.5 (0.9–130.2)
Student						
No vs. yes	1.5 (1.2–1.8) c	2.1 (1.4–3.1) c	1.3 (1.1–1.6) a	1.3 (0.9–1.7)	0.7 (0.3–1.6)	0.5 (0.2–1.1)
Employment status						
Full-time vs. not employed	0.8 (0.7–1.1)	0.7 (0.4–1.1)	0.9 (0.7–1.2)	1.0 (0.7–1.5)	5.2 (1.9–14.5) b	1.4 (0.5–3.9)
Part-time vs. not employed	1.0 (0.8–1.2)	0.7 (0.5–1.0)	1.0 (0.8–1.3)	1.0 (0.7–1.4)	3.9 (1.4–10.7) a	1.1 (0.5–2.6)
Unemployed vs. not employed	1.2 (0.9–1.6)	1.7 (1.0–2.9)	1.2 (0.9–1.6)	1.1 (0.6–1.6)	2.5 (0.7–9.5)	1.4 (0.4–4.7)
Marital status						
Single vs. ever married	2.4 (1.7–3.6) c	1.6 (0.9–2.9)	2.6 (1.6–4.0) c	5.6 (2.2–13.8) c	0.8 (0.2–2.5)	1.1 (0.4–2.8)
Family income						
\$ 0–19,999 vs. \$ 75,000+	1.2 (0.9–1.4)	1.3 (0.8–1.9)	1.1 (0.9–1.4)	2.0 (1.3–3.1) c	1.4 (0.6–3.2)	1.4 (0.6–3.5)
\$ 20,000–39,999 vs. \$ 75,000+	1.1 (0.9–1.4)	0.8 (0.5–1.3)	1.0 (0.8–1.4)	1.7 (1.1–2.6) b	1.1 (0.4–2.7)	1.8 (0.7–4.2)
\$ 40,000–74,999 vs. \$ 75,000+	1.1 (0.9–1.3)	1.1 (0.7–1.7)	1.0 (0.8–1.3)	1.2 (0.8–1.8)	1.6 (0.6–4.0)	1.1 (0.5–2.6)
Population density						
Large metro vs. nonmetro	1.6 (1.3–2.0) c	0.9 (0.6–1.4)	1.9 (1.5–2.4) c	1.5 (0.9–2.3)	2.5 (0.9–6.7)	2.7 (1.1–6.5) a
Small metro vs. nonmetro	1.4 (1.2–1.7) c	1.0 (0.7–1.4)	1.7 (1.4–2.2) c	1.5 (0.9–2.3)	2.0 (0.8–5.1)	2.9 (1.3–6.6) b
Booked or arrested, past year						
Once vs. none	2.2 (1.7–2.8) c	2.5 (1.6–3.8) c	2.1 (1.6–2.7) c	2.2 (1.5–3.1) c	3.1 (1.7–5.8) c ^c	3.5 (1.9–6.5) c ^c
Twice or more vs. none	4.0 (2.9–5.4) c	3.6 (2.2–5.9) c	3.4 (2.4–4.7) c	4.0 (2.6–6.1) c	NA	NA
Past year alcohol use						
Dependence vs. no use	35.0 (22.4–54.6) c	31.6 (14.5–68.9) c	34.3 (20.4–57.8) c	30.6 (11.9–78.4) c	18.8 (3.6–96.9) c	7.4 (2.0–27.1) b
Abuse vs. no use	27.1 (17.7–41.5) c	17.4 (8.6–35.3) c	30.0 (17.7–50.8) c	23.5 (9.5–58.4) c	10.5 (2.0–54.8) b	8.1 (2.2–30.5) b
Use only vs. no use	11.4 (7.5–17.1) c	9.4 (4.9–18.0) c	11.9 (7.2–19.8) c	12.2 (4.9–30.7) c	7.5 (1.6–34.8) b	4.2 (1.3–13.4) a

Meth, methamphetamine; MDMA, ecstasy; LSD, lysergic acid diethylamide; flunitrazepam, rohypnol; 95% CI, 95% confidence intervals; a, $p \leq 0.05$; b, $p \leq 0.01$; c, $p \leq 0.001$.

^a Native American includes American Indians and Alaska Natives; Asian includes Asians, Pacific Islanders, and Native Hawaiians; NA, estimates are not available due to a very small cell size in that specific category.

^b The reference group is white.

^c Ever been booked or arrested.

Past year methamphetamine use. Females and nonstudents were more likely than males and students to use methamphetamine in the past year. Past year methamphetamine users were most likely to be among in the youngest age group (16 or 17 years). Race/ethnicity was highly associated with methamphetamine use. Youths reporting more than one race, Native Americans, whites, and Hispanics were 31, 17, 13, and 11 times, respectively, as likely as blacks to use methamphetamines recently. When compared with Hispanics (data not shown), whites were equally likely to use methamphetamines, yet youths reporting more than one race were three times as likely to do so. Methamphetamine users also were more likely than nonusers to be arrested and booked for engaging in criminal activities, as

well as to have co-occurring alcohol abuse and dependence in the past year.

Past year MDMA use. Unlike methamphetamine use, there were no gender differences in MDMA use. Past year MDMA users (mostly likely youths aged 18–21) were slightly older than past year methamphetamine users (mostly likely youths aged 16 or 17). Relative to blacks, youths who reported being white, Asian, or more than one race were about twice as likely to use MDMA in the past year. When compared with Hispanics (data not shown), the latter three racial/ethnic groups also had increased odds of MDMA use. Staying in school, being married, and residing in nonmetropolitan areas appeared to protect youths from using MDMA. Like methamphetamine use, MDMA use

was highly associated with engaging in multiple criminal activities and with alcohol abuse or dependence in the past year.

Past year LSD use. As with MDMA, females were as likely as males to use LSD in the past year. Past year LSD use was predominantly among young youths aged 16–19. Native Americans were 20 times as likely as blacks to use LSD in the past year. Whites and Native Americans were three times as likely as Hispanics to use LSD (data not shown). LSD use was most likely to be reported by youths from a family with a lower level of income (less than \$ 40,000 annually), while family income was unassociated with the use of methamphetamine and MDMA. Past year LSD use also was highly associated with the presence of multiple criminal activities and with alcohol abuse or dependence in the past year.

