

# Ecstasy and Drug Consumption Patterns: A Canadian Rave Population Study

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**Objective:** This study investigates the drug consumption patterns of a sample of rave attendees in the city of Montreal, Quebec, and seeks to identify the prevalence of 3,4-methylenedioxymethamphetamine (MDMA) and other drug use in this population.

**Method:** We administered a self-report questionnaire to 210 respondents. For various licit and illicit substances, participants reported their age of first use, number of lifetime uses, and usage in the previous 30 days.

**Results:** We found a significant rank order for the sequence of first use: 1) alcohol, 2) nicotine, 3) cannabis, 4) LSD, 5) psilocybin, 6) amphetamine, 7) cocaine, 8) MDMA, 9) gamma-hydroxybutyrate (GHB), 10) ephedrine, 11) ketamine. Alcohol and cannabis were the most commonly used substances, both in cumulative number of lifetime uses and in usage in the preceding 30 days. MDMA and amphetamine were also notable as the next 2 most popular drugs for use in the preceding 30 days and in terms of those who had tried the drugs at least once. We identified a progressive rank order of experimentation, with early alcohol or cannabis use (or both) associated with the early use of all other drugs tried by more than 25% of the sample. We found MDMA and amphetamine use to be prevalent, as was general experimentation with all drugs studied, other than heroin.

**Conclusion:** Drug consumption levels were substantial in this “rave” population, particularly with respect to recent use of MDMA, amphetamine, cannabis, and alcohol. Results also indicate that the sequence of drug experimentation in this population follows an identifiable pattern.

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## Clinical Implications

- This is the first study to identify the drug-use patterns and histories of individuals attending Canadian raves.
- A progression of drug use has been identified.
- These findings could be used to target specific at-risk individuals in prevention programs.

## Limitations

- This study relied on retrospective self-report data.
- The sample size was moderate.
- The sample was self-selected.

**Key Words:** *ecstasy, 3,4-methylenedioxymethamphetamine, MDMA, polydrug use, rave, alcohol, cannabis, amphetamine*

Beginning in the late 1980s, a new “rave” subculture emerged. It was characterized by all-night technodance parties and the use of illicit drugs, particularly 3,4-methylenedioxymethamphetamine (MDMA; also known as

“ecstasy,” “E,” “X,” and “XTC”). Originating in Great Britain, the trend for youth to attend these parties became strong in Canada around 1991 and has reportedly been growing exponentially ever since, as has an overall increase in MDMA use

(1,2). Despite these increases, very little is known about the overall drug-use patterns of individuals who attend raves and how these patterns relate to MDMA use.

MDMA is classified as an empathogen or enactogen (3) because the subjective experience has been described as intensely emotional and as creating the perception that one can experience the emotions of others (4). Users typically report the impression of feeling clear-headed, serene, euphoric, and sensual; significant visual illusions common to LSD and other psychedelics generally do not occur (4–6).

As recently as 1986, some physicians believed ecstasy to be a safe drug (7). However, recent research has revealed many negative effects associated with ecstasy use. Acute adverse effects include restlessness, ataxia, tremor, myoclonus, diarrhea, and the most severe side effect, hyperthermia (8). MDMA use has been associated with sudden death and cardiovascular collapse (9), with the most common cause of death being hyperthermia (10). The behavioural and environmental factors that often coexist with MDMA consumption (for example, concomitant ingestion of other illicit drugs and high ambient temperature) may increase the risk for severe adverse effects, particularly cardiovascular complications and hyperthermia. Prolonged exercise (for example, dancing), high ambient temperatures, and high humidity are typical in rave and club environments and are believed to potentiate the neurologic toxicity of MDMA (11,12). Indeed, in the US emergency room visits related to MDMA consumption have increased from 637 in 1997 to 1143 in 1998 (13).

The possible long-term consequences of MDMA use have also generated concern. It has been reported that repeated administration of MDMA in laboratory animals diminishes serotonin and dopamine levels and damages the nerve terminals from which serotonin is released, in a dose-related manner and with incomplete recovery (14–17). With some controversy, many researchers nonetheless regard animal studies on MDMA to be relevant to human use. For example, the finding that the loss of serotonergic (5-HT) axons in monkeys is greater than in rats given a fourfold greater dosage of MDMA has led some to conclude that MDMA is potentially far more neurotoxic in primates than in nonprimate mammals (18).

