

Use of *Salvia divinorum* in a Nationally Representative Sample

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Background: *Salvia divinorum* has known hallucinogenic effects and is legal in most parts of the United States. Given that this psychoactive substance has a potential of misuse and abuse, further data regarding the clinical and psychosocial factors associated with use are needed. **Objectives:** To examine the clinical and psychosocial characteristics associated with use of salvia. **Methods:** The study uses data from the National Survey on Drug Use and Health, 2008 (N = 55,623). **Results:** The results of this study suggest that salvia use is most common among young adults aged 18–25 years as well as individuals who had engaged in risk-taking behaviors (selling illicit drugs, stealing) or illicit drug use (especially other hallucinogens/ecstasy). Self-reported depression and anxiety were also associated with salvia use. **Conclusions/Scientific Significance:** The results provide evidence that salvia use is part of a broader constellation of psychosocial and behavioral problems among youth and young adults. The accessibility, legal status, and psychoactive effects of salvia can be a potentially complicating health risk to young people, especially among those with existing substance use problems.

Keywords: salvia, hallucinogens, drug use, NSDUH

INTRODUCTION

Salvia divinorum, commonly referred to as “Diviner’s Sage” or “salvia,” is a plant from the Mexican *Lamiaceae* mint family that has been known to produce hallucinogenic effects. The active ingredient in salvia is the non-alkaloidal hallucinogen salvinorin A, which is the primary agent for salvia’s psychoactive effects and regarded as one of the most potent naturally occurring

hallucinogens (1). Salvia can be taken in different ways, including chewing the leaves, smoking the leaves in a rolled cigarette, as concentrated extract administered sublingually, or smoking in a pipe (2).

A growing body of literature has documented the effects of salvia, such as depersonalization, laughter, feelings of levitation, colored visions, loss of consciousness, déjà vu, and anxiety (2–4). Generally speaking, effects typically appear within 1 minute of use and last 15 minutes or less (2), but this varies depending on the amount used, concentration, and mode of administration. Doses of purified salvinorin A between 200 and 500 µg have shown intense psychoactive effects (5,6). A recent clinical study by Johnson and colleagues (7) found that salvia produced effects having similarities to classic hallucinogens, including mystical-type effects.

The US Drug Enforcement Administration has identified salvia as a “drug of concern.” Various states have attempted to regulate salvia (8). However, under US federal law, it is not illegal to possess or distribute this substance, as it is not a controlled substance under the Controlled Substances Act of 1970 (9). Although salvia is banned in some places in the United States, salvia can be easily obtained via the Internet and legally in many places (e.g., “head shops”) throughout the United States and abroad (4).

Results from the 2009 Monitoring the Future Survey revealed that 5.7% of 12th graders reported past-year use of salvia (10). Although the prevalence of use is significantly lower compared with other substances such as marijuana, inhalants, and alcohol, the inclusion of this measure in this on-going survey is in response to the increased surveillance need for this substance. Results from the 2006 National Survey on Drug Use and Health (NSDUH) showed that about 1.8 million persons aged 12 years or older used salvia in their lifetime, and approximately 750,000 used salvia in the past year (11). These

data also revealed that young adults (18–25 year olds) were more likely to be past-year users of salvia compared with 12–17 year olds. Males were more likely than females to be past-year users. In a study of college students, Lange et al. (12) found that 4.4% of respondents used salvia at least once in the past year. Use of salvia was associated with being white, male, a fraternity member, and self-reported heavy episodic drinking (12). A recent study also showed that salvia use among college students was more common among white males who were frequent smokers of marijuana and exhibited low self-control (13).

Currently, a small body of research exists to document the immediate effects of salvia, prevalence of salvia use, and sociodemographic correlates. However, given that salvia is a psychoactive substance with potential of misuse and abuse, further data regarding the clinical and psychosocial factors associated with use are needed. This information can help guide the development of targeted prevention efforts, in addition to providing a stronger knowledge base for informing regulation of the substance. This study draws on nationally representative data to identify important clinical and psychosocial correlates of salvia use to help fill this gap in knowledge.