Lifetime ketamine and flunitrazepam use. Contrary to other drug use data, employment status was the only demographic

variable associated with lifetime ketamine use. Full-time employed youths were about five times and part-time employed youths were four times as likely as youths not in the labor force to have ever used ketamine. Whites and Hispanics were 8 and 10 times, respectively, as likely as blacks to have ever used flunitrazepam. Flunitrazepam users were predominantly youths who resided in a metropolitan area. Both ketamine use and flunitrazepam use were associated with criminal activity and each level of alcohol use.

3.4. Odds ratios of multiple club drug use

We then conducted multinomial logistic regression analyses to examine the correlates of lifetime and past year multidrug use of club drugs (one drug used versus none; at least two drugs used versus none) (Table 4). *Lifetime multidrug use* refers to those

Table 4
Adjusted odds ratios (AORs) of multidrug use of club drugs among youths aged 16–23 (unweighted $N=19,084$)

Adjusted multinomial logistic regression model	Lifetime multidrug use of club drugs		Past year multidrug use of club drugs	
	One club drug vs. none AOR (95% CI)	Two or more club drugs vs. none AOR (95% CI)	One club drug vs. none AOR (95% CI)	Two or more club drugs vs. none AOR (95% CI)
Age group				
16–17 vs. 22–23	0.6 (0.5–0.8) c	0.5 (0.3–0.6) c	1.4 (1.1–1.9) a	2.2 (1.3–3.6) b
18–19 vs. 22–23	0.9 (0.7–1.0)	0.7 (0.6–0.9) b	1.5 (1.2–1.9) c	2.1 (1.4–3.2) c
20–21 vs. 22–23	1.1 (0.9–1.3)	1.0 (0.9–1.2)	1.5 (1.2–1.9) b	1.3 (0.8–2.0)
Gender				
Male vs. female	0.8 (0.7–0.9) b	0.9 (0.8–1.0) a	0.8 (0.7–1.0) b	1.0 (0.7–1.3)
Race/ethnicity^a				
White vs. black	3.4 (2.7–4.4) c	18.3 (10.8–31.0) c	2.5 (1.8–3.5) c	12.8 (5.2–31.4) c
Hispanic vs. black	2.1 (1.6–2.8) c	6.5 (3.6–11.6) c	1.6 (1.1–2.3) a	4.2 (1.5–11.9) b
Native American vs. black	3.4 (1.3–8.6) b	17.3 (8.3–36.4) c	1.1 (0.4–2.7)	15.6 (4.1–60.1) c
Asian vs. black	2.9 (2.0–4.2) c	8.9 (4.3–18.5) c	2.3 (1.4–3.9) c	2.9 (0.5–16.5)
More one race vs. black	3.5 (2.0–6.1) c	19.8 (9.6–37.8) c	2.9 (1.5–5.4) b	11.8 (3.6–38.5) c
Student				
No vs. yes	1.4 (1.2–1.6) c	1.5 (1.3–1.8) c	1.5 (1.2–1.8) c	1.4 (1.0–2.0)
Employment status				
Full-time vs. not employed	0.9 (0.7–1.1)	1.0 (0.8–1.3)	0.8 (0.6–1.1)	0.9 (0.6–1.4)
Part-time vs. not employed	0.9 (0.8–1.1)	1.0 (0.8–1.2)	1.0 (0.8–1.2)	0.9 (0.6–1.4)
Unemployed vs. not employed	1.1 (0.8–1.4)	1.5 (1.1–1.9) b	1.2 (0.8–1.6)	1.3 (0.8–2.1)
Marital status				
Single vs. ever married	1.0 (0.8–1.3)	1.4 (1.1–1.7) c	2.3 (1.5–3.6) c	2.7 (1.4–5.3) b
Family income				
\$ 0–19,999 vs. \$ 75,000+	1.2 (1.0–1.5) a	1.1 (0.8–1.3)	1.0 (0.8–1.3)	1.9 (1.3–2.9) c
\$ 20,000–39,999 vs. \$ 75,000+	1.3 (1.0–1.6) a	1.1 (0.9–1.4)	1.0 (0.8–1.3)	1.4 (0.9–2.3)
\$ 40,000–74,999 vs. \$ 75,000+	1.2 (1.0–1.4)	1.0 (0.8–1.2)	1.0 (0.8–1.3)	1.2 (0.8–1.8)
Population density				
Large metro vs. nonmetro	1.8 (1.5–2.1) c	1.8 (1.5–2.2) c	1.7 (1.3–2.1) c	1.5 (1.0–2.0)
Small metro vs. nonmetro	1.5 (1.2–1.8) c	1.6 (1.3–1.9) c	1.4 (1.1–1.7) b	1.7 (1.2–2.6) b
Booked or arrested, past year				
Once vs. no	2.3 (1.8–2.9) c	3.2 (2.5–4.1) c	2.1 (1.6–2.7) c	2.5 (1.7–3.6) c
Twice or more vs. no	4.1 (2.9–5.9) c	6.2 (4.2–9.2) c	3.5 (2.5–5.0) c	5.0 (3.2–7.7) c
Past year alcohol use				
Dependence vs. no use	13.9 (10.2–19.0) c	23.7 (16.7–33.8) c	31.8 (19.7–51.5) c	44.7 (15.7–127.6) c
Abuse vs. no use	11.3 (8.4–15.1) c	17.0 (12.2–23.7) c	26.3 (16.6–41.7) c	28.8 (10.3–80.9) c
Use only vs. no use	5.1 (4.0–6.6) c	6.3 (4.6–8.8) c	11.1 (7.2–17.2) c	11.6 (4.0–33.3) c

95% CI, 95% confidence intervals; a, $p \leq 0.05$; b, $p \leq 0.01$; c, $p \leq 0.001$.

^a Native American includes American Indians and Alaska Natives; Asian includes Asians, Pacific Islanders, and Native Hawaiians.

who reported ever having used two or more of the drugs from methamphetamine, MDMA, LSD, ketamine, GHB, and flunitrazepam. *Past year multidrug use* refers to those who reported the use of two or more drugs from methamphetamine, MDMA, and LSD due to the lack of past year data on the other club drugs.