According to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), recent use is higher for ecstasy than for amphetamines and LSD (19). Although similar results have been reported in the US (20), very little is known about the patterns of MDMA consumption in Canada. While some general surveys have identified illicit drug-use patterns of high school students (21–24), university students (25,26),

and university athletes (27), none have targeted individuals who attend rave parties—individuals thought to be at greater risk for MDMA use.

The Centre for Addiction and Mental Health (CAMH) produced a study that surveyed 7800 university students across Canada (25). This study identified 10.2% of the population as using illicit drugs other than cannabis. Alcohol was noted as the drug of choice among university students, with 92% of the population having tried it at least once. Quebec students had the highest rate of both cannabis and alcohol use in the previous 12 months (28.7% and 88.3%, respectively). MDMA was reportedly used by 4% of the entire sample; in accordance with the EMCDDA study (19), this reveals the greatest prevalence for lifetime use, compared with drugs other than cigarettes, cannabis, or alcohol. Although the prevalence of ecstasy use might not appear to be salient, it comprises a substantial proportion of the 10.2% trying any drug other than alcohol or cannabis. Another series of surveys was conducted by Parent Resources Institute for Drug Education (PRIDE) every other year between 1987 and 1992. These studies surveyed students in grades 6 through 12 and found that 14.1% of the population used cannabis in 1991–1992, while 5.7% of the population used hallucinogens (21,22). While such surveys indicate the usage of an age group similar to that assumed to attend rave parties, a sequence of experimentation has yet to be identified in Canada. Australian and European studies have, however, identified the progression or patterns of drug use. The following drug-use sequence was found in a survey of 10 812 students in Norway (aged 14 to 17 years): 1) alcohol, 2) cigarettes, 3) cannabis, 4) amphetamines, 5) ecstasy, and 6) heroin (28). This study suggested that adolescents with a pattern of polydrug use have used ecstasy and that ecstasy is significantly associated with attendance at house parties and with subcultural music preferences. In Australia, studies of rave populations found that 90% of attendees had tried LSD, 76% had tried ecstasy, and 69% had tried amphetamine (29). The researchers noted that LSD is a possible sequential gateway drug to other substances and indicated the popularity of both ecstasy and amphetamines among rave attendees.

Our study aimed to delineate the drug consumption histories of those attending raves in Montreal, Canada, and to determine whether these are similar to the histories found elsewhere. In addition, we attempted to determine the popularity of MDMA in this group and to identify potential specific sequences of drug experimentation within samples of rave-attending individuals.

**Table 1 Drug consumption in Canadian youth attending raves**

Drug	Respondents ever using (%)	Age of first use Mean (SD)	Estimated number lifetime uses Mean (SD)	Users consuming in preceding 30 days (%)	Number of uses in preceding 30 days
Alcohol	89.5	14.1 (2.2)	361.2 (828.6)	69.7	9.3 (13.2)
Amphetamine	73.3	18.5 (3.1)	52.6 (268.3)	64.9	2.3 (2.0)
Cannabis	91.4	15.1 (2.6)	1088.4 (388.0)	67.7	23.6 (28.6)
Cocaine	34.8	18.6 (2.7)	23.2 (46.0)	27.4	2.0 (1.8)
Ephedrine	21.0	20.2 (3.6)	167.2 (667.5)	31.8	19.9 (38.6)
GHB	18.6	19.7 (2.8)	6.1 (18.22)	28.2	3.0 (5.7)
Heroin	3.8	19.6 (3.6)	43.3 (82.5)	0.0	0.0 (0.0)
Ketamine	13.8	20.2 (3.5)	5.5 (8.93)	34.5	1.2 (0.4)
LSD	56.2	16.3 (2.7)	63.6 (317.2)	12.7	1.7 (1.4)
MDMA	65.2	19.3 (3.4)	27.4 (52.3)	53.2	1.9 (1.9)
Nicotine	64.3	14.2 (2.3)	NA	NA	NA
Psilocybin	70.0	16.5 (2.9)	22.5 (48.1)	22.1	1.7 (0.8)