METHODS

Data Source

Data were drawn from the 2008 NSDUH public-use data file (14). NSDUH provides nationally representative estimates of substance use and related disorders among civilian, noninstitutionalized US citizens aged 12 years or older. It used multistage area probability sampling methods to identify participants from all 50 US states and the District of Columbia living in households, shelters, rooming houses, group homes, and military bases (15). The multistage sampling design of NSDUH identifies selected individuals in each state, within stratified blocks and dwelling units, and oversamples adolescents and young adults to improve drug use estimates. Methodological details on NSDUH are available at <http://www.oas.samhsa.gov/NSDUH/Methods.cfm> (accessed 25 January 2011).

Within participants' place of residence, computer-assisted interviewing methodology was used in private to increase the validity of responses regarding substance use behaviors (12). Field interviewers ensured participants that responses would be confidential, and procedures and relevant protections were explained when obtaining informed consent. Participants were offered a \$30 incentive for participation in the interview. A total of 68,736 respondents completed interviews in the 2008 survey. The weighted household screening and interviewing response rates were 89.0% and 74.4%, respectively (14). The public-use data file contains 55,739 respondents due to exclusions to ensure anonymity.

Measures

Adults (≥ 18 years) and youth (12–17 years) received different surveys in the NSDUH. The following measures

were based on equivalent survey items from both the adult and youth samples, with the exception of psychosocial supports and carrying of a handgun (see below), which were administered only among youth.

Demographics

Participants' race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, other), age group, gender, and total family income were examined.

Substance Use

The primary variable, lifetime salvia use, was based on the following question: "Have you ever, even once, used *S. divinorum*?" We assessed whether respondents reported ever using marijuana, ecstasy, hallucinogens (lysergic acid diethylamide/LSD, phencyclidine/PCP, peyote, mescaline, psilocybin), cocaine/crack, or heroin in their lifetime. It should be noted that past-year salvia use was not examined due to a low base rate.

Risk-Taking Behaviors and Mental Health

Risk-taking behavior variables were dichotomized (yes or no) and included past-year selling of illegal drugs, stealing an item worth \$50 or more, attacking someone with the intent to injure, and carrying a handgun (youth sample only). Two other variables were also used to assess propensity for risk-taking behaviors: "How often do you get a real kick out of doing things that are a little dangerous?" and "How often do you like to test yourself by doing something a little risky?" They had a three-level response (never, seldom, sometimes/always). Additionally, we examined history of depression and anxiety (i.e., whether the respondents were told by a doctor or other medical professional if they had either of these disorders) as potential correlates of *S. divinorum* use.

Prevention-related and Protective Variables

We examined whether youth respondents had ever been exposed to prevention messages or programs, including drug education in school; drug prevention programs outside of school; seeing or hearing drug prevention messages outside of school; violence prevention programs; groups regarding problem solving, communication skills, or self-esteem; participation in programs to help with drug abuse; and having ever participated in youth activities. We also determined whether youth felt that they could talk with their parents about the dangers of alcohol/tobacco/drugs and had someone to talk to about serious problems.

Analysis

We used Stata version 11.0 to conduct all statistical analyses and obtain nationally representative estimates (16). Stata implements a Taylor series linearization to adjust standard errors based on the stratified sampling methodology and survey nonresponse. We used weighted percents to indicate prevalence estimates for all study variables among lifetime salvia users. Unadjusted odds

ratios (UOR) and adjusted odds ratios (AOR) from logistic regression analyses were used to identify correlates of lifetime salvia use. We included age, sex, race/ethnicity, and family income in the adjusted analyses.

RESULTS

Sociodemographics

Table 1 provides prevalence estimates and unadjusted and adjusted logistic regression analyses for the full sample, including the sociodemographic, substance use, psychological, and risk-taking behavior variables. Overall, approximately 2.8% of the sample reported lifetime salvia use, with the highest percentage among persons aged 18–25 years (6.1%). Unadjusted logistic regression analyses showed that persons in this age group were 4.12 times more likely to report lifetime salvia use compared to those aged 12–17 years. The effect size was slightly attenuated in the adjusted analyses (AOR = 3.93, 95% CI = 3.25–4.75). Other sociodemographic factors associated with lifetime salvia use included being male, white, and having lower levels of family income. These associations remained significant in adjusted regression analyses.

Substance Use and Psychological Variables

Use of other drugs was consistently associated with lifetime salvia use. Respondents who were lifetime marijuana users exhibited the lowest rate of use (3.00%), whereas lifetime ecstasy users exhibited the highest rate (13.05%). Unadjusted and adjusted logistic regression analyses revealed strong associations for each type of drug. After adjustments, the strongest associations were observed for lifetime use of hallucinogens (AOR = 19.65) and marijuana (AOR = 27.20). Persons with depression and anxiety were also more likely to be lifetime users of salvia, although AOR estimates were lower in comparison to other drug use (AOR = 2.68 and 2.36, respectively).

