The high prevalence of substance use disorders among recent MDMA users compared with other drug users: Implications for intervention

Li-Tzy Wu, Andy C. Parrott, Christopher L. Ringwalt, Ashwin A. Patkar, Paolo Mannelli, Dan G. Blazer

Introduction

The use of MDMA (3,4-methylenedioxymethamphetamine; ecstasy) is a growing public health concern due to its increasing use, association with polysubstance use, various health consequences, and potential neurotoxic effects on the human brain (Johnston, O'Malley, Bachman, & Schulenberg, 2007a; Maxwell, 2005; Parrott, 2006, 2007). MDMA's reported associations with polysubstance use, as well as its likely negative effects, have important implications for prevention and treatment. It is, however, uncertain whether MDMA users should be targeted for focused interventions to reduce the adverse consequences of polysubstance use. Little is presently known about the extent to which MDMA users are characterized by a severe pattern of substance abuse and whether early case finding and interventions with this population are warranted. Given the recent increase in MDMA use among adults (Substance Abuse and Mental Health Services Administration [SAMHSA], 2007), better understanding of the prevention and treatment needs of this population is needed.

1. Introduction

The use of MDMA (3,4-methylenedioxymethamphetamine; ecstasy) is a growing public health concern due to its increasing use, association with polysubstance use, various health consequences, and potential neurotoxic effects on the human brain (Johnston, O'Malley, Bachman, & Schulenberg, 2007a; Maxwell, 2005; Parrott, 2006, 2007). MDMA's reported associations with polysubstance use, as well as its likely negative effects, have important implications for prevention and treatment. It is, however, uncertain whether MDMA users should be targeted for focused interventions to reduce the adverse consequences of polysubstance use. Little is presently known about the extent to which MDMA users are characterized by a severe pattern of substance abuse and whether early case finding and interventions with this population are warranted. Given the recent increase in MDMA use among adults (Substance Abuse and Mental Health Services Administration [SAMHSA], 2007), better understanding of the prevention and treatment needs of this population is needed.

In the United States, MDMA is commonly known as one of several “club drugs” (e.g., MDMA/ecstasy, methamphetamine, d-lysergic acid diethylamide or LSD, gamma-hydroxybutyrate or GHB, and ketamine) (Wu, Schlenger, & Galvin, 2006). In the 1990s, the drug appeared to be used predominantly by whites and party or club participants (Koesters, Rogers, & Rajasingham, 2002; Maxwell, 2005), but MDMA use later spread to nonwhite groups (e.g., Hispanics and blacks) and non-club settings (Maxwell, 2005). National surveys of Americans show a significant upsurge in MDMA use during the late 1990s and early 2000s (Johnston, O'Malley, Bachman, & Schulenberg, 2007b; SAMHSA, 2007). Nationally, rates of MDMA-related mortality and admissions to emergency departments also increased substantially from 1994 to 2001 (Patel, Wright, Ratcliff, & Miller, 2004; SAMHSA, 2002). Probably due to increased reports of MDMA-related health consequences and mortality, its use had declined since then. However, the 2006 and 2007 Monitoring the Future surveys indicate that MDMA is the only illicit drug currently demonstrating evidence of an increase in use and a concomitant decline in perceptions of associated risks (Johnston et al., 2007a,b). Similarly, the 2006 National Survey on Drug Use and Health (NSDUH) reports that the number of new past-year MDMA users increased substantially from approximately 642,000 in 2003 to 860,000 in 2006 (SAMHSA, 2007).
Epidemiological studies suggest that MDMA users are also likely to use cigarettes, alcohol, and other drugs (Carlson, Wang, Falck, & Siegal, 2005; Parrott, 2001, 2007; Strote, Lee, & Wechsler, 2002; Topp, Hando, Dillon, Roche, & Solowij, 1999; Wu et al., 2006). The 2002 NSDUH showed that the majority of past-year MDMA users reported a history of use of alcohol (99%), marijuana (98%), prescription opioids (63%), cocaine (57%), and inhalants (45%) (Wu et al., 2006). Another study of a purposive sample of 402 MDMA users recruited from Ohio (Carlson et al., 2005) also reported a high prevalence of use of other substances: alcohol (100%), marijuana (99%), cigarettes (91%), prescription opioids (80%), cocaine (63%), and inhalants (58%). In Australia, similarly high rates of history of polysubstance use have been observed among MDMA users (Topp et al., 1999).

