Published in final edited form as:
Drug Alcohol Depend. 2010 January 15; 106(2-3): 193. doi:10.1016/j.drugalcdep.2009.08.020.

Factors Associated with Initiation of Ecstasy Use among US Adolescents: Findings from a National Survey

Ping Wu[1,2,3], **Xinhua Liu**[2], and **Bin Fan**[3]

[1] College of Physicians and Surgeons, Unit 43, Columbia University, New York, NY, 10032, USA

[2] Mailman School of Public Health, Columbia University, New York, NY, 10032, USA

[3] New York State Psychiatric Institute, New York, NY, 10032, USA

Abstract

Aims—To investigate adolescent pathways to ecstasy use by (1) examining how early onsets of smoking, drinking, and marijuana use are related to a child's risk of initiation of ecstasy use and (2) assessing the influence of other individual and parental factors on ecstasy use initiation.

Methods—Data on 6,426 adolescents (12–17 years old at baseline) from the National Survey of Parents and Youth (NSPY), a longitudinal, nationally-representative household survey of youth and their parents, were used in the analyses. Information on youth substance use, including ecstasy use, as well as familial and parental characteristics, was available.

Results—Initiation of ecstasy use is predicted by an adolescent's early initiation of smoking, drinking, or marijuana use. In particular, early initiation either of marijuana use, or of both smoking and drinking, increases a child's risk for ecstasy use initiation. Among the familial and parental variables, parent drug use emerged as significantly predictive of child initiation of ecstasy use; living with both parents and close parental monitoring, on the other hand, are negatively associated with ecstasy use initiation, and may be protective against it. At the individual level, sensation seeking tendencies and positive attitudes toward substance use, as well as close associations with deviant peers, are predictive of adolescent initiation of ecstasy use.

Conclusion—Our findings on the risk and protective factors for initiation of ecstasy use, especially with regard to factors that are modifiable, will be useful for prevention programs targeting youth use not only of ecstasy, but also of other drugs.

Keywords

Adolescents; Ecstasy; Marijuana; Alcohol; Tobacco; Risk Factors

1. Introduction

The results of a recent national community survey indicate that in 2007 there were more than 12 million people in the United States who had used ecstasy (MDMA) at least once (SAMHSA, 2008). Although the drug's overall popularity had been declining since its peak in 2000–2002, recent increases had been seen in rates of ecstasy use, and initiation of use, among adolescents (SAMHSA, 2006; SAMHSA, 2008).

There is increasing evidence that ecstasy use, especially if it is heavy use, can be neurotoxic to human beings, leading to deficits in memory and verbal fluency (Cowan et al., 2009; Gouzoulis-Mayfrank and Daumann, 2006; Montgomery and Fisk, 2008; NIDA, 2004; Rogers et al., 2009). It has also been found to lead, at least in the short term, to sleep disturbances and lowered immune function (Connor, 2004; Parrott, 2006; Schierenbeck et al., 2008). Deaths clearly linked to ecstasy use, usually resulting from hyperthermia, have also occasionally been reported (Rogers et al., 2009). Ecstasy users have also been found to frequently suffer from symptoms of ecstasy abuse and dependence (Cottler et al., 2001; Scheier et al., 2008; Yen and Hsu, 2007). Ecstasy users under 18 years of age are likely to be especially vulnerable to the drug's potential neurotoxic effects (Buchert et al., 2001). Thus, it is important to better understand adolescents' patterns of ecstasy use and the risk and protective factors associated with use, particularly those affecting onset of ecstasy use.

Gateway theory has been used to understand how adolescents initiate, and progress in, the use of various drugs (Fergusson et al., 2006; Kandel, 2002; Macleod et al., 2004). In the United States, adolescent substance use progression has generally been found to begin with the use of tobacco or alcohol before proceeding to the use of marijuana and other illicit drugs. Studies of adolescent ecstasy use have also found that marijuana use is predictive of initiation of ecstasy use (Martins et al., 2006; Zimmermann et al., 2005). The current study examines the specific roles, not only of marijuana use, but also of tobacco and alcohol use, in the onset of ecstasy use.

In addition to previous substance use, many other factors may affect an adolescent's substance use progression. As emphasized by Problem Behavior Theory, a multiplicity of social, psychological, and other factors may affect an adolescent's level of involvement in drug use and other problematic behaviors (Donovan et al., 1999; Jessor, 1991). For example, adolescents' personal inclinations towards risk-taking, and associations with peers and adults engaged in deviant activities, have been found to increase the risk that the adolescent will also engage in such activities; family cohesion and adolescents' involvement in conventional social activities such as church attendance have, on the other hand, been found to be protective against the development of deviant behaviors (Jessor, 1991).