Risk-taking Behaviors

Nearly one in five persons (18.59%) who reported selling illegal drugs had a lifetime history of salvia use. Other risk-taking behaviors examined also exhibited significant associations, although selling illegal drugs exhibited the largest effect size in the adjusted analysis (AOR = 11.33). A graded relationship across the variables measuring risk propensity was also observed. Persons who endorsed “sometimes/always” getting a real kick out of doing dangerous things or liking to test oneself by doing risky things had the highest percentage of lifetime salvia use, followed by those who endorsed “seldom” and “never.” This pattern of association remained significant in adjusted analyses.

Prevention and Protective Variables

Table 2 summarizes analyses for psychosocial supports among persons aged 12–17 years. Only two of these psychosocial support variables assessed exhibited significant associations in the unadjusted and adjusted logistic

regression analyses. The adjusted analysis showed that youth who participated in a drug abuse program were 3.38 times more likely to report lifetime salvia use than youth who did not participate in a drug abuse program. Youth who participated in two or more youth activities were less likely (AOR = .52) to report lifetime salvia use compared to those who participated in none or only one youth activity.

DISCUSSION

Although salvia is regarded as one of the most potent naturally occurring hallucinogens (1), very little is known about the clinical and psychosocial correlates of use. Such information is important in order to better understand the extent and patterns of use, which can then help inform targeted interventions for prevention and drug control policy. This study, using nationally representative data, is an initial step toward filling this gap.

The results of this study suggest that salvia use is most common among young adults aged 18–25 years as well as individuals who had engaged in risk-taking behaviors (selling illicit drugs, stealing) or illicit drug use (especially other hallucinogens/ecstasy). Self-reported depression and anxiety were also associated with salvia use, suggesting that some users are affected by mental health problems. Because this is a cross-sectional study, it is not possible to determine whether use of salvia is a cause of these problems (e.g., self-medication hypothesis) or a consequence of use. Nonetheless, the results provide evidence that salvia use is part of a broader constellation of psychosocial and behavioral problems among youth and young adults. The accessibility, legal status, and psychoactive effects of salvia can be a potentially complicating health risk to young people, especially among those with existing substance use problems.

Detection of salvia use in routine treatment settings is problematic, as it is not well known among health-care providers and current biological drug screens do not detect this substance. Despite detection challenges, this study provides an initial understanding of potential risk factors to guide health-care providers in targeting assessments. In particular, providers working with youth and young adults with a history of risk-taking behaviors or substance use problems (e.g., cocaine, marijuana, other hallucinogens) could benefit from further information and assessment strategies regarding salvia (5). Although the abuse liability of salvia is unclear, its psychoactive effects and case descriptions of salvia-related medical complications have been documented (4,17,18). During treatment, providers should ensure that individuals affected by salvia use are aware of possible health complications and symptoms (19), despite its status as a legal substance.

Research to date is not developed enough to inform strategies for primary prevention. Nonetheless, this study showed that youth who were involved in two or more youth activities were less likely to use salvia, which is consistent with the broader knowledge on positive youth

TABLE 1. Lifetime prevalence and correlates of salvia use based on the 2008 National Survey on Drug Use and Health ($N = 55,623$).