Despite the widely reported concern over polysubstance use by MDMA users and its potential influence on functional deficits and structural changes to the brain (Parrott, 2006; Reneman, de Win, van den Brink, Booij, & den Heetem, 2006), the extent of specific current substance use disorders (SUDs) among MDMA users is unknown. Previous studies have focused mainly on substance use per se (e.g., Carlson et al., 2005; Parrott, 2001; Strote et al., 2002; Scholey et al., 2004; Topp et al., 1999; Wu et al., 2006)—a crude measure that provides limited information concerning the intensity and magnitude of problems related to the use of specific substances among MDMA users. As a result, there is limited information concerning whether MDMA users actually constitute a unique group of polysubstance abusers who are distinct from users of other drugs and whether MDMA users may be particularly adversely affected by the concomitant abuse of other substances (Carlson et al., 2005) also reported a high prevalence of use of other substances: alcohol (100%), marijuana (99%), cigarettes (91%), prescription opioids (80%), cocaine (63%), and inhalants (58%). In Australia, similarly high rates of history of polysubstance use have been observed among MDMA users (Topp et al., 1999).

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The 2006 NSDUH is the most recent year available and demonstrates the significant upsurge in MDMA use among adults (SAMHSA, 2007). This study is based on data from adult respondents contained in the national representative sample of American adults aged 18 years or older. The focus on adults is based on the findings that the vast majority (70%) of new MDMA users are aged 18 years or older (SAMHSA, 2007). We examine past-year measures of SUDS and MDMA use because they are indicators of recent or active use and because the information they provide is highly relevant to the design of early intervention and prevention programs, as well as selecting MDMA users for clinical research.

In this study, we investigate the 12-month prevalence of specific Diagnostic and Statistical Manual of Mental Disorders (DSM-IV SUDs (American Psychiatric Association, 2000) and their associations with MDMA use within the context of a nationally representative sample of American adults aged 18 years or older. The survey design and data collection procedures and protections were carefully administered. The NSDUH survey uses computer-assisted interviewing (CAI) methods to increase the validity of respondents’ reports of substance use and sensitive behaviors (Turner et al., 1998). The CAI methodology includes a combination of computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI) methodologies. Demographic items were administered by the field interviewer via CAPI. The interview then was conducted via ACASI, which provided respondents with a highly private and confidential setting in which to answer sensitive questions (e.g., about their use of alcohol and other drugs). This mode, questions were displayed on a computer screen and administered orally through headphones to respondents, who then entered responses directly into a laptop computer.

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## 2. Methods

### 2.1. Study sample

This study is based on data from adult respondents contained in the public use file of the 2006 NSDUH (SAMHSA, 2007). NSDUH is the only ongoing survey that provides population estimates of substance use, SUDs, and health in the U.S. population. The survey’s sampling frame covers approximately 98% of the total U.S. population aged 12 years or older and uses multistage area probability sampling methods to select a representative sample of the civilian noninstitutionalized population. Participants include household residents; residents of shelters, rooming houses, and group homes; residents of Alaska and Hawaii; and civilians residing on military bases. To increase the accuracy of drug use estimates, young adults aged 18–25 years are oversampled.

Participants were interviewed in private at their places of residence. They were assured that their names would not be recorded and that their responses would be kept strictly confidential. All field interviewers signed a confidentiality agreement, and consent forms that explained data collection procedures and protections were carefully administered.

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### 2.2. Study variables

NSDUH assesses nine categories of drug use, including the use of marijuana/hashish, cocaine/crack, inhalants, heroin, and hallucinogens (including MDMA, LSD, phencyclidine or PCP, peyote, mescaline, or psilocybin), as well as non-medical use of prescription pain relievers/opioids, stimulants/amphetamines, sedatives, and tranquilizers. Assessments include a detailed verbal description of each drug group, lists of qualifying drugs, and history of use. The survey defines non-medical use as any self-reported use of prescription drugs (pain relievers/opioids, stimulants, sedatives, and tranquilizers) that were not prescribed for the respondent or that the respondent took only for the experience or feeling they caused.