With regard to ecstasy use specifically, previous studies have examined its associations with socio-demographic and other family- and individual-level factors (Martins and Alexandre, 2009; Martins et al., 2007; Martins et al., 2008; Puente et al., 2008; Singer et al., 2004). It has been found to be positively related to older age (Zimmermann, 2005; Martins, 2007), being White (Martins, 2007, 2009), having a low income (Martins, 2007), and having positive attitudes toward drug use (Martins 2008). With regard to adolescent drug use in general, other family- and individual-level risk and protective factors that have been identified in previous studies include family structure, parental drug use, and parenting practices, as well as child sensation seeking, peer deviance and religiosity (Kaminer, 1994). These factors, then, should be taken into account in studies on ecstasy use initiation.

The current study, using data from a longitudinal survey, examines (1) how early onset of smoking, drinking, and/or marijuana use relates to an adolescent's risk of initiation of ecstasy use; (2) how individual and parental factors affect an adolescent's risk of ecstasy use initiation; and (3) the nature of adolescents' pathways to ecstasy use.

2. Methods

2.1. Study Design

The NSPY is a longitudinal household survey of youth and their parents, designed to evaluate the impact of the National Youth Anti-Drug Media Campaign sponsored by the Office of

National Drug Control Policy. It was conducted by Westat under contract to the National Institute on Drug Abuse. The survey includes questions about drug use behaviors and about other factors related to substance abuse (Westat, 2004). NSPY's sample is nationally representative and consists of approximately 8,117 children and youth who were 9–17 years of age at baseline. Interviews with youth 12 and older included questions on use and abuse of drugs. For a total of 6,426 youth ages 12 and over, interviews with both youth and parent were completed; this subsample was used in our analyses. The adolescents who were included in the study did not differ from those who were excluded with regard to race/ethnicity, family income, or family structure; boys were, however, a slightly higher proportion of those included in the study (51.1%) than of those who were excluded (48.5%). The study was conducted in full compliance with the institutional review boards of the New York State Psychiatric Institute.

There were four rounds of data collection from November 1999 to June 2004. Data were collected using computer-assisted interview (CAPI) and audio computer assisted self interview (ACASI) technology. A broad range of information was collected from each parent-youth pair concerning the youth's attitudes towards drug use, drug use behaviors, exposure to drug prevention activities and to the anti-drug media campaign, and the characteristics of the youth's friends, and about the parent's awareness regarding youth drug use and related behaviors, as well as parent-child interactions related to drug use. Details of the survey's study design and procedures are reported elsewhere (Westat, 2004).

2.2. Measures used in this study

Adolescent use of ecstasy (youth report)—Information from all four waves of data was used to create the outcome variable of age at onset of ecstasy use. At each wave, adolescent respondents (ages 12–18) were asked if they had ever used ecstasy, and if so, whether they had most recently used it "during the last 30 days," "more than 30 days ago, but within the last 12 months" or "more than 12 months ago." For this study, information from all 4 waves was used to identify the subgroup of adolescents who tried ecstasy at any time up to the end of the survey period. For the members of this ecstasy user group, age at onset of ecstasy use was then estimated on the basis of the information available from the survey. For example, for a respondent who reported no lifetime ecstasy use at baseline, but who, in the second wave of the survey, did report use, initiation of use was assumed to have taken place between the respondent's first and second interviews. However, for a respondent reporting, at the time of the baseline interview, having already used ecstasy, and stating that his/her last use took place more than 12 months before the interview, the precise age of onset could not be determined, but its left-censored value (Turnbull, 1976) was one year less than the adolescent's age at the time of the baseline interview.

Demographic factors (youth report)—Information on the child's age, gender, and race/ethnicity was obtained in the child interview.

Family variables (parent report)—Information on the parent's level of education, household annual income, and the structure of the family, was obtained in the parent interview. Parents were asked to report the highest grade or level of schooling they had completed; they then were divided into four groups: college degree, some college, high school diploma, and less than high school. The household income variable had 4 categories: under $14,999, $15,000 to $34,999, $35,999 to $74,000, $75,000 and more. For family structure, a dummy variable was created, coded 1 if the child was living in a two-parent household, and 0 otherwise.