GHB = Gamma-hydroxybutyrate  
MDMA = 3,4-methylenedioxyamphetamine

## Method

Participants ( $n = 210$ ) were recruited from 3 different raves in Montreal, a bilingual metropolitan Canadian city ( $n = 48$ ,  $n = 64$ ,  $n = 98$ , respectively). The 3 events were all large-scale (3000 to 10 000 people) and held indoors at private venues. Events similar in size and type are frequently held in other large Canadian metropolitan areas. Subjects were randomly approached by 3 research associates and asked to complete an anonymous self-report questionnaire for a scientific investigation. Participants were informed that their responses would remain strictly confidential and that their participation was strictly voluntary. The questionnaire, conducted in both English and French, was based on an abbreviated version of the Addiction Severity Index (ASI) (30), modified to incorporate drug classes not included on the original index. At the first 2 events, participants were asked to identify age of first use, number of lifetime uses, and number of uses in the past 30 days for 11 different substances. Information was collected on alcohol, heroin, marijuana, amphetamine, ephedrine, cocaine, LSD, psilocybin, ketamine, gamma-hydroxybutyrate (GHB), and MDMA use. At the third rave, a question regarding the age of first use of nicotine was added to the survey.

## Results

Questionnaires were completed by 80 women (38.8%) and 126 men (61.2%), with 4 participants not indicating their sex. Statistical analyses were based on 11 of the drugs surveyed; we omitted heroin because only 8 respondents had used it. Participant ages ranged from 16 to 32 years (mean 21.4 years, SD 3.18). In all analyses, we considered sex and event attended; however, no significant interaction effects were found. Drug histories are summarized in Table 1.

### *Progression of Drug Use*

Average age of first use for alcohol was 14.05 years (SD 2.18,  $n = 188$ ), for cannabis 15.13 years (SD 2.59,  $n = 192$ ), and for nicotine 14.21 years (SD 2.34,  $n = 63$ ), which identified these drugs as potentially the first 3 steps in drug experimentation (see Table 1).

To accommodate the data that fit a block design with missing values, we used a univariate analysis of variance to calculate significant differences between the means of age of first use. We treated subjects independently to account for variability in the number of different drugs used by each participant. We found an overall significant difference between mean age of first use and the particular drug used ( $F = 60.125$ ,  $P < 0.001$ ). We then applied Bonferroni and Tukey honestly significant difference (HSD) contrasts to identify specific significant mean differences. We found significant mean differences with the following subsets, defined using harmonic mean sample sizes and an alpha level of 0.05: 1) alcohol, nicotine, and cannabis; 2) cannabis, LSD, and psilocybin; 3) amphetamine, cocaine, MDMA, GHB, ephedrine, and ketamine. Based on overall significance, a rank order for progression can be inferred, which indicates the following linear trend in progression of first use: 1) alcohol, 2) nicotine, 3) cannabis, 4) LSD, 5) psilocybin, 6) amphetamine, 7) cocaine, 8) MDMA, 9) GHB, 10) ephedrine, and 11) ketamine.

To test for linear and quadratic trends, we also applied a repeated-measures analysis of variance (ANOVA) to the data on drugs used by more than 25% of the sample. While this analysis yields results only for those subjects who used all the

listed substances ( $n = 44$ ), we found a similarly significant linear trend for the experimentation order: 1) alcohol, 2) cannabis, 3) LSD, 4) psilocybin, 5) amphetamine, 6) cocaine, 7) MDMA ( $F = 304.8$ ,  $P < 0.001$ ). To further delineate these trends, we employed a correlational analysis using the non-parametric Spearman's rho to account for monotonic relations between variables. We found significant positive correlations at the 0.01 level between the age of first use of alcohol and cannabis, cocaine, amphetamines, ephedrine, GHB, psilocybin, MDMA, nicotine, and LSD. As well, we found significant positive correlations between age of first use of cannabis and age of first use of all drugs except ketamine. After we applied a Bonferroni correction, significant relations were maintained for all except the alcohol-to-amphetamine, -ephedrine and -GHB correlations and the cannabis-to-GHB and -ephedrine relations.