History of MDMA use was assessed by the question “Have you ever used ‘Ecstasy,’ also called MDMA?” This question is almost identical to the question used by the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) (National Institute on Alcohol Abuse and Alcoholism, 2007), but only 129 respondents reported that they were past-year MDMA users in NESARC, which precluded our...
analysis of the NESARC dataset for our present purposes. Respondents also reported age of first use (onset) and any MDMA use within the 12 months preceding the interview (past-year MDMA use). Use of MDMA prior to the past 12 months was defined as former MDMA use. We created four mutually exclusive groups of past-year drug users: 1) recent (past-year) MDMA users regardless of whether they used other drugs; 2) former MDMA users who reported use of drugs other than MDMA in the past year; 3) other drug users who reported past-year use of drugs other than MDMA; and 4) non-drug users who had not used any drug within the past 12 months. Age of onset of MDMA use was categorized into three groups: before age 18 (adolescence), 18–22 years (college years as defined by NSDUH), and 23 years or older (after-college years).

Self-reported past-year use of cigarettes and alcohol was dichotomized. Past-year SUDs (abuse or dependence as defined by the DSM-IV) (American Psychiatric Association, 2000) were dichotomized. The survey specifically assessed abuse or dependence of alcohol, inhalants, marijuana, cocaine/crack, hallucinogens, heroin, prescription pain relievers/opioids, sedatives, tranquilizers, and stimulants (e.g., SAMHSA, 2007; Wu, Ringwalt, Mannelli, & Patkar, 2008a,b). Diagnostic assessments were based on the questions used in the National Comorbidity Survey (NCS) (Kessler et al., 1994; Wu et al., 2004), and they had been revised and standardized to meet the DSM-IV criteria and to be used by NSDUH, which administered these structured questions to respondents through the ACASI method. Past-month nicotine dependence was defined as specified by the Nicotine Dependence Syndrome Scale (NDS) (Shiffman, Hickcox, Guys, Paty, & Kassel, 1995; Shiffman, Waters, & Hickcox, 2004) and the Fagerstrom Test of Nicotine Dependence (FTND) (Fagerstrom, 1978). Healtherton, Kolkowski, Frecker, & Fagerstrom, 1991). NDSS questions were designed to assess dependence similar to the concepts specified by the DSM-IV, while FTND focuses on its ability to discriminate between dependent smokers and non-dependent smokers by assessing how soon after waking that smokers have their first cigarette. To optimize the number of respondents who can be classified for current nicotine dependence, the NSDUH classifies respondents as having nicotine dependence in the past month if they meet criteria for dependence as specified either by the NDS or FTND (SAMHSA, 2007). A past-year measure of nicotine dependence was not available.

Based on previous studies, age of first drug use, history of polydrug use, anxiety disorder, and major depression were examined as potential confounders in the adjusted logistic regression analysis of SUDs in relation to MDMA use status (e.g., Grant & Dawson, 1998; Parrott, 2006; Wu et al., 2008a). Age of first drug use referred to the age of initiation of any of the nine drug classes assessed by the survey (inhalants, marijuana, cocaine/crack, heroin, hallucinogens, and nonmedical use of prescription pain relievers/opioids, sedatives, tranquilizers, and stimulants). History of polydrug use was measured by summing the number of these classes ever used by respondents. Self-reported past-year anxiety disorder was assessed by the question “Has a doctor or other medical professional ever told you that you had an anxiety disorder in the past 12 months?” A detailed DSM-IV assessment of anxiety disorder was not available. Questions assessing past-year major depressive episodes were based on DSM-IV criteria (American Psychiatric Association, 2000) and were adapted from the NCS-Replication (Kessler, Chiu, Demler, Merikangas, & Walters, 2005; SAMHSA, 2007).

We examined the following demographic variables: gender, age (18–25, 26–34, +35 years), race/ethnicity, educational level, current marital status, total annual family income, and population density of the area in which the respondent resided (large metropolitan with a population ≥1 million, small metropolitan with population <1 million, and non-metropolitan outside a standard metropolitan statistical area).

2.3. Data analysis

We first examined the demographic distributions and the prevalence of MDMA use among all adults (N = 36,965). Multinomial logistic regression procedures were conducted to determine the characteristics of the three mutually exclusive groups of past-year drug users: recent (past-year) MDMA users (regardless of the use of other drugs), former MDMA users (who had used other drugs in the past year), and other drug users (who had never used MDMA). We then generated the prevalence of SUDs and age of onset of first substance use by MDMA use status. Bivariate associations were assessed with chi-square tests for categorical variables and with F-tests for continuous variables.