	%	95% CI		UOR	95% CI		AOR	95% CI		
Age										
12–17 years old ($n = 17,777$)	1.55	1.32	1.82	1.00	–	–	1.00	–	–	
18–25 years old ($n = 19,111$)	6.10	5.65	6.58	4.12	3.43	4.94	3.93	3.25	4.75	
26–34 years old ($n = 5567$)	1.74	1.35	2.23	1.12	.83	1.52	1.11	.82	1.50	
35 or older ($n = 13,168$)	.15	.09	.24	.09	.06	.16	.08	.05	.14	
Sex										
Male ($n = 26,679$)	1.93	1.75	2.12	2.78	2.32	3.32	2.70	2.25	3.24	
Female ($n = 28,944$)	.70	.61	.82	1.00	–	–	1.00	–	–	
Race/ethnicity										
White ($n = 34,483$)	1.58	1.45	1.73	1.00	–	–	1.00	–	–	
Black ($n = 7,213$)	.19	.11	.34	.12	.07	.21	.09	.05	.15	
Hispanic ($n = 9,105$)	1.00	.76	1.32	.63	.47	.84	.41	.30	.56	
Other ($n = 4,822$)	.95	.67	1.35	.60	.41	.86	.48	.33	.69	
Annual family income										
Less than \$20,000 ($n = 11,998$)	1.83	1.55	2.16	1.00	–	–	1.00	–	–	
\$20,000 – \$49,999 ($n = 19,010$)	1.39	1.21	1.59	.76	.61	.94	.95	.75	1.19	
\$50,000 – \$74,999 ($n = 9,954$)	1.06	.86	1.31	.58	.44	.76	.71	.53	.94	
\$75,000 or more ($n = 14,661$)	1.07	.93	1.24	.58	.47	.73	.80	.63	1.03	
Attacked with intent to seriously harm										
Yes ($n = 2,662$)	6.35	5.05	7.94	5.64	4.37	7.29	2.46	1.88	3.22	
No ($n = 52,831$)	1.19	1.09	1.29	1.00	–	–	1.00	–	–	
Sold illegal drugs										
Yes ($n = 1926$)	18.59	16.09	21.37	23.66	19.37	28.90	11.33	9.14	14.04	
No ($n = 53,526$)	.96	.87	1.05	1.00	–	–	1.00	–	–	
Stole > \$50										
Yes ($n = 1639$)	8.64	6.97	10.66	7.84	6.12	10.06	3.99	3.07	5.19	
No ($n = 53,838$)	1.19	1.09	1.30	1.00	–	–	1.00	–	–	
Ever used ecstasy										
Yes ($n = 3744$)	13.05	11.61	14.63	22.37	18.86	26.53	12.30	10.24	14.79	
No ($n = 51,879$)	.67	.60	.74	1.00	–	–	1.00	–	–	
Ever used other hallucinogens										
Yes ($n = 6008$)	6.96	6.28	7.71	16.13	13.54	19.22	19.65	16.22	23.82	
No ($n = 49,493$)	.46	.40	.53	1.00	–	–	1.00	–	–	
Ever used cocaine or “crack”										
Yes ($n = 6584$)	5.23	4.67	5.84	8.89	7.54	10.48	11.35	9.44	13.64	
No ($n = 49,039$)	.62	.55	.69	1.00	–	–	1.00	–	–	
Ever used marijuana										
Yes ($n = 21,655$)	3.00	2.76	3.25	27.23	17.86	41.50	27.20	17.57	42.10	
No ($n = 33,968$)	.11	.08	.17	1.00	–	–	1.00	–	–	
Ever used heroin										
Yes ($n = 717$)	9.47	7.24	12.31	8.84	6.51	12.00	9.93	6.94	14.22	
No ($n = 54,906$)	1.17	1.08	1.27	1.00	–	–	1.00	–	–	
Lifetime depression										
Yes ($n = 5436$)	2.26	1.88	2.72	1.97	1.60	2.43	2.68	2.13	3.38	
No ($n = 48,873$)	1.16	1.06	1.27	1.00	–	–	1.00	–	–	
Lifetime anxiety										
Yes ($n = 3438$)	2.31	1.88	2.84	1.93	1.54	2.43	2.36	1.85	3.01	
No ($n = 50,871$)	1.21	1.11	1.32	1.00	–	–	1.00	–	–	
Getting a real kick out of doing dangerous things										
Never ($n = 21,772$)	.18	.13	.25	1.00	–	–	1.00	–	–	
Seldom ($n = 17,161$)	1.24	1.06	1.45	7.11	4.90	10.33	3.64	2.54	5.22	
Sometimes/always ($n = 16,319$)	4.39	3.99	4.84	26.01	18.28	37.01	8.72	6.15	12.35	
Like to test yourself by doing risky things										
Never ($n = 21,693$)	.26	.19	.34	1.00	–	–	1.00	–	–	
Seldom ($n = 19,869$)	1.44	1.26	1.63	5.68	4.18	7.70	3.06	2.27	4.14	
Sometimes/always ($n = 13,841$)	4.19	3.75	4.68	17.04	12.63	22.99	5.98	4.39	8.14	

Notes: CI, confidence interval; UOR, unadjusted odds ratio; AOR, adjusted odds ratio. All percentages are reported as row percentages and weighted estimates. Adjusted analyses included age, sex, race, and income. Values in bold are statistically significant based on a 95% CI that does not bound the value 1.00.