Parental drug use (parent report)—At baseline, parents were also asked if they had ever used marijuana, and if they had ever used any other illicit drugs such as inhalants, cocaine,

heroin, hallucinogens, methamphetamine, or speed. The dichotomous parental drug use variable was coded affirmatively if the parent reported any lifetime illicit drug use.

Parental Monitoring (parent report)—The parental monitoring variable is based on three survey questions regarding (1) how often a child's parent(s) know what the child is doing when he/she is away from home; (2) how often a child's parent(s) know the child's plan for the coming day and (3) how often the child hangs out with friends without having adults around. Each question has 5 response options ranging from 1 for "strongly disagree" to 5 for "strongly agree". The coding for the last question was reversed, and the mean for the three items obtained. A high score indicates close monitoring.

Adolescent use of tobacco, alcohol, and marijuana (youth report)—At each wave adolescents were asked about their use of tobacco, alcohol, and marijuana, including the age at which they had first used that substance. Age 12 was the median age of onset for both smoking and drinking, for the adolescent smokers and drinkers in this sample; for marijuana use, the median age of onset was 13. For the purposes of our analyses, three binary variables were created: smoked before age 12, drank before age 12, and used marijuana before age 12. The age 12 cut-off point was selected based on information from previous national surveys indicating that very few adolescent ecstasy users report having initiated use before age 12. Thus, onsets of alcohol, cigarette, and marijuana use that take place when a child is less than 12 years old will almost always occur before any ecstasy use.

We also created a summary measure dividing adolescents into five groups according to the level of substance use initiated before age 12: (1) those who had not begun using any of the three substances before the age of 12 (the reference group), (2) those who began smoking, but did not initiate use of any other substance, before age 12, (3) those who began drinking, but did not initiate use of any other substance, before age 12, (4) those who initiated both smoking and drinking before age 12, and (5) those who initiated marijuana use before age 12. This summary variable was constructed using a Guttman scale (Windle et al., 1991). For example, if an adolescent had initiated marijuana use before age 12, he or she was placed in the last group regardless of his or her age at onset of smoking and/or drinking. The creation of this scale-based measure was guided by gateway theory's perspectives on progression of substance use in adolescents (Kandel et al., 1992) taking into account the fact that most young substance users begin using legal substances (cigarettes or alcohol) before progressing to use of illicit drugs (Kandel et al., 1992).

Adolescent Attitude towards Substance Use (youth report)—At baseline, adolescents were asked about their attitudes concerning a person who tries marijuana once or twice. There were five response options: strongly disapprove, disapprove, neither approve nor disapprove, approve, and strongly approve. The last two categories were combined to create a dummy variable: "Positive attitude towards marijuana use".

Adolescent sensation seeking (youth report)—This is a Likert-type scale consisting of four items: "I would like to explore strange places;" "I like to do frightening things;" "I like new and exciting experiences, even if I have to break the rules;" and "I prefer friends who are exciting and unpredictable." Each item has five response options ranging from 1 for "strongly disagree" to 5 for "strongly agree". The summary score is based on the mean of the four items.

Peer deviance (youth report)—This is a Likert-type scale consisting of four questions regarding how many times, in the 7 days prior to the interview, the child got together with friends who "get into trouble a lot;" "fight a lot;" "take things that do not belong to them;" or "smoke cigarettes or chew tobacco." Each item has 7 response options ranging from 0 for

"never" to 6 for "more than 7 times". The mean of the four items is the score which is used in the analyses. A high score indicates that the child has close associations with deviant peers.

Adolescent religious attendance (youth report)—At baseline, adolescents were asked how often they attended religious services. The response options included never, rarely, 1–3 times a month, and about once a week or more often. For the purposes of the analyses they were divided into three groups: never attenders, infrequent attenders (less than once a month), and frequent (at least monthly) attenders.

2.3. Statistical analysis

Summary statistics were obtained to describe the study sample. The main outcome variable was the child's age at initial use of ecstasy. The variable is considered to be right censored by the adolescent's age at the time of the last round of data collection, for those adolescents not reporting any ecstasy use up to that time. For the ecstasy users, the variable was completely observed if the exact age of onset of ecstasy use was reported, but was left censored if the age of onset was only known to have occurred prior to a specified age. To estimate the distribution of age at onset of ecstasy use using all available data, including the censored data, we used Turnbull's (Turnbull, 1976) nonparametric maximum likelihood estimation method. The shape of the non-parametrically estimated cumulative distribution curve suggested that the distribution of age at onset of ecstasy use could be approximately described by a Weibull distribution. After examining the patterns of the non-parametrically estimated distribution curves for each of the socio-demographic variables and specific risk factors, we used a Weibull regression model with a single predictor, for age at onset of ecstasy use, to assess the bivariate association between the outcome and each of the predictors (Kabfleisch and Prentice, 2002).