Next, we conducted logistic regression procedures to compare the odds of each SUD across the three groups and the effects of age of MDMA onset on SUD. Each discrete logistic regression model was adjusted for gender, age, race/ethnicity, education, marital status, family income, population density, major depressive episode, anxiety disorder, age of first drug use, and history of polydrug use. All analyses were conducted with SUDAAN (Research Triangle Institute, 2006) to generate accurate standard errors for estimates presented. All estimates are weighted, while sample sizes presented are unweighted.
### 3. Results

#### 3.1. MDMA users vs. other drug users

Out of 36,965 adult respondents, approximately 14% reported drug use in the past year. We found that 0.8% of the sample comprised recent MDMA users who had used MDMA in the past year; 2.5% were former MDMA users who had used drugs other than MDMA in the past year, and 10.5% were other drug users who had never used MDMA (Table 1).

Compared with non-drug users, past-year drug users (irrespective of MDMA use) were more likely to be male, white, under age 35, and to report anxiety disorder and major depressive episodes (Table 2). There were also differences across groups. Compared with other drug users, recent and former MDMA users were younger and more likely to reside in large metropolitan areas. Recent MDMA users also were more likely to report anxiety disorders than were other drug users. Compared with former MDMA users, recent MDMA users were more likely to be younger, black, Asian/Pacific Islander/native Hawaiian, to reside in large metropolitan areas, and not to have attended college.

#### 3.2. Prevalence of SUDs and onset of substance use

As shown in Table 3, both recent (72%) and former (67%) MDMA users exhibited a higher prevalence of any SUD than did other drug users (50%). Recent MDMA users had the highest prevalence of disorders related to the use of alcohol (41%), marijuana (30%), cocaine (10%), pain relievers/opioids (8%), and tranquilizers (3%). Former MDMA users (39.5%) resembled recent MDMA users (39%) in their high prevalence of nicotine dependence; they also exhibited a higher prevalence of alcohol (32% vs. 24%) and marijuana (14% vs. 9%) use disorders than other drug users.

Both groups of MDMA users reported younger mean age of first use of several substances (alcohol, marijuana, pain relievers/opioids, cocaine, tranquilizers, and stimulants) than other drug users (Table 3). Recent MDMA users also reported a younger mean age of first use of pain relievers/opioids (18.7 vs. 20.2 years) and heroin (19.2 vs. 23.1 years) than former MDMA users.

#### 3.3. Odds ratios of SUDs

In Table 4, we summarize adjusted odds ratios of SUDs in relation to lifetime and age of first use of MDMA among past-year drug users. To determine the independent association of MDMA use with each SUD, we adjusted for potentially confounding variables in each discrete logistic regression model, including gender, age, race/ethnicity, education, marital status, family income, population density, major depressive episode, anxiety disorder, age of first drug use, and history of polydrug use. Inhalant, stimulant, sedative, and heroin use disorders were not associated with MDMA use from previous bivariate analyses, and each of their prevalence rates was low. Thus they are not reported in Table 4.

Compared with other drug users, recent MDMA users were twice as likely to meet criteria for any drug, marijuana, and pain reliever/opioid use disorders. They also were about twice as likely as former MDMA users to meet criteria for any drug, marijuana, cocaine, and tranquilizer use disorders. The analysis of the age of onset variable showed that, relative to drug users who had never used MDMA, those who initiated MDMA use before adulthood were more likely to report nicotine dependence and pain reliever/opioid use disorder. Onset of MDMA use at age 23 years or older also was associated with marijuana