Lifetime multidrug use. Females were more likely than males to have ever used at least two club drugs. All of the other racial/ethnic groups were much more likely than blacks to have ever used multiple drugs. In particular, whites, American Indians or Alaska Natives, and youths reporting more than one race were 17–20 times as likely as blacks to do so. Increased odds of lifetime multidrug use were found among nonstudents, unemployed youths, those who were not married, and residents of metropolitan areas.

Past year multidrug use. Youths who used at least two drugs from methamphetamine, MDMA, and LSD in the past year were most likely to be under the age of 20, single, living in low-income families (less than \$ 20,000), and residing in small metropolitan areas. Except for Asians, all of the other racial/ethnic groups also were much more likely than blacks to use multiple drugs recently. When compared with Hispanics (data not shown), whites, American Indians or Alaska Natives, and youths reporting more than one race also had increased odds of past year multidrug use. Both lifetime and past year multidrug use were highly associated with an increased level of criminal activity and of alcohol use, and the strength of this association suggested a dose-related pattern. For example, alcohol dependents were 45 times and alcohol abusers were 29 times as likely as nonusers of alcohol to use multiple club drugs recently.

4. Discussion

This study provides population-based prevalence estimates and correlates of the use of methamphetamine, MDMA, LSD, ketamine, GHB, and flunitrazepam in a nationally representative sample of American youths residing in the community. The most salient finding was the relatively high prevalence of lifetime use of these drugs and the excess multidrug use of club drugs among females. Among youths aged 16–23, one in five (20%) had ever used at least one of these drugs. Multidrug use of club drugs among club drug users was very common (51%). Regardless of the type of club drugs used, nearly all club drug users reported having used drugs other than club drugs (99%).

Given the young age of this sample, these findings raise concerns regarding the potential adverse consequences of risk-taking behaviors and transmission of sexually transmitted diseases (e.g., the human immunodeficiency virus [HIV]) among club drug users (e.g., Romanelli et al., 2003; Semple et al., 2004; Shrier et al., 1997; Tapert et al., 2001; Yen, 2004). Recent studies have suggested that even intermittent use of club drugs and other drugs may lead to risky sexual behaviors (Colfax et al., 2005). In particular, the disturbingly high rate of cocaine/crack use and heroin use among both lifetime and recent club drug users is a cause of concern. Among each different type of club drug user, lifetime prevalence rates ranged from 35% to 79% for cocaine/crack use and 8–23% for heroin use. Nationally, lifetime prevalence rates of cocaine/crack use among American youths

aged 12–17 and young adults aged 18–25 in 2002 were just 3% and 15%, respectively; the corresponding estimates for heroin use among these two age groups were only 0.4% and 1.6%, respectively (OAS, 2003).

Marijuana, an important gateway drug, has been found to be the first (illicit) drug used by youths (Kandel et al., 1992; Yamaguchi and Kandel, 1984). We found that, regardless of the types of club drugs used, marijuana was the drug most frequently used by club drug users, ranging from 97% to 100%. Following marijuana, the majority of club drug users also had used prescription pain relievers nonmedically (60–87%), inhalants (45–84%), and cocaine/crack (35–79%). The very high prevalence of pain reliever use among club drug users also is consistent with the recent literature that indicates a dramatic increase in nonmedical pain reliever use in the United States among adolescents and young adults (OAS, 2004; Zacny et al., 2003). A recent study even found an important proportion of adolescent drug users who used pain relievers nonmedically without having ever used marijuana and inhalants (Wu et al., 2005), suggesting a potentially new emerging pattern of initial involvement of drug use among adolescents.

We also found some variations in the pattern of multidrug use across different club drugs used. More than 95% of users of methamphetamine (96%), ketamine (98%), GHB (100%), and flunitrazepam (96%) had used three or more drug classes, and more than 82% of users of MDMA (83%) and LSD (88%) did so. In addition, users of ketamine, GHB, and flunitrazepam were most likely to use inhalants (58–84%) and heroin (17–23%). Inhalants, following marijuana, are the second drug most likely to be used by American adolescents (Johnston et al., 2003) and are suggested to be the second gateway drug to other drug use (Johnson et al., 1995; Novins et al., 2001). Inhalant use has been found to be associated with the use of heroin, stimulants, depressants, and hallucinogens (Dinwiddie et al., 1991a,b; Johnson et al., 1995). Our findings also suggest that methamphetamine users appear to be in a more advanced stage of drug use than MDMA users. Methamphetamine users were more likely than MDMA users to use three or more drugs (96% versus 83%). They also reported greater use of inhalants (56% versus 45%), cocaine/crack (76% versus 56%), heroin (14% versus 8%), sedatives (15% versus 8%), tranquilizers (52% versus 40%), and pain relievers (73% versus 60%).

Our findings that females were more likely than males to use multiple club drugs in their lifetime and to use methamphetamine in the past year were noteworthy. The literature has suggested a changing pattern of drug use behaviors among young females. Investigators have found that the prevalence of drug use disorders among females is increasing to match the rate of males and that young females appear to initiate drug use and to develop abuse or dependence at a younger age than older females (Grant, 1996; Warner et al., 1995). Wu and Schlenger (2003) found that female users of stimulants (e.g., amphetamine and methamphetamine) were about three times as likely as male users to develop stimulant dependence in the past year. Among a sample of juvenile offenders, females were found to be more likely than males to use MDMA (Yacoubian et al., 2002). Investigators in Germany reported that, among a community sample

of youths aged 14–24, female users of stimulants and/or hallucinogens started their first use at a younger age than male users (von Sydow et al., 2002). Investigators in the United States have found that approximately 50% of females who are offered a chance to try an hallucinogen (i.e., exposure opportunity) start their hallucinogen use within 1 year (Van Etten and Anthony, 1999). Previous U.S. data show that males are more likely than females to have an opportunity to use an hallucinogen and that the prevalence of hallucinogen use also is higher among males (Van Etten and Anthony, 1999). Hence, our findings indicate that the use of a club drug among females aged 16–23 appear to have increased at least moderately to exceed the rate of same-aged young males.