To assess the simultaneous effects of several variables on age at onset of ecstasy use, we used Weibull regression models with multiple predictors. The independent variables included two demographic factors, i.e., adolescent gender and race/ethnicity, as well as all of the other variables that had been found to be significantly ($p<.05$) predictive, in the bivariate analyses, of age of onset of ecstasy use. Because Weibull regression models belong to the family of proportional hazards models, to aid interpretation we calculated, for each predictor, the hazard ratio for onset of ecstasy use for a one-unit change in the predictor, and 95% confidence intervals.

3. Results

3.1. Sample description

Table 1 shows that among the 6,426 adolescents aged 12 to 17 at baseline for whom both parent and child interview information is available, 52.1% were boys, 67.2% were non-Hispanic Whites, and 70.7% were living in two-parent households. Among the parents, about 13% had less than a high school education and about 12% had a low annual income (<$15K). More than half of the parents (55%) reported at least some lifetime drug use. Among the adolescents, about 6.7% had started smoking before age 12, 8.5% had started drinking before age 12, and 1.3% had started using marijuana before age 12. Adolescents tend to begin using legal substances (e.g. cigarettes or alcohol) before trying illicit drugs (Kandel, 2002). A five-category variable was created, representing the stages of substance use progression that our subjects had attained by age 12, for use in analyses examining the impact of patterns of early smoking, drinking, and marijuana use on adolescent initiation of ecstasy use. The results indicate that about 13% of the sample (N=837) had initiated use of at least one of the substances before age 12; 5.9% had initiated alcohol use only, 4.0% had begun smoking only, 1.8% had initiated both drinking and smoking, and 1.3% had begun using marijuana before age 12.

Among the 6,426 adolescents, about 4.7% (N=300) had used ecstasy by the last round of data collection. For 159 of these adolescents, full information was available regarding age of onset of use. For the remaining 141, the initial use of ecstasy was only known to have occurred prior to a specific age; thus, in the regression analyses this group was treated as having left-censored data. The estimated median age of onset of ecstasy use was 15.

3.2. Bivariate analyses

The findings of the bivariate analyses are shown in Table 1. Age at onset of ecstasy use was not found to be significantly associated with either of the demographic factors of gender and ethnic group, or with parental education or income. Living in a two-parent household, on the other hand, was negatively related to risk of ecstasy use initiation. Parental drug use was positively associated, and parental monitoring negatively associated, with risk of ecstasy use initiation. An early age of onset of use of any of the three listed substances (nicotine, alcohol, and marijuana) was associated with a greater risk of ecstasy use initiation. In addition, the risk of initiation increased with higher levels of general adolescent substance use involvement. For example, compared to those who had not used any substance before age 12, those who had begun smoking or drinking before age 12 were about twice as likely to initiate ecstasy use. Those who had started both smoking and drinking before age 12 had a fivefold higher risk of initiating ecstasy use, and for those who had begun using marijuana before age 12 it was tenfold higher. Other individual level risk factors that were found to be associated with an adolescent's age at initial ecstasy use include parental substance use, adolescent positive attitude towards marijuana use, sensation seeking, and peer deviance. Frequent involvement in religious activities appears to be protective against initiation of ecstasy use.

3.3. Regression analysis

A Weibull model with multiple predictors was used to examine the effects of those baseline factors that had emerged as significant predictors in the bivariate analyses. The substance use progression summary variable was used in the model, rather than the three separate variables measuring early onset of smoking, drinking, and marijuana use, to better understand the effects of general substance use progression on the onset of ecstasy use. Also, two demographic factors, i.e., gender and race/ethnicity, were included as controls even though the bivariate analyses had not found them to be significantly associated with age at initial ecstasy use. Compared to the adolescents who had not used alcohol, tobacco, or marijuana before age 12, those who had used alcohol only had a slightly higher but non-significant adjusted hazard ratio, while those who had used only tobacco before age 12 had a hazard ratio that was marginally significantly higher. In contrast, the hazard ratio for those with early use of both alcohol and tobacco was significantly higher, and those with early use of marijuana had the highest hazard of initiating ecstasy use. In addition, when child gender, race/ethnicity and other factors were controlled for, parental substance use, child positive attitude towards marijuana use, sensation seeking, and peer deviance were found to increase a child's risk for ecstasy use. Being from a two parent household, close parental monitoring, and frequent religious attendance, on the other hand, seemed to decrease the risk of ecstasy use initiation.