<table>
<thead>
<tr>
<th>Multinomial logistic regression modela</th>
<th>Recent MDMA use vs. no drug use</th>
<th>AOR(95% CI)</th>
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<th>AOR(95% CI)</th>
<th>AOR(95% CI)</th>
<th>AOR(95% CI)</th>
<th>AOR(95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male vs. female</td>
<td>1.5 (1.2-2.0)b</td>
<td>2.3 (1.9-2.6)b</td>
<td>1.5 (1.7-2.0)b</td>
<td>0.9 (0.7-1.2)</td>
<td>1.3 (1.1-1.6)b</td>
<td>0.8 (0.6-1.0)</td>
</tr>
<tr>
<td>Age in years</td>
<td>18-25 vs. 35+</td>
<td>24.6 (12.4-48.9)b</td>
<td>5.3 (3.9-7.2)b</td>
<td>5.1 (2.2-12)b</td>
<td>8.7 (4.7-16.2)b</td>
<td>1.9 (1.4-2.7)b</td>
<td>4.4 (2.3-8.4)b</td>
</tr>
<tr>
<td>Family income</td>
<td>$0-$9,999 vs. $75 K+</td>
<td>11.7 (6.1-22.4)b</td>
<td>6.2 (4.6-8.4)b</td>
<td>1.9 (1.6-2.2)b</td>
<td>6.3 (3.4-11.3)b</td>
<td>6.2 (3.4-11.3)b</td>
<td>2.0 (1.0-3.9)b</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td>Asian/nat. Hawaiian vs. white</td>
<td>1.8 (0.5-6.6)</td>
<td>0.4 (0.1-12)</td>
<td>1.1 (0.7-17)</td>
<td>0.5 (0.2-0.2)</td>
<td>4.7 (1.0-23.5)</td>
<td>0.8 (0.5-13)</td>
</tr>
<tr>
<td>Education</td>
<td>High school vs. ≥ college</td>
<td>1.3 (0.9-1.9)</td>
<td>0.8 (0.6-0.9)</td>
<td>1.1 (1.0-14)</td>
<td>0.8 (0.6-0.9)</td>
<td>1.3 (1.0-14)</td>
<td>1.6 (1.2-2.4)</td>
</tr>
<tr>
<td>Current marital status</td>
<td>Married vs. single</td>
<td>0.3 (0.1-0.5)b</td>
<td>0.2 (0.1-0.3)b</td>
<td>0.4 (0.3-0.5)b</td>
<td>0.6 (0.3-1)</td>
<td>0.3 (0.1-0.3)b</td>
<td>0.6 (0.4-0.8)</td>
</tr>
<tr>
<td>Family income</td>
<td>Sep./div./wld. vs. single</td>
<td>0.5 (0.3-1)</td>
<td>0.6 (0.4-0.8)</td>
<td>0.7 (0.5-0.8)b</td>
<td>0.7 (0.4-1)</td>
<td>0.7 (0.5-0.8)b</td>
<td>0.8 (0.4-1)</td>
</tr>
<tr>
<td>Income</td>
<td>$0-$19,999 vs. $75 K+</td>
<td>1.4 (1.0-2)</td>
<td>1.0 (0.8-14)</td>
<td>1.2 (1.0-14)</td>
<td>0.9 (0.7-1)</td>
<td>1.3 (0.9-2)</td>
<td>0.9 (0.6-1)</td>
</tr>
<tr>
<td>Family income</td>
<td>$20 K-$39,999 vs. $75 K+</td>
<td>1.2 (0.7-19)</td>
<td>1.2 (1.0-16)</td>
<td>1.0 (0.8-11)</td>
<td>1.3 (1.0-18)</td>
<td>0.9 (0.5-16)</td>
<td>1.0 (0.6-15)</td>
</tr>
<tr>
<td>Family income</td>
<td>$40 K-$74,999 vs. $75 K+</td>
<td>1.1 (0.7-16)</td>
<td>1.0 (0.8-14)</td>
<td>1.0 (0.8-11)</td>
<td>1.1 (0.7-17)</td>
<td>1.1 (0.8-15)</td>
<td>1.0 (0.6-15)</td>
</tr>
<tr>
<td>Population density</td>
<td>Non-metro vs. large metro</td>
<td>0.7 (0.6-0.9)b</td>
<td>0.7 (0.5-0.8)b</td>
<td>0.6 (0.5-0.9)b</td>
<td>0.7 (0.6-0.9)b</td>
<td>0.7 (0.6-0.9)b</td>
<td>0.9 (0.7-13)</td>
</tr>
<tr>
<td>Anxiety disorder</td>
<td>Yes vs. no</td>
<td>3.0 (1.8-5.1)b</td>
<td>2.5 (1.7-3.5)b</td>
<td>2.0 (1.6-2.5)b</td>
<td>1.6 (1.0-2.5)b</td>
<td>1.2 (0.8-1.8)</td>
<td>1.1 (0.6-2.0)</td>
</tr>
<tr>
<td>Major depressive episode</td>
<td>Yes vs. no</td>
<td>3.0 (1.3-11)b</td>
<td>2.1 (1.7-2.5)b</td>
<td>2.1 (1.8-2.5)b</td>
<td>1.1 (0.8-1.7)</td>
<td>1.1 (0.8-1.4)</td>
<td>1.1 (0.7-19)</td>
</tr>
</tbody>
</table>

AOR = adjusted odds ratio; CI = confidence interval.

a The logistic regression model included all variables listed in the first column.

b p<0.05.
use disorders as compared with drug users who had never used MDMA.