#### *Total Number of Lifetime Uses*

Table 1 indicates the percentage of the subjects who had used each drug.

Although mean computations suggest the highest use for cannabis (mean 1088.4) and alcohol (mean 361.2), it is important to note that we did not collect lifetime estimates of tobacco consumption. When median scores are calculated to account for outliers in the data, alcohol (median 100) and cannabis (median 150) remain the most frequently used substances.

We conducted bivariate correlations using the nonparametric Spearman's rho to determine relations among the number of lifetime uses for different drug types. After we applied a Bonferroni statistical correction, we found significant relations ( $P < 0.01$ ) for the following groupings: alcohol lifetime use correlated with cannabis lifetime use; amphetamine lifetime use with MDMA lifetime use; cannabis lifetime use with psilocybin lifetime use; and LSD lifetime use with psilocybin lifetime use.

#### *Number of Uses in Preceding 30 Days*

Table 1 reports what percentage of subjects who had reported at least 1 use of a particular drug had used that drug in the preceding 30 days, as well as the mean number of uses for each drug during this time period. Listed in descending order according to percentage of recent recurrent users, the drugs rank as follows: alcohol, cannabis, amphetamine, MDMA, ketamine, ephedrine, GHB, psilocybin, and LSD.

Median scores were also considered, to account for extreme users. With these scores, cannabis is notable as the most frequently consumed drug during the preceding 30 days (median 15), followed by alcohol (median 5).

## **Discussion**

Our study sought to clarify the drug-consumption patterns of Montreal youth who attend raves. Research on this population suggests that rave attendees represent a significant proportion of illicit drug users. Our findings confirm that members of this group take greater quantities and experiment with a greater variety of substances than do their peers who do not attend raves (21–27).

To determine whether there was a general pattern of stepwise drug experimentation, we applied 2 different statistical analyses to the data. We identified the following progressive pattern: 1) alcohol, 2) nicotine, 3) cannabis, 4) LSD, 5) psilocybin, 6) amphetamine, 7) cocaine, 8) MDMA, 9) GHB, 10) ephedrine, and 11) ketamine. It is notable that the substances used by more than 10% but less than 25% of this population appeared as the last 3 in the sequence of experimentation. A similar study in Norway determined the following best-fit for the progression pattern: 1) alcohol, 2) cigarettes, 3) cannabis, 4) amphetamines 5) ecstasy, and 6) heroin (28). Despite the fact that this was a normal population survey, and questions on hallucinogen use were not incorporated, the overall similarities with our findings are striking.

The sample used alcohol and cannabis substantially. Overall, 89.5% of the subjects reported prior intoxication with alcohol, 69.7% of these in the past 30 days. Similarly, 91.4% of those surveyed reported having used cannabis, 67.7% of these in the previous 30 days. Interestingly, the early use of either substance was associated with an early use of cocaine, psilocybin, LSD, and MDMA, suggesting their potential as possible "gateway" drugs.

While MDMA was the third most commonly used drug in this sample, the age of first use appeared later (that is, 8th) in the drug experimentation sequence than had been anticipated. As well, the lifetime uses and uses in the preceding 30 days were also lower than had been expected. MDMA, however, is still among the most prevalent drugs consumed at raves. Indeed, the high prevalence of MDMA use found in this study is consistent with research findings in rave samples surveyed in Australia (76%) (29). Since rave events typically occur on weekends, however, occasion to take MDMA may be regarded as less frequent than occasion for consuming substances such as alcohol or cannabis.

The prevalence of amphetamine use, including both recent and overall consumption, was comparable to that of MDMA. It was the third most popular drug for use in the preceding 30 days: 47.6% of those surveyed reported amphetamine use,

slightly exceeding the 40% reporting MDMA use during this period. Further, while 73.3% of the overall sample reported ever using amphetamine, a comparable 75.2% reported MDMA lifetime use. These findings suggest that, in addition to MDMA, amphetamine should be examined as a primary drug used by rave populations.