4. Discussion

Using data from a national longitudinal study of adolescents, this study examined initiation of ecstasy use among adolescents in relation to early onset of use of other substances, and to other associated risk and protective factors. The study's findings are of potential value to policy makers and clinicians, and to others who may be involved in prevention and intervention efforts.

Our findings on ecstasy use initiation are supportive of the findings of a number of previous studies that have been conducted under the guidance of gateway theory, regarding the role of adolescent alcohol, cigarette, and marijuana use in the development of use of other illicit drugs in general (Fergusson et al., 2006; Kandel, 2002; Kandel et al., 1992; Macleod et al., 2004). Similarly to previous studies, we found that early onset of marijuana use increases the risk of initiation of ecstasy use (Martins et al., 2006; Zimmermann et al., 2005). We also found that early use of the two major legal substances, tobacco and alcohol, in combination, raises the risk of initiation of ecstasy use. Programs that succeed in delaying the onset of use of substances such as tobacco, alcohol, and marijuana may thereby also help to delay the onset of ecstasy use.

Our findings also generally support Jessor's Problem Behavior Theory, which states that the risk and protective factors related to adolescent risk behavior are varied and may be classified into five conceptual domains, i.e., biology/genetics, social environment, perceived environment, personality, and behavior (Jessor, 1991). In our study, sensation seeking, an aspect of an adolescent's personality, was found, consistently with other studies (Martins et al., 2008; Puente et al., 2008), to be significantly predictive of adolescent ecstasy use. Two social environmental variables related to adolescents' family relationships, i.e., parental monitoring and living in a two-parent household, appeared to decrease adolescents' risks of ecstasy initiation, in findings that are consistent with previous studies of substance use in general (Kaminer, 1994) and of ecstasy use in particular (Martins et al., 2008; Singer et al., 2004). Peer deviance, also a social environmental variable, was found to be predictive of ecstasy use, while religious attendance, which Jessor has classified as a protective factor in the behavioral domain, decreased the risk of ecstasy initiation (Jessor, 1991).

Parental drug use history was also found to be predictive of ecstasy initiation. Although previous studies have documented the influence of parental drug use on children's substance use in general (Casswell et al., 1991; Donovan et al., 2004; Kaminer, 1994), our study is the first to show that parental drug use predicts child initiation of ecstasy use. In the absence of genetic data on the study subjects, however, we cannot ascertain the extent to which this finding may be an indicator of genetic transmission of characteristics that increase one's propensity to engage in drug use, or nongenetic social transmission, by parental role modeling or other means, of related attitudes and behaviors (Moffitt, 2005).

In terms of demographic factors, neither gender nor race/ethnicity was found, in our study, to be significantly associated with adolescent onset of ecstasy use. Previous studies' findings with regard to gender have been inconsistent, with some reporting more ecstasy use in young males (Singer et al., 2004; Zimmermann et al., 2005), and others reporting more use in young females (Martins and Alexandre, 2009). Our finding of no racial/ethnic difference in ecstasy use is consistent with those of Singer (Singer et al., 2004) and Zimmermann (Zimmermann et al., 2005), but inconsistent with some other studies where whites were found to be more likely to be ecstasy users compared to youth from other racial/ethnic groups, especially African Americans (Martins and Alexandre, 2009; Martins et al., 2007).

Because many adolescent ecstasy users eventually may use multiple drugs or develop drug abuse/dependence, our findings on the risk factors for ecstasy use, especially those that are modifiable, and on the related protective factors, can inform prevention programs targeting youth use not only of ecstasy, but also of other drugs.

4.1. Limitations

The study is limited by being based on an existing dataset which does not offer information on some factors, such as adolescent psychiatric problems, that have been found to be closely related to youth substance use (Wu, 2006, Wu, 2007, Wu, 2008; Kaminer, 1994). Also, for

subjects who had already begun using ecstasy by the time of the baseline interview, only incomplete (left-censored) data on their ecstasy use ages of onset were available. By including in the regression analyses observations that were treated as left-censored, the statistical power of the analyses may have been reduced. Also, because use of only a few types of substances was covered in the survey's interviews, the role of ecstasy use in the development of use of hard drugs, such as cocaine or heroin, could not be assessed.