4. Discussion

This study reports new findings on specific DSM-IV SUDs in a large nationally representative sample of adult MDMA users. In 2006, approximately one in seven adults reported drug use in the past year. Of these drug users, close to 6% had used MDMA in the past year, and approximately one in seven adults reported drug use in the past year.

Table 3

<table>
<thead>
<tr>
<th>Substance use disorders</th>
<th>Recent MDMA users</th>
<th>Former MDMA users</th>
<th>Other drug users</th>
<th>( \chi^2 (df) ) or F test p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>2.1 (1.1)</td>
<td>1.2 (0.8)</td>
<td>1.2 (0.8)</td>
<td>0.007</td>
</tr>
<tr>
<td>Cocaine/crack</td>
<td>3.3 (2.1)</td>
<td>2.1 (1.3)</td>
<td>2.1 (1.3)</td>
<td>0.007</td>
</tr>
<tr>
<td>Hallucinogens</td>
<td>4.3 (2.7)</td>
<td>2.2 (1.4)</td>
<td>2.2 (1.4)</td>
<td>0.007</td>
</tr>
<tr>
<td>Tranquilizers</td>
<td>1.2 (0.7)</td>
<td>0.8 (0.5)</td>
<td>0.8 (0.5)</td>
<td>0.007</td>
</tr>
<tr>
<td>Sedatives</td>
<td>1.0 (0.6)</td>
<td>0.5 (0.3)</td>
<td>0.5 (0.3)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

Note: The prevalence of stimulant, heroin, inhalant, and sedative use disorders was low; and each was not associated with MDMA use status.

Table 4

<table>
<thead>
<tr>
<th>Substance use disorders</th>
<th>Recent MDMA use vs. other drug use</th>
<th>Former MDMA use vs. other drug use</th>
<th>Recent MDMA use vs. former MDMA use</th>
<th>Age of first MDMA use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicotine</td>
<td>1.2 (0.9–1.5)</td>
<td>1.2 (1.0–1.5)</td>
<td>1.0 (0.7–1.4)</td>
<td>Before 18 vs. never used</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.2 (0.8–1.6)</td>
<td>0.8 (0.7–1.0)</td>
<td>1.0 (1.0–2.0)</td>
<td>18–22 vs. never used</td>
</tr>
<tr>
<td>Marijuana</td>
<td>2.4 (1.7–3.5)</td>
<td>1.1 (0.8–1.4)</td>
<td>2.2 (1.5–3.0)</td>
<td>23+ vs. never used</td>
</tr>
<tr>
<td>Cocaine/crack</td>
<td>1.6 (1.0–2.7)</td>
<td>0.9 (0.5–1.6)</td>
<td>1.8 (3.1–3.0)</td>
<td></td>
</tr>
<tr>
<td>Hallucinogens</td>
<td>5.8 (2.7–12.7)</td>
<td>0.5 (0.2–1.4)</td>
<td>12.0 (4.8–29.8)</td>
<td></td>
</tr>
<tr>
<td>Pain relievers/opioids</td>
<td>2.0 (1.2–3.2)</td>
<td>1.2 (0.8–1.9)</td>
<td>1.3 (0.8–2.3)</td>
<td></td>
</tr>
<tr>
<td>Tranquilizers</td>
<td>2.1 (0.9–4.7)</td>
<td>0.8 (0.4–1.7)</td>
<td>2.7 (1.2–5.8)</td>
<td></td>
</tr>
</tbody>
</table>

Note: The prevalence of stimulant, heroin, inhalant, and sedative use disorders was low; and each was not associated with MDMA use status.

Table 4

<table>
<thead>
<tr>
<th>Substance use disorders</th>
<th>Recent MDMA use status</th>
<th>Other drug users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicotine</td>
<td>1.2 (0.9–1.5)</td>
<td>1.2 (1.0–1.5)</td>
</tr>
<tr>
<td>Alcohol</td>
<td>1.2 (0.8–1.6)</td>
<td>0.8 (0.7–1.0)</td>
</tr>
<tr>
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<td>0.8 (0.4–1.7)</td>
</tr>
</tbody>
</table>

Notes:
- AOR = adjusted odds ratios; CI = confidence interval.
- \( \chi^2 (df) \) or F test p value.
- *p < 0.05.