We also found some variations in the correlates of club drug use. Recent methamphetamine users were most likely to be females, nonstudents, and aged 16 or 17. Recent MDMA users tended to be aged 18–21, nonstudents, single, and residents of metropolitan areas; while most recent LSD users were aged 16–19 or those living in a family with an income of less than \$ 40,000. Interestingly, we found that lifetime ketamine users were primarily employed youths, while none of the other demographics examined were associated with its use. As our findings indicate, there is a very low prevalence of ketamine use among young people in the general population. However, ketamine use appears to be very common (47–66%) among people attending parties or clubs (Colfax et al., 2001; Lua et al., 2003; Mansergh et al., 2001; Mattison et al., 2001). Dillon et al. (2003) found that ketamine users were frequently experienced drug users who use a variety of drugs and were primarily employed and well-educated. Ketamine users seem to be older than other club drug users (Dillon et al., 2003).

Overall, our findings suggest that blacks are the least likely to use a club drug, while whites, Native Americans, and youths reporting more than one race are generally more likely than the other racial/ethnic groups to use one or more club drugs. Additionally, our analyses show that Hispanics are more likely than blacks to use methamphetamine and LSD in the past year. Asians generally have the lowest prevalence of any drug use (OAS, 2003). Yet we found that Asians were more likely than blacks to use MDMA in the past year. These findings appear to be consistent with studies on hallucinogen exposure opportunities (Van Etten and Anthony, 1999, 2001). Investigators have suggested that the proportion of blacks who have a chance to try hallucinogens tends to be lower than those of the other racial/ethnic groups and that, among those who have the opportunity to use it, blacks also have a lower proportion of progression to actual hallucinogen use (Van Etten and Anthony, 1999, 2001). In particular, persons in the “other” category of race/ethnicity (e.g., Native Americans and Asians) are more likely than the other racial/ethnic groups to make the transition from having the hallucinogen opportunity to actually use an hallucinogen (Van Etten and Anthony, 1999).

On the other hand, staying in school, being married, and residing in nonmetropolitan areas appear to protect youths from using club drugs. Studies have found that adolescent marijuana use may adversely affect an individual’s ability to successfully assume conventional adult roles (e.g., such use has an effect on

unemployment and postponement of marriage) and that marriage during early adulthood decreases the risk for later marijuana use (Brook et al., 1999a). We suspect that the greater odds of club drug use among youths residing in the metropolitan areas may be related to a greater exposure opportunity of club drugs in the metropolitan areas than in the nonmetropolitan areas.

These findings are limited by the cross-sectional nature of the NSDUH design and the reliance on self-reported drug use, which preclude the interpretation of causality of observed associations. Self-reports of drug use are generally considered valid and reliable, yet underreporting of drug use can occur in a household setting (Gfroerer et al., 1997; Harrison et al., 1993; Needle et al., 1983; Winters et al., 1990–1991). It is noteworthy that NSDUH uses the most sophisticated survey methodology available to recruit a nationally representative sample of noninstitutionalized U.S. residents. It also utilizes computer-assisted survey technology to increase respondents’ self-reports of drug use and the other risky behaviors (Turner et al., 1998). Previous studies of NSDUH data found that the survey’s estimates of both lifetime substance use and past year substance dependence were generally consistent with estimates from other national surveys of the general population in the United States, such as the National Comorbidity Survey and the National Longitudinal Alcohol Epidemiologic Survey (Anthony et al., 1994; Kandel et al., 1997).

Additionally, we may have underestimated the prevalence of club drug use among youths aged 16–23. For instance, because the use of GHB and flunitrazepam has received considerable negative publicity in the media (e.g., been implicated in drug-facilitated sexual assaults), its use may be underreported. Further, NSDUH focuses on noninstitutionalized, household residents. A small but high-risk group of youths (less than 2% of the U.S. population), such as youths who were homeless, incarcerated, or in inpatient or residential care for substance abuse or other psychiatric problems at the time of survey, were not included in the study. Our findings cannot apply to these subgroups.

Finally, the term “club drugs” is based on the circumstances under which the drugs are used, not on their chemical composition or their psychotropic effects. Therefore, as the pattern of use of drugs at raves and other parties changes, the drugs considered “club drugs” will also change. For this and other reasons, we reported findings for individual drugs in the class and for the class as a whole.

Despite these limitations, our findings have important implications for researchers and clinicians. Especially, recent club drug users in this study were most likely to be youths under the age of 20. Given that adolescent multidrug use is a significant predictor of risky behaviors (Baker et al., 1994) and adult multidrug use (Galaif and Newcomb, 1999), there is a need for both primary and focused prevention programs to prevent the initiation of club drug use and to reduce the adverse consequences of continued drug use, such as risky sexual behaviors, injection drug use, HIV infection, and neuropsychological impairment (Baker et al., 1994; Boyd et al., 2003; Frosch et al., 1996; Klitzman et al., 2002; Molitor et al., 1998; Romanelli et al., 2003; Strote et al., 2002; Verdejo-Garcia et al., 2005). Some subgroups may deserve more research attention from investigators,

such as females, nonstudents (e.g., school dropouts), whites, Native Americans, youths reporting more than one race, current alcohol or drug users, and those involved with the juvenile or criminal justice system. Primary prevention programs, such as the use of media campaigns or school-based prevention programs, should start early (e.g., middle school years) and need to take into account age, gender, and racial/ethnic variations in different club drugs used. The increased trend of MDMA and methamphetamine use worldwide (United Nations, 2003) also implies a need for universal efforts to educate the general public about the adverse health consequences of misusing these drugs.

Additionally, family-based interventions or other integrated treatment programs are recommended to reduce youths' multidrug use, co-occurring delinquency, and/or family-related problems (Liddle, 2004). For instance, we found that past year club drug users, regardless of the type of club drugs used, tended to have used multiple drugs, to have had encounters with the criminal justice system, and to have had an alcohol use disorder in the past year. These findings suggest that at least some recent club drug users are in need of treatment or counseling for both drug use and other psychosocial problems, which may include sexual or physical abuse, delinquency or criminality, school problems, psychological distress, and family dysfunction (e.g., poor parenting or family substance use) (e.g., Chilcoat and Anthony, 1996; Galaif and Newcomb, 1999; Johnson and Leff, 1999; Martin et al., 1996; Moran et al., 2004). Further, the clustering of drug use and alcohol abuse or dependence is a cause for concern because of its heightened risk for HIV-related risky behaviors and consequences (Baldwin et al., 2000; Rasch et al., 2000; Stein et al., 2000, 2001). Hence, prevention or treatment programs should include risk-reduction interventions to increase club drug users' knowledge of HIV prevention and to reduce unprotected sexual behaviors (Semple et al., 2004; Yen, 2004).