However, because the NSPY survey was longitudinal and is nationally representative, with reports from both youth and their parents, the dataset did provide us with a unique opportunity to explore the risk and protective factors related to adolescent pathways to ecstasy use, and to produce findings which will assist in determining the optimum timing for preventive interventions, and in the development of prevention programs.

References

Buchert R, Obrocki J, Thomasius R, Vaterlein O, Petersen K, Jenicke L, Bohuslavizki KH, Clausen M. Long-term effects of 'ecstasy' abuse on the human brain studied by FDG PET. Nucl Med Commun 2001;22:889–897. [PubMed: 11473208]

Casswell S, Stewart J, Connolly G, Silva P. A longitudinal study of New Zealand children's experience with alcohol. British Journal of Addiction 1991;86:277–285. [PubMed: 2025690]

Connor TJ. Methylenedioxymethamphetamine (MDMA, 'Ecstasy'): a stressor on the immune system. Immunology 2004;111:357–367. [PubMed: 15056370]

Cottler LB, Womack SB, Compton WM, Ben-Abdallah A. Ecstasy abuse and dependence among adolescents and young adults: Applicability and reliability of DSM-IV criteria. Human Psychopharmacology: Clinical & Experimental 2001;16:599–606. [PubMed: 12404539]

Cowan RL, Joers JM, Dietrich MS. N-acetylaspartate (NAA) correlates inversely with cannabis use in a frontal language processing region of neocortex in MDMA (Ecstasy) polydrug users: a 3 T magnetic resonance spectroscopy study. Pharmacol Biochem Behav 2009;92:105–110. [PubMed: 19032963]

Donovan JE, Jessor R, Costa FM. Adolescent problem drinking: Stability of psychosocial and behavioral correlates across a generation. Journal of Studies on Alcohol 1999;60:352–361. [PubMed: 10371263]

Donovan JE, Leech SL, Zucker RA, Loveland-Cherry CJ, Jester JM, Fitzgerald HE, Puttler LI, Wong MM, Looman WS. Really underage drinkers: Alcohol use among elementary students. Alcoholism: Clinical and Experimental Research 2004;28:341–349.

Fergusson DM, Boden JM, Horwood L. Cannabis use and other illicit drug use: Testing the cannabis gateway hypothesis. Addiction 2006;101:556–569. [PubMed: 16548935]

Gouzoulis-Mayfrank E, Daumann J. The confounding problem of polydrug use in recreational ecstasy/MDMA users: a brief overview. Journal of Psychopharmacology 2006;20:188–193. [PubMed: 16510477]

Jessor R. Risk behavior in adolescence: A psychosocial framework for understanding and action. Journal of Adolescent Health 1991;12:597–605. [PubMed: 1799569]

Kabfleisch, JD.; Prentice, RL. The Statistical Analysis of Failure Time Data. John Wiley & Sons; New York: 2002.

Kaminer, Y. Adolescent substance abuse: A comprehensive guide to theory and practice. Plenum Medical Book Co; New York: 1994.

Kandel, DB. Stages and pathways of drug involvement: Examining the Gateway Hypothesis. 2002.

Kandel DB, Yamaguchi K, Chen K. Stages of progression in drug involvement from adolescence to adulthood: Further evidence for the gateway theory. Journal of Studies on Alcohol 1992;53:447–457. [PubMed: 1405637]

Macleod J, Oakes R, Copello A, Crome I, Egger M, Hickman M, Oppenkowski T, Stokes-Lampard H, Smith GD. Psychological and social sequelae of cannabis and other illicit drug use by young people: A systematic review of longitudinal, general population studies. Lancet 2004;363:1579–1588. [PubMed: 15145631]

Martins SS, Alexandre PK. The association of ecstasy use and academic achievement among adolescents in two U.S. national surveys. Addictive Behaviors 2009;34:9–16. [PubMed: 18778898]

Martins SS, Ghandour LA, Chilcoat HD. Pathways between ecstasy initiation and other drug use. Addictive Behaviors 2007;32:1511–1518. [PubMed: 17174036]

Martins SS, Mazzotti G, Chilcoat HD. Recent-onset ecstasy use: Association with deviant behaviors and psychiatric comorbidity. Experimental and Clinical Psychopharmacology 2006;14:275–286. [PubMed: 16893270]

Martins SS, Storr CL, Alexandre PK, Chilcoat HD. Adolescent ecstasy and other drug use in the National Survey of Parents and Youth: The role of sensation-seeking, parental monitoring and peer's drug use. Addictive Behaviors 2008;33:919–933. [PubMed: 18355973]

Moffitt TE. The New Look of Behavioral Genetics in Developmental Psychopathology: Gene-Environment Interplay in Antisocial Behaviors. Psychological Bulletin 2005;131:533–554. [PubMed: 16060801]

Montgomery C, Fisk JE. Ecstasy-related deficits in the updating component of executive processes. Hum 2008;23:495–511.