MDMA users differ from drug users who had never used MDMA in a variety of demographic and mental health characteristics. Overall, MDMA users were more likely than other drug users to be young and meet criteria for marijuana and pain reliever/opioid use disorders, but they were also more likely than former MDMA users to meet criteria for marijuana, cocaine, and tranquilizer use disorders. This findings provide evidence that recent adult MDMA users constitute a uniquely vulnerable subgroup of polysubstance abusers who are likely to benefit from regular screening and referrals for problems related to substance abuse.

4.1. MDMA users are distinct from other drug users

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adults (<35 years), whites, and residents of large metropolitan areas. Recent MDMA users also exhibit higher odds of anxiety disorder than other drug users, which might be associated with their higher rates of SUDs and other pre-existing differences in psychopathology (Medina & Shear, 2007; Soar, Turner, & Parrott, 2006). The comparison between recent and former MDMA users further reveals that blacks, Asians/Pacific Islanders/native Hawaiians, and those who did not attend college might be at risk for using MDMA in the past year. Other reports also have found that MDMA use has spread from predominantly white users to non-white groups, including black adults (National Institute on Drug Abuse, 2006; Boeri, Sterk, & Elison, 2004).

4.2. Recent MDMA users have a particularly high rate of SUDs

This study’s most salient finding concerns the disturbingly high prevalence of SUDs among drug users in general and recent MDMA users in particular. More than seven in ten recent MDMA users and close to seven in ten former users of MDMA also reported an SUD. The high rates of SUDs among MDMA users are also consistent with our descriptive findings showing that MDMA users on average start consuming several substances earlier than other drug users. These findings not only are in line with the previously reported pervasiveness of substance use among MDMA users (Carlson et al., 2005; Parrott, 2001; Strote et al., 2002; Topp et al., 1999; Wu et al., 2006) but also help elucidate specific SUDs that disproportionately affect MDMA users. By employing logistic regression procedures to hold constant the potentially confounding influences of a variety of respondents’ characteristics and drug use patterns, recent MDMA users were found to be twice as likely as other drug users to manifest any drug, marijuana, and pain reliever/opioid use disorders, and they also found to be twice as likely as other drug users to manifest any drug, marijuana, and pain reliever/opioid use disorders, and they also be common risk factors (e.g., early behavior problems, delinquency, and personality traits) that co-occur early and influence each other to increase the risk of substance use and subsequent polysubstance abuse (Jessor, 1998; Newcomb & Felix-Ortiz, 1992; Alati et al., 2008). A recent longitudinal analysis shows that the association between early delinquency and later MDMA use appears to be explained, in part, by early alcohol or tobacco use (Alati et al., 2008).

Pharmacodynamic reasons may also account for the co-use of multiple drugs. Chronic tolerance often develops with MDMA, and this can lead to the use of other stimulants such as amphetamines or cocaine (Parrott, 2005; Scholey et al., 2004). Cross-tolerance may then become an issue, with dosage escalation likely across different stimulants. In such circumstances, the mono-stimulant user may escalate to a poly-stimulant user or even a problematic polydrug user (Parrott, Morinan, Moss, & Scholey, 2004). Another problem with MDMA is the recovery period afterwards, which is accompanied by feelings of lethargy and depression that can last for several days (Parrott, Lock, Conner, Kissling, & Thome, 2008). MDMA users often take marijuana or alcohol to relieve later discomfort associated with post-MDMA comedown (Winstock, Griffiths, & Stewart, 2001).

Drug users also may co-use multiple substances (i.e., alcohol, marijuana, stimulants, or opioids/heroin) with or without MDMA to either improve or modulate their subjective effects (Boys, Marsden, & Strang, 2001; Leri et al., 2003). Together, the present data confirm challenges related to the role played by polydrug use in studies of the adverse effects of MDMA use in humans. Clearly, longitudinal studies of large cohorts of young participants before their initiation of drug use are needed to better understand the neurotoxic consequences of MDMA use (Gouzoulis-Mayfrank & Daumann, 2006).