Additionally, more than 90% of adolescents have a regular source of primary care and have received a checkup during the past 2 years (Klein et al., 1999). When asked, the majority of adolescents report that they want to discuss with their health care providers issues of drug use, but often fail to do so (Klein and Wilson, 2002). Even among adolescents who used a drug in the past month, only about one third reported discussing drug use with their health care providers (Klein and Wilson, 2002). Increasing youths' access to confidential care, such as allowing them to speak privately with their pediatricians, may increase their willingness to disclose their substance use and to get help (Klein et al., 1999; Klein and Wilson, 2002).

Finally, the family can play a central role in preventing the onset of drug use, escalation to a more serious level of drug use, and delinquency (Chilcoat and Anthony, 1996; Paschall et al., 2003; Steinberg et al., 1994; Velleman et al., 2005). Parents or guardians are in the best position to observe behavioral changes in their children and, hence, should be involved in drug use prevention or treatment interventions. They should be made aware that good family relationships could protect their sons or daughters from using drugs and engaging in delinquent activities. These protective family factors include, but are not limited to, a close parent–child relationship, parental disapproval of

substance use, parental monitoring and supervision, and frequent family dinners (Bogenschneider et al., 1998; Brook et al., 1999b; Chilcoat and Anthony, 1996; Galaif and Newcomb, 1999; McIntosh et al., 2005; National Center on Addiction and Substance Abuse, 2005; Steinberg et al., 1994).

Acknowledgments

This work was supported primarily by the Division of Workplace Programs, Center for Substance Abuse Prevention, Substance Abuse and Mental Health Services Administration (contract no. 270-2003-00001). It also was supported in part by the National Institute on Drug Abuse (R21DA015938; L.T. Wu). The Substance Abuse and Mental Health Data Archive and the Inter-university Consortium for Political and Social Research provided the public use data files for the 2002 NSDUH, which is sponsored by the Office of Applied Studies, Substance Abuse and Mental Health Services Administration.

References

- American Psychiatric Association, 1994. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. American Psychiatric Association, Washington, DC.
- Anthony, J.C., Warner, L.A., Kessler, R.C., 1994. Comparative epidemiology of dependence on tobacco, alcohol, controlled substances, and inhalants: basic findings from the National Comorbidity Survey. *Exp. Clin. Psychopharmacol.* 2, 244–268.
- Baker, A., Kochan, N., Dixon, J., Wodak, A., Heather, N., 1994. Drug use and HIV risk-taking behaviour among injecting drug users not currently in treatment in Sydney, Australia. *Drug Alcohol Depend.* 34, 155–160.
- Baldwin, J.A., Maxwell, C.J., Fenaughty, A.M., Trotter, R.T., Stevens, S.J., 2000. Alcohol as a risk factor for HIV transmission among American Indian and Alaska Native drug users. *Am. Ind. Alsk. Native Ment. Health Res.* 9 (1), 1–16.
- Barrett, S.P., Gross, S.R., Garand, I., Pihl, R.O., 2005. Patterns of simultaneous polysubstance use in Canadian rave attendees. *Subst. Use Misuse* 40, 1525–1537.
- Bialer, P.A., 2002. Designer drugs in the general hospital. *Psychiatr. Clin. North Am.* 25, 231–243.
- Bogenschneider, K., Wu, M.Y., Raffaelli, M., Tsay, J.C., 1998. Parent influences on adolescent peer orientation and substance use: the interface of parenting practices and values. *Child Dev.* 69, 1672–1688.
- Boys, A., Lenton, S., Norcross, K., 1997. Polydrug use at raves by a Western Australian sample. *Drug Alcohol Rev.* 16, 227–234.
- Bowman, K.R., Chromy, J.R., Odom, D.M., Penne, M.A., 2003. 2001 National Household Survey on drug abuse: sample design report. In: 2001 National Household Survey on Drug Abuse: Methodological Resource Book. RTI, Research Triangle Park, NC. PDF accessed on May 26, 2005 at: <http://www.oas.samhsa.gov/nhsda/methods.cfm#2k1>.
- Boyd, C.J., McCabe, S.E., d'Arcy, H., 2003. Ecstasy use among college undergraduates: gender, race and sexual identity. *J. Subst. Abuse Treat.* 24, 209–215.
- Brook, J.S., Richter, L., Whiteman, M., Cohen, P., 1999a. Consequences of adolescent marijuana use: incompatibility with the assumption of adult roles. *Genet. Soc. Gen. Psychol. Monogr.* 125, 193–207.
- Brook, J.S., Brook, D.W., De La Rosa, M., Whiteman, M., Montoya, I.D., 1999b. The role of parents in protecting Colombian adolescents from delinquency and marijuana use. *Arch. Pediatr. Adolesc. Med.* 153, 457–464.
- Chilcoat, H.D., Anthony, J.C., 1996. Impact of parent monitoring on initiation of drug use through late childhood. *J. Am. Acad. Child Adolesc. Psychiatry* 35, 91–100.