NIDA. MDMA (Ecstasy) Abuse. NIDA Research Report Series. 2004

Parrott AC. MDMA in humans: factors which affect the neuropsychobiological profiles of recreational ecstasy users, the integrative role of bioenergetic stress. Journal of Psychopharmacology 2006;20:147–163. [PubMed: 16510474]

Puente CP, Gutierrez JLG, Abellan IC, Lopez AL. Sensation seeking, attitudes toward drug use, and actual use among adolescents: Testing a model for alcohol and ecstasy use. Substance Use & Misuse 2008;43:1615–1627. [PubMed: 18752163]

Rogers G, Elston J, Garside R, Roome C, Taylor R, Younger P, Zawada A, Somerville M. The harmful health effects of recreational ecstasy: a systematic review of observational evidence. Health Technol Assess 2009;13:iii–iv. ix–xii, 1–315. [PubMed: 19195429]

SAMHSA. Results from the 2005 National Survey on Drug Use and Health: National findings Office of Applied Studies. Substance Abuse and Mental Health Services Administration; Rockville, MD: 2006.

SAMHSA. Results from the 2007 National Survey on Drug Use and Health: National findings. Office of Applied Studies, Substance Abuse and Mental Health Services Administration; Rockville, MD: 2008. NSDUH Series H-34, DHHS Publication No SMA 08-4343

Scheier LM, Ben Abdallah A, Inciardi JA, Copeland J, Cottler LB. Tri-city study of Ecstasy use problems: A latent class analysis. Drug and Alcohol Dependence 2008;98:249–263. [PubMed: 18674872]

Schierenbeck T, Riemann D, Berger M, Hornyak M. Effect of illicit recreational drugs upon sleep: cocaine, ecstasy and marijuana. Sleep Medicine Reviews 2008;12:381–389. [PubMed: 18313952]

Singer LT, Linares TJ, Ntiri S, Henry R, Minnes S. Psychosocial profiles of older adolescent MDMA users. Drug & Alcohol Dependence 2004;74:245–252. [PubMed: 15194202]

Turnbull BW. The Empirical Distribution Function with Arbitrarily Grouped, Censored and Truncated Data. Journal of the Royal Statistical Society 1976;38:290–295.

Westat. Prepared for the National Institute on Drug Abuse. Westat; Rockville, MD: 2004. User's guide for the evaluation of the National Youth Anti-Drug Media Campaign.

Windle M, Miller-Tutzauer C, Barnes GM, Welte J. Adolescent perceptions of help-seeking resources for substance abuse. Child Development 1991;62:179–189. [PubMed: 2022134]

Yen CF, Hsu SY. Symptoms of ecstasy dependence and correlation with psychopathology in Taiwanese adolescents. Journal of Nervous and Mental Disease 2007;195:866–869. [PubMed: 18043529]

Zimmermann P, Wittchen HU, Waszak F, Nocon A, Hofler M, Lieb R. Pathways into ecstasy use: the role of prior cannabis use and ecstasy availability. Drug & Alcohol Dependence 2005;79:331–341. [PubMed: 15913921]

Drug Alcohol Depend. Author manuscript; available in PMC 2011 January 15.

Table 1

Bivariate Associations between Ecstasy Use Initiation and Demographic, Family and Individual Factors (N = 6426)