4.3. SUDs are not limited to early-onset MDMA users

This study also extends previously unaddressed questions by clarifying the association with SUDs by age of onset of MDMA use. Previous research indicates that adolescent onset of drug use confers a risk for SUDs (Grant & Dawson, 1998). In this study, early MDMA use (before adulthood) was associated moderately with only two SUDs (nicotine and pain reliever/opioid), which is likely to be explained by the finding that MDMA users on average initiate MDMA use at a later age (i.e., 21–22 years) than the average ages of initial use of most other substances. In addition, we found that onset of MDMA use at age 23 years or older was associated with marijuana use disorders. This finding may be explained by the possibility that MDMA often is used within the context of other substance use (Parrott, 2001). Adult-onset MDMA use therefore may reflect a serious pattern of substance use exhibited primarily by a subset of problematic drug users (i.e., marijuana abusers).

4.4. Pharmacodynamic reasons for polydrug use

There are several possible reasons for our finding concerning extensive polydrug use among drug users in general and MDMA users in particular. Research suggests that once individuals are exposed to drug use, they are likely to have additional opportunities to use other substances (Wilcox, Wagner, & Anthony, 2002); the use of multiple drugs can then become problematic or develop into a formal disorder. For example, the use of MDMA in dance clubs provides another social gateway into polydrug use, as the use of one drug at clubs leads to others—often through the same dealer (Parrott, 2004a). There may also be common risk factors (e.g., early behavior problems, delinquency, and personality traits) that co-occur early and influence each other to increase the risk of substance use and subsequent polysubstance abuse (Jessor, 1998; Newcomb & Felix-Ortiz, 1992; Alati et al., 2008). A recent longitudinal analysis shows that the association between early delinquency and later MDMA use appears to be explained, in part, by early alcohol or tobacco use (Alati et al., 2008).

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4.5. Study limitations and strengths

These findings are subject to several limitations. The cross-sectional design of the NSDUH precludes making inferences of causal relationships from our findings. In addition, the survey relies on respondents’ self-reports, which may be influenced by under-reporting and memory errors. Individuals who suffered severe consequences from MDMA use might not have been included in the sampling frame of this household survey or may otherwise have been unable to participate. Further, as with any other U.S. national survey, the NSDUH does not collect information concerning either the dosage or purity of MDMA tablets consumed, both of which may affect substance use patterns. Nonetheless, Parrott (2004b) reviewed the literature and concluded that MDMA impurity was predominantly a phenomenon of the 1990s. By the early 2000s, non-MDMA tablets had become rare, and high-dose MDMA tablets have been seen more frequently. Last, the assessment of anxiety disorder was assessed only in terms of overt medical diagnosis, which may be under-estimated. The NSDUH data also have noteworthy strengths. The very large sample represents the domiciled U.S. population aged 18 years and older, and the sample thus has a high degree of generalizability. Perhaps the most important characteristic of potentially productive MDMA research is a sample of sufficient size to support the comparison of specific SUDs between distinct groups of MDMA users and other drug users, which is precluded in smaller-scale studies. Additionally, the survey employs the most advanced technology available (i.e., computer-assisted self-interviewing) to increase
respondents’ reporting of socially stigmatized, illegal, or otherwise sensitive drug use behaviors (Turner et al., 1998).

4.6. Implications and conclusions

The disturbingly high prevalence SUDs among drug users in general and recent MDMA users in particular has important implications for intervention. Regular polysubstance users may suffer from the adverse and potentially multiplicative effects of multiple drugs. For instance, cognitive skills are impaired by either MDMA or marijuana use, but are impaired to a greater extent among marijuana-using MDMA users (Rodgers et al., 2003; Gouzoulis-Mayfrank et al., 2000). Similar interactive processes may underlie the use of MDMA in conjunction with nicotine or alcohol, in which case long-term psychobiological distress can be further increased (Parrott, 2006). Substance abuse can also cause long-term adverse effects on health, including cardiovascular disease, stroke, kidney and liver damage, cancer, HIV/AIDS, hepatitis, lung disease, mental disorders, and mortality (Brick, 2004). These results thus emphasize the need to screen recent drug users in health care settings for medical and psychiatric problems related to the use of a variety of substances and then to intervene as appropriate. Given the pervasiveness of their substance abuse, recent MDMA users may particularly benefit from targeted interventions or additional medical monitoring.