- Chilcoat, H.D., Schütz, C.G., 1996. Age-specific patterns of hallucinogen use in the US population: an analysis using generalized additive models. *Drug Alcohol Depend.* 43, 143–153.
- Colfax, G., Coates, T.J., Husnik, M.J., Huang, Y., Buchbinder, S., Koblin, B., Chesney, M., Vittinghoff, E., 2005. Longitudinal patterns of methamphetamine, popper (amyl nitrite), and cocaine use and high-risk sexual behavior among a cohort of San Francisco men who have sex with men. *J. Urban Health* 82 (1 Suppl. 1), i62–i70.
- Colfax, G.N., Mansergh, G., Guzman, R., Vittinghoff, E., Marks, G., Rader, M., Buchbinder, S., 2001. Drug use and sexual risk behavior among gay and bisexual men who attend circuit parties: a venue-based comparison. *J. Acquir. Immune Defic. Syndr.* 28, 373–379.
- Cregg, M.T., Tracey, J.A., 1993. Ecstasy abuse in Ireland. *Ir. Med. J.* 86 (4), 118–120.
- Cuomo, M.J., Dymont, P.G., Gammino, V.M., 1994. Increasing use of “Ecstasy” (MDMA) and other hallucinogens on a college campus. *J. Am. Coll. Health* 42, 271–274.
- Dillon, P., Copeland, J., Jansen, K., 2003. Patterns of use and harms associated with non-medical ketamine use. *Drug Alcohol Depend.* 69, 23–28.
- Dinwiddie, S.H., Reich, T., Cloninger, C.R., 1991a. The relationship of solvent use to other substance use. *Am. J. Drug Alcohol Abuse* 17, 173–186.
- Dinwiddie, S.H., Reich, T., Cloninger, C.R., 1991b. Solvent use as a precursor to intravenous drug abuse. *Compr. Psychiatry* 32, 133–140.
- Freese, T.E., Miotto, K., Reback, C.J., 2002. The effects and consequences of selected club drugs. *J. Subst. Abuse Treat.* 23, 151–156.
- Frosch, D., Shoptaw, S., Huber, A., Rawson, R.A., Ling, W., 1996. Sexual HIV risk among gay and bisexual male methamphetamine abusers. *J. Subst. Abuse Treat.* 13, 483–486.
- Galaif, E.R., Newcomb, M.D., 1999. Predictors of polydrug use among four ethnic groups: a 12-year longitudinal study. *Addict. Behav.* 24, 607–631.
- Gfroerer, J., Wright, D., Kopstein, A., 1997. Prevalence of youth substance use: the impact of methodological differences between two national surveys. *Drug Alcohol Depend.* 47, 19–30.
- Golub, A., Johnson, B.D., Sifanek, S.J., Chesluk, B., Parker, H., 2001. Is the U.S. experiencing an incipient epidemic of hallucinogen use? *Subst. Use Misuse* 36, 1699–1729.
- Grant, B.F., 1996. Prevalence and correlates of drug use and DSM-IV drug dependence in the United States: results of the National Longitudinal Alcohol Epidemiologic Survey. *J. Subst. Abuse* 8, 195–210.
- Gross, S.R., Barrett, S.P., Shestowsky, J.S., Pihl, R.O., 2002. Ecstasy and drug consumption patterns: a Canadian rave population study. *Can. J. Psychiatry* 47, 546–551.
- Harrison, E.R., Haaga, J., Richards, T., 1993. Self-reported drug use data: what do they reveal? *Am. J. Drug Alcohol Abuse* 19, 423–441.
- Hosmer, D.W., Lemeshow, S., 2000. *Applied Logistic Regression*, 2nd ed. John Wiley & Sons Inc., New York.
- Jansen, K.L., 1993. Non-medical use of ketamine. *BMJ* 306, 601–602.
- Joe Laidler, K.A., 2005. The rise of club drugs in a heroin society: the case of Hong Kong. *Subst. Use Misuse* 40, 1257–1278.
- Johnson, E.O., Schütz, C.G., Anthony, J.C., Ensminger, M.E., 1995. Inhalants to heroin: a prospective analysis from adolescence to adulthood. *Drug Alcohol Depend.* 40, 159–164.
- Johnson, J.L., Leff, M., 1999. Children of substance abusers: overview of research findings. *Pediatrics* 103, 1085–1099.
- Johnston, L.D., O’Malley, P.M., Bachman, J.G., 2002. *Monitoring the Future National Results on Adolescent Drug Use: Overview of Key Findings*, NIH Publication No. 03-5374. National Institute on Drug Abuse, Bethesda, MD.
- Kandel, D., Chen, K., Warner, L.A., Kessler, R.C., Grant, B., 1997. Prevalence and demographic correlates of symptoms of last year dependence on alcohol, nicotine, marijuana and cocaine in the U.S. population. *Drug Alcohol Depend.* 44, 11–29.
- Kandel, D.B., Yamaguchi, K., Chen, K., 1992. Stages of progression in drug involvement from adolescence to adulthood: further evidence for the gateway theory. *J. Stud. Alcohol* 53, 447–457.
- Klein, J.D., Wilson, K.M., 2002. Delivering quality care: adolescents’ discussion of health risks with their providers. *J. Adolesc. Health* 30, 190–195.