The use of the hallucinogenic drugs LSD and psilocybin was also reported by a substantial portion of the sample (56.2% and 70%, respectively). Although participants reported initially experimenting with these drugs at a relatively early age, most users did not report consuming them in the preceding 30 days (22% reported psilocybin use, and 12.7% reported LSD use). These findings suggest that while the use of hallucinogenic drugs often precedes the consumption of drugs like MDMA and amphetamine, these drugs are seldom in active use by individuals attending raves. It is interesting to note that while the level of LSD use was positively associated with the level of psilocybin consumption, using these drugs did not reliably predict the subsequent level of MDMA or amphetamine use, suggesting a limited role for hallucinogens as gateway drugs in a rave population.

Several drugs, including ketamine, GHB, and ephedrine, did not surface as popular substances within this sample, each having been used by fewer than 25% of those surveyed. Nevertheless, approximately one-third of those who had experimented with these drugs had done so recently. It seems plausible that the apparent infrequent use of these 3 drugs is related to their late introduction into the typical sequence of drug experimentation.

Although this study identifies the drug-consumption patterns and histories of individuals who attend Montreal-area raves, it is appropriate to address some of the investigation's possible limitations. Because this study relied on retrospective recall, the accuracy of such reports might be questioned. However, it should be noted that the research question precludes prospective data collection and that the methods used are in accord with abundant published reports that use a similar methodology (for example, 27–29). In addition there are several indications that substance use self-report data can be both reliable and valid (for example, 30,31).

A second issue involves the degree to which this moderate sample can accurately reflect the drug-taking patterns of Montreal rave attendees in general. Because the participants were self-selected for this investigation, it is possible that they do not represent the group as a whole. Although we attempted to minimize this by administering questionnaires at 3 separate

events and found no significant differences among these subgroups, only a random sample of rave attendees would ensure the generalizability of these findings. Nevertheless, the present results are consistent with findings obtained from other samples of drug users (for example 28,29). As well, since an entire generation of ages was surveyed (range 16 to 32 years), this study potentially captured both long-term and relatively new partygoers.

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### Résumé : L'ecstasy et les modèles de consommation de drogues : une étude de la population canadienne des raves

**Objectif :** Cette étude examine les modèles de consommation de drogues d'un échantillon de participants à un rave à Montréal, au Québec, et cherche à déterminer la prévalence de la 3, 4 - méthylènedioxyamphétamine (MDA) et de l'utilisation d'autres drogues au sein de cette population.

**Méthode :** Nous avons administré un questionnaire d'auto-évaluation à 210 répondants. En ce qui concerne diverses substances légales et illégales, les participants ont déclaré l'âge de leur première utilisation, le nombre d'utilisations à vie, et l'utilisation dans les 30 jours précédents.

**Résultats :** Nous avons trouvé un rang significatif dans la séquence de première utilisation : 1) alcool, 2) nicotine, 3) cannabis, 4) LSD, 5) psilocybine, 6) amphétamine, 7) cocaïne, 8) MDA, 9) gamma-hydroxybutyrate (GHB), 10) éphédrine, 11) kétamine. L'alcool et le cannabis étaient les substances le plus fréquemment utilisées, tant en nombre cumulatif d'utilisations à vie qu'en nombre d'utilisations dans les 30 jours précédents. La MDA et l'amphétamine étaient également mentionnées comme étant les deux drogues dont l'utilisation venait en deuxième dans les 30 jours précédents et pour ceux qui avaient essayé les drogues au moins une fois. Nous avons repéré un ordre d'expérimentation progressif, soit une première utilisation d'alcool ou de cannabis (ou des deux) associée avec une première utilisation de toutes les autres drogues essayées par plus de 25 % de l'échantillon. Nous avons constaté la prévalence de l'utilisation de la MDA et de l'amphétamine, et de l'expérimentation générale de toutes les autres drogues à l'étude, autres que l'héroïne.

**Conclusion :** Les niveaux de consommation de drogues étaient substantiels chez cette population de « rave », en particulier en ce qui concerne l'utilisation récente de MDA, d'amphétamine, de cannabis et d'alcool. Les résultats indiquent également que la séquence d'expérimentation des drogues chez cette population est conforme à un modèle identifiable.