TABLE 2. Risk and preventive factors associated with lifetime salvia use among youth (ages 12–17 years) based on the 2008 National Survey of Drug Use and Health ($N = 17,777$).

	%	95% CI		UOR	95% CI		AOR	95% CI	
Talk with about serious problems									
Someone ($n = 16,838$)	1.51	1.28	1.79	.59	.30	1.14	.55	.28	1.07
No one ($n = 588$)	2.56	1.36	4.75	1.00	–	–	1.00	–	–
Talk with parent about danger of tobacco, alcohol, or drugs									
Yes ($n = 10,361$)	1.65	1.36	2.01	1.19	.84	1.70	1.12	.78	1.59
No ($n = 7,208$)	1.39	1.04	1.85	1.00	–	–	1.00	–	–
Participated in problem solving/communication skills/self-esteem group									
Yes ($n = 3,928$)	1.53	1.06	2.22	.98	.64	1.49	1.01	.66	1.55
No ($n = 13,488$)	1.57	1.31	1.88	1.00	–	–	1.00	–	–
Participated in violence prevention program									
Yes ($n = 2,531$)	1.82	1.15	2.85	1.22	.74	2.00	1.38	.84	2.27
No ($n = 15,072$)	1.50	1.26	1.78	1.00	–	–	1.00	–	–
Participated in drug prevention program outside school									
Yes ($n = 1,970$)	1.87	1.19	2.92	1.25	.77	2.05	1.31	.79	2.18
No ($n = 15,666$)	1.49	1.26	1.78	1.00	–	–	1.00	–	–
Participated in program to help drug abuse									
Yes ($n = 786$)	3.90	2.39	6.31	2.79	1.63	4.77	3.38	1.93	5.90
No ($n = 16,805$)	1.43	1.21	1.70	1.00	–	–	1.00	–	–
Participated in youth activities									
2 or more activities ($n = 14,985$)	1.38	1.15	1.65	.56	.38	.84	.52	.34	.78
None or 1 activity ($n = 2,721$)	2.43	1.72	3.42	1.00	–	–	1.00	–	–
Youth seen drug prevention messages outside of school									
Yes ($n = 13,744$)	1.65	1.38	1.97	1.45	.92	2.27	1.40	.90	2.18
No ($n = 3,831$)	1.15	.76	1.73	1.00	–	–	1.00	–	–
Youth had any drug education in school									
Yes ($n = 12,532$)	1.42	1.16	1.73	.70	.50	1.00	.70	.49	1.00
No ($n = 3,949$)	2.00	1.52	2.63	1.00	–	–	1.00	–	–
Carried a handgun									
Yes ($n = 626$)	3.77	2.32	6.07	2.65	1.56	4.49	2.22	1.28	3.86
No ($n = 17,078$)	1.46	1.23	1.73	1.00	–	–	1.00	–	–

Notes: CI, confidence interval; UOR, unadjusted odds ratio; AOR, adjusted odds ratio. All percentages are reported as row percentages and weighted estimates. Adjusted analyses included age, sex, race, and income. Values in bold are statistically significant based on a 95% CI that does not bound the value 1.00.

development (19,20). This suggests that a social network approach may be particularly useful to inform youth of the possible negative consequences of use and offer meaningful recreational and social opportunities. However, the existing research, albeit limited, also suggests the role of the Internet as a mechanism for obtaining information and the actual substance. For example, videos of youth and young adults using salvia can easily be found on YouTube (17). At the time of this study, some videos showing salvia trips, especially those that characterize salvia in a favorable way, have been viewed over 1 million times. In a recent study, salvia was endorsed by more than 75% of the salvia-associated websites examined, whereas only 2% were classified as anti-use/treatment information websites (9). Thus, as knowledge of salvia continues to develop, it is important to consider effective uses of the Internet to disseminate educational or preventive information that may counter potentially inappropriate information sources.

These results should be considered in the context of its limitations. As indicated, we are unable to establish causal associations among the relationships identified

in this study. Additionally, the survey did not contain data on amount of use, frequency of use, and mode of administration. These are important factors that could change the nature of the relationships. Future research that includes detailed assessment of patterns of use, reasons for initiation, and effects of use is needed to develop effective prevention, assessment, and treatment strategies.

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Declaration of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

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