- Klein, J.D., Wilson, K.M., McNulty, M., Kappahn, C., Collins, K.S., 1999. Access to medical care for adolescents: results from the 1997 Commonwealth Fund Survey of the Health of Adolescent Girls. *J. Adolesc. Health* 25, 120–130.
- Klitzman, R.L., Greenberg, J.D., Pollack, L.M., Dolezal, C., 2002. MDMA (‘ecstasy’) use, and its association with high risk behaviors, mental health, and other factors among gay/bisexual men in New York City. *Drug Alcohol Depend.* 66, 115–125.
- Koesters, S.C., Rogers, P.D., Rajasingham, C.R., 2002. MDMA (‘ecstasy’) and other ‘club drugs’. The new epidemic. *Pediatr. Clin. North Am.* 49, 415–433.
- Landry, M.J., 2002. MDMA: a review of epidemiologic data. *J. Psychoactive Drugs* 34, 163–169.
- Liddle, H.A., 2004. Family-based therapies for adolescent alcohol and drug use: research contributions and future research needs. *Addiction* 99 (Suppl. 2), 76–92.
- Lua, A.C., Lin, H.R., Tseng, Y.T., Hu, A.R., Yeh, P.C., 2003. Profiles of urine samples from participants at rave party in Taiwan: prevalence of ketamine and MDMA abuse. *Forensic Sci. Int.* 136 (1–3), 47–51.
- Mansergh, G., Colfax, G.N., Marks, G., Rader, M., Guzman, R., Buchbinder, S., 2001. The Circuit Party Men’s Health Survey: findings and implications for gay and bisexual men. *Am. J. Public Health* 91, 953–958.
- Martin, C.S., Kaczynski, N.A., Maisto, S.A., Tarter, R.E., 1996. Polydrug use in adolescent drinkers with and without DSM-IV alcohol abuse and dependence. *Alcohol. Clin. Exp. Res.* 20, 1099–1108.
- Mattison, A.M., Ross, M.W., Wolfson, T., Franklin, D., 2001. Circuit party attendance, club drug use, and unsafe sex in gay men. *J. Subst. Abuse* 13, 119–126.
- Maxwell, J.C., 2004. *Patterns of Club Drug Use in the U.S., 2004: ecstasy, GHB, ketamine, LSD, methamphetamine, rohypnol*. Center for Excellence in Drug Epidemiology, Gulf Coast Addiction Technology Transfer Center, University of Texas at Austin. PDF accessed on May 26, 2005 at: <http://www.utexas.edu/research/cswr/gcattc/>, then <http://www.utexas.edu/research/cswr/gcattc/Trends/ClubDrug-2004-web.pdf>.
- McIntosh, J., MacDonald, F., McKeganey, N., 2005. The reasons why children in their pre and early teenage years do or do not use illegal drugs. *Int. J. Drug Policy* 16, 254–261.
- Molitor, F., Truax, S.R., Ruiz, J.D., Sun, R.K., 1998. Association of methamphetamine use during sex with risky sexual behaviors and HIV infection among non-injection drug users. *West. J. Med.* 168 (2), 93–97.
- Moran, P.B., Vuchinich, S., Hall, N.K., 2004. Associations between types of maltreatment and substance use during adolescence. *Child Abuse Negl.* 28, 565–574.
- National Center on Addiction and Substance Abuse at Columbia University, 2005. *The Importance of Family Dinners II*. Accessed November 26, 2005 from: http://www.casacolumbia.org/Absolutenm/articlefiles/380-2005_family_dinners_ii_final.pdf.
- National Institute on Drug Abuse, 1999. *Methamphetamine Abuse Alert*. NIDA Notes 13 (6), Tearoff. Accessed May 27, 2005 from: http://165.112.78.61/NIDA_Notes/NNVol13N6/tearoff.html.
- National Institute on Drug Abuse, 2000. *What are Club Drugs?* NIDA Notes 14 (6), 40. Accessed May 27, 2005 from: http://www.drugabuse.gov/NIDA_Notes/NNVol14N6/WhatAre.html.
- National Institute on Drug Abuse, 2001. *Information on LSD, PCP, and Related Drugs*. NIDA Notes 16 (2), Tearoff. Accessed May 27, 2005 from: http://www.drugabuse.gov/NIDA_Notes/NNVol16N2/tearoff.html.
- National Institute on Drug Abuse, 2005. *Club Drugs*. Accessed November 25, 2005 from: <http://www.drugabuse.gov/DrugPages/Clubdrugs.html>.
- Needle, R., McCubbin, H., Lorence, J., Hochhauser, M., 1983. Reliability and validity of adolescent self-reported drug use in a family-based study: a methodological report. *Int. J. Addict.* 18, 901–912.
- Nichols, D.E., 2004. Hallucinogens. *Pharmacol. Ther.* 101, 131–181.
- Nicholson, K.L., Balster, R.L., 2001. GHB: a new and novel drug of abuse. *Drug Alcohol Depend.* 63, 1–22.
- Novins, D.K., Beals, J., Mitchell, C.M., 2001. Sequences of substance use among American Indian adolescents. *J. Am. Acad. Child Adolesc. Psychiatry* 40, 1168–1174.