Predictor	Categories	n	% or Mean (SD)	Hazard ratio	95% Confidence Interval	p-value
Demographic factors						
Gender						
	Girl (Ref.)[a]	3078	47.9	1.00		.9791
	Boy	3348	52.1	1.00	(0.79, 1.25)	
Race/Ethnicity						
	White (Ref.)	4317	67.2	1.00		.1271
	African-American	921	14.3	0.72	(0.50, 1.05)	
	Hispanic	945	14.7	1.23	(0.91, 1.67)	
	Other	243	3.8	1.11	(0.64, 1.95)	
Family and Parental Factors						
Parental education						
	College degree (Ref.)	1674	26.3	1.00		.1695
	Some college	1747	27.4	0.91	(0.64, 1.28)	
	HS diploma	2118	33.2	0.86	(0.60, 1.24)	
	<HS	838	13.1	0.68	(0.46, 0.99)	
Income						
	$ 0 $14,999 (Ref.)	716	11.6	1.00		.3560
	$15,000–34,999	1620	26.1	0.86	(0.59, 1.26)	
	$ 35,000–74,999	2462	39.7	0.80	(0.56, 1.14)	
	$ 75,000+	1403	22.6	0.67	(0.47, 1.05)	
Two-parent household						
	No (Ref.)	1882	29.3	1.00		<.0001
	Yes	4544	70.7	0.58	(0.46, 0.73)	
Parent history of drug use						
	No (Ref.)	2894	45.0	1.00		
	Yes	3532	55.0	1.67	(1.32, 2.12)	<.0001
Parental monitoring[b]		6426	3.6 (0.95)	0.55	(0.49, 0.61)	<.0001
Individual Factors						
Smoked before age 12						

Predictor	Categories	n	% or Mean (SD)	Hazard ratio	95% Confidence Interval	p-value
	No (Ref)	5994	93.3	1.00		<.0001
	Yes	432	6.7	3.43	(2.62, 4.49)	
Drank before age 12						
	No (Ref.)	5883	91.5	1.00		<.0001
	Yes	543	8.5	2.98	(2.25, 3.95)	
Used marijuana before age 12						
	No (Ref.)	6345	98.7	1.00		<.0001
	Yes	81	1.3	8.50	(5.75, 12.56)	
Substance use before age 12						
	(1) No substance use (ref)	5589	87.0	1.00		<.0001
	(2) Drinking only	380	5.9	1.81	(1.18, 2.79)	
	(3) Smoking only	258	4.0	2.36	(1.60, 4.38)	
	(4) Drinking & smoking	118	1.8	5.17	(3.33, 8.04)	
	(5) Marijuana use	81	1.3	10.18	(6.84, 15.13)	
Positive attitude towards marijuana use						
	No (Ref.)	6124	95.3	1.00		<.0001
	Yes	302	4.7	5.09	(3.94, 6.58)	
Sensation seeking[b]		6412	2.5 (0.92)	2.19	(1.93, 2.48)	<.0001
Peer deviance[b]		6426	1.7 (1.05)	1.68	(1.58, 1.79)	<.0001
Religious attendance						
	Monthly or more often (Ref.)	4031	62.7	1.00		<.0001
	Less than once a month	1576	24.5	1.52	(1.17, 1.99)	
	Never	819	12.8	2.30	(1.73, 3.06)	

[a] Ref. = Reference group

[b] Continuous variable; mean is reported, with standard deviation (SD) in parenthesis.

Table 2

Adjusted Hazard Ratios of Ecstasy Use Initiation

Predictors	Hazard ratio	95% CI	p-value
Demographic factors			
Girl (Ref.[a])	1.00		
Boy	0.87	(0.69, 1.09)	.2356
Race/Ethnicity			
White (Ref.)	1.00		
African-American	0.84	(0.57, 1.24)	.3952
Hispanic	1.31	(0.96, 1.80)	.0725
Other	1.36	(0.77, 2.42)	.2853
Family and Parental factors			
Two-parent household			
No (Ref.)	1.00		
Yes	0.70	(0.55, 0.89)	.0043
Parent history of drug use			
No (Ref.)	1.00		
Yes	1.34	(1.04, 1.72)	.0219
Parental Monitoring [b]	0.84	(0.73, 0.96)	.0094
Individual factors			
Substance use before age 12			
None (ref)	1.00		
Alcohol only	1.21	(0.78, 1.87)	.3948
Tobacco only	1.44	(0.97, 2.15)	.0711
Alcohol & tobacco	2.12	(1.34, 3.36)	.0015
Marijuana	3.08	(1.99, 4.75)	<.0001
Positive Attitude Towards Marijuana Use			
No (Ref.)	1.00		
Yes	2.09	(1.57, 2.77)	<.0001
Sensation seeking [b]	1.38	(1.20, 1.60)	<.0001
Peer deviance [b]	1.30	(1.19, 1.41)	<.0001
Religious attendance			
Monthly or more often (Ref.)	1.00		
Less than once a month	1.15	(0.88, 1.51)	.3184
Never	1.38	(1.02, 1.86)	.0271

[a] Ref. = Reference group

[b] Continuous variable