- Office of Applied Studies, 2002. Club drugs, 2001 update. The DAWN Report. Accessed May 27, 2005 from: <http://www.oas.samhsa.gov/facts.cfm> and <http://www.oas.samhsa.gov/2k2/DAWN/clubdrugs2k1.pdf>.
- Office of Applied Studies, 2004. Nonmedical use of prescription pain relievers. The NSDUH Report. Accessed May 27, 2005 from: <http://www.oas.samhsa.gov/facts.cfm> and <http://www.oas.samhsa.gov/2k4/pain/pain.cfm>.
- Office of Applied Studies, 2003. Results from the 2002 National Survey on Drug Use and Health: National Findings. DHHS Publication No. SMA 03-3836, NSDUH Series H-22. Substance Abuse and Mental Health Services Administration, Rockville, MD.
- Paschall, M.J., Ringwalt, C.L., Flewelling, R.L., 2003. Effects of parenting, father absence, and affiliation with delinquent peers on delinquent behavior among African-American male adolescents. *Adolescence* 38 (149), 15–34.
- Patel, M.M., Wright, D.W., Ratcliff, J.J., Miller, M.A., 2004. Shedding new light on the “safe” club drug: methylenedioxyamphetamine (ecstasy)-related fatalities. *Acad. Emerg. Med.* 11, 208–210.
- Raikos, N., Tsoukali, H., Psaroulis, D., Vassiliadis, N., Tsoungas, M., Njau, S.N., 2002. Amphetamine derivative related deaths in northern Greece. *Forensic Sci. Int.* 128 (1–2), 31–34.
- Rasch, R.F., Weisen, C.A., MacDonald, B., Wechsberg, W.M., Perritt, R., Dennis, M.L., 2000. Patterns of HIV risk and alcohol use among African-American crack abusers. *Drug Alcohol Depend.* 58, 259–266.
- Research Triangle Institute, 2002. SUDAAN® User’s Manual: Release 8.0. Research Triangle Institute, Research Triangle Park, NC.
- Rickert, V.I., Siqueira, L.M., Dale, T., Wiemann, C.M., 2003. Prevalence and risk factors for LSD use among young women. *J. Pediatr. Adolesc. Gynecol.* 16, 67–75.
- Romanelli, F., Smith, K.M., Pomeroy, C., 2003. Use of club drugs by HIV-seropositive and HIV-seronegative gay and bisexual men. *Top. HIV Med.* 11 (1), 25–32.
- Rusch, M., Lampinen, T.M., Schilder, A., Hogg, R.S., 2004. Unprotected anal intercourse associated with recreational drug use among young men who have sex with men depends on partner type and intercourse role. *Sex. Transm. Dis.* 31, 492–498.
- Schifano, F., Oyefeso, A., Corkery, J., Cobain, K., Jambert-Gray, R., Martinotti, G., Ghodse, A.H., 2003. Death rates from ecstasy (MDMA, MDA) and polydrug use in England and Wales 1996–2002. *Hum. Psychopharmacol.* 18, 519–524.
- Schulenberg, J.E., Maggs, J.L., 2002. A developmental perspective on alcohol use and heavy drinking during adolescence and the transition to young adulthood. *J. Stud. Alcohol Suppl.* (14), 54–70.
- Schuster, P., Lieb, R., Lamertz, C., Wittchen, H.U., 1998. Is the use of ecstasy and hallucinogens increasing? Results from a community study. *Eur. Addict. Res.* 4 (1–2), 75–82.
- Semple, S.J., Patterson, T.L., Grant, I., 2004. The context of sexual risk behavior among heterosexual methamphetamine users. *Addict. Behav.* 29, 807–810.
- Shrier, L.A., Emans, S.J., Woods, E.R., DuRant, R.H., 1997. The association of sexual risk behaviors and problem drug behaviors in high school students. *J. Adolesc. Health* 20, 377–383.
- Stein, M.D., Anderson, B., Charuvastra, A., Friedmann, P.D., 2001. Alcohol use and sexual risk taking among hazariously drinking drug injectors who attend needle exchange. *Alcohol. Clin. Exp. Res.* 25, 1487–1493.
- Stein, M.D., Hanna, L., Natarajan, R., Clarke, J., Marisi, M., Sobota, M., Rich, J., 2000. Alcohol use patterns predict high-risk HIV behaviors among active injection drug users. *J. Subst. Abuse Treat.* 18, 359–363.
- Steinberg, L., Fletcher, A., Darling, N., 1994. Parental monitoring and peer influences on adolescent substance use. *Pediatrics* 93 (6 Pt. 2), 1060–1064.
- Strote, J., Lee, J.E., Wechsler, H., 2002. Increasing MDMA use among college students: results of a national survey. *J. Adolesc. Health* 30, 64–72.
- Tapert, S.F., Aarons, G.A., Sedlar, G.R., Brown, S.A., 2001. Adolescent substance use and sexual risk-taking behavior. *J. Adolesc. Health* 28, 181–189.
- Turner, C.F., Ku, L., Rogers, S.M., Lindberg, L.D., Pleck, J.H., Sonenstein, F.L., 1998. Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology. *Science* 280, 867–873.
- United Nations Office on Drugs and Crime, 2003. Ecstasy and Amphetamines: Global Survey 2003. UN Publication Sales No. E.03.XI.15. United Nations Office on Drugs and Crime, United Nations, New York, NY/Vienna, Austria.
- Van Etten, M.L., Anthony, J.C., 1999. Comparative epidemiology of initial drug opportunities and transitions to first use: marijuana, cocaine, hallucinogens and heroin. *Drug Alcohol Depend.* 54, 117–125.
- Van Etten, M.L., Anthony, J.C., 2001. Male-female differences in transitions from first drug opportunity to first use: searching for subgroup variation by age, race, region, and urban status. *J. Womens Health Gen. Based Med.* 10, 797–804.
- Velleman, R.D., Templeton, L.J., Copello, A.G., 2005. The role of the family in preventing and intervening with substance use and misuse: a comprehensive review of family interventions, with a focus on young people. *Drug Alcohol Rev.* 24, 93–109.
- Verdejo-Garcia, A.J., Lopez-Torrecillas, F., Aguilar de Arcos, F., Perez-Garcia, M., 2005. Differential effects of MDMA, cocaine, and cannabis use severity on distinctive components of the executive functions in polysubstance users: a multiple regression analysis. *Addict. Behav.* 30, 89–101.
- Volkow, N.D., 2004. NIDA Community Drug Alert Bulletin—Club Drugs. Accessed November 26, 2005 from: <http://www.drugabuse.gov/ClubAlert/ClubDrugAlert.html>.
- von Sydow, K., Lieb, R., Pfister, H., Hofler, M., Wittchen, H.U., 2002. Use, abuse and dependence of ecstasy and related drugs in adolescents and young adults—a transient phenomenon? Results from a longitudinal community study. *Drug Alcohol Depend.* 66, 147–159.
- Warner, L.A., Kessler, R.C., Hughes, M., Anthony, J.C., Nelson, C.B., 1995. Prevalence and correlates of drug use and dependence in the United States: results from the National Comorbidity Survey. *Arch. Gen. Psychiatry* 52, 219–229.
- Wilkins, C., Bhatta, K., Pledger, M., Casswell, S., 2003. Ecstasy use in New Zealand: findings from the 1998 and 2001 National Drug Surveys. *N.Z. Med. J.* 116, U383.
- Winters, K.C., Stinchfield, R.D., Henly, G.A., Schwartz, R.H., 1990–1991. Validity of adolescent self-report of alcohol and other drug involvement. *Int. J. Addict.* 25, 1379–1395.
- Wu, L.T., Pilowsky, D.J., Schlenger, W.E., 2005. High prevalence of substance use disorders among adolescents who use marijuana and inhalants. *Drug Alcohol Depend.* 78, 23–32.
- Wu, L.T., Pilowsky, D.J., Schlenger, W.E., 2004. Inhalant abuse and dependence among adolescents in the United States. *J. Am. Acad. Child Adolesc. Psychiatry* 43, 1206–1214.
- Wu, L.T., Schlenger, W.E., 2003. Psychostimulant dependence in a community sample. *Subst. Use Misuse* 38, 221–248.
- Wu, L.T., Schlenger, W.E., Galvin, D.M., 2003. The relationship between employment and substance use among students aged 12 to 17. *J. Adolesc. Health* 32, 5–15.
- Yacobian Jr., G.S., Arria, A.M., Fost, E., Wish, E.D., 2002. Estimating the prevalence of Ecstasy use among juvenile offenders. *J. Psychoactive Drugs* 34, 209–213.
- Yamaguchi, K., Kandel, D.B., 1984. Patterns of drug use from adolescence to young adulthood. II. Sequences of progression. *Am. J. Public Health* 74, 668–672.
- Yen, C.F., 2004. Relationship between methamphetamine use and risky sexual behavior in adolescents. *Kaohsiung J. Med. Sci.* 20, 160–165.
- Zacny, J., Bigelow, G., Compton, P., Foley, K., Iguchi, M., Sannerud, C., 2003. College on Problems of Drug Dependence taskforce on prescription opioid non-medical use and abuse: position statement. *Drug Alcohol Depend.* 69, 215–232.
- Zacny, J.P., Galinkin, J.L., 1999. Psychotropic drugs used in anesthesia practice: abuse liability and epidemiology of abuse. *Anesthesiology* 90, 269–288.