AKADÉMIAI KIADÓ

Journal of Psychedelic Studies

8 (2024) 2, 248–259

DOI:
10.1556/2054.2024.00309

ORIGINAL RESEARCH PAPER

LSD use in the United States: Examining user demographics and their evolution from 2015–2019

JEREMY WELEFF[1]*, AKHIL ANAND[2,3], ELIZABETH N. DEWEY[4,5] and BRIAN S. BARNETT[2,3]

[1] Department of Psychiatry, Yale University School of Medicine, New Haven, CT, USA

[2] Department of Psychiatry and Psychology, Center for Behavioral Health, Neurological Institute, Cleveland Clinic, Cleveland, OH, USA

[3] Cleveland Clinic Lerner College of Medicine at Case Western Reserve University, EC-10 Cleveland Clinic, Cleveland, OH, USA

[4] Department of Quantitative Health Sciences, Cleveland Clinic, Cleveland, OH, USA

[5] Center for Populations Health Research, Cleveland Clinic, Cleveland, OH, USA

Received: August 5, 2023 • Revised manuscript received: December 27, 2023 • Accepted: January 14, 2024
Published online: February 1, 2024

ABSTRACT

Background: Lysergic acid diethylamide (LSD) use has risen in the United States in recent years amid increased interest in therapeutic applications of psychedelics. Despite this, contemporary epidemiological investigations of LSD users are few. To expand the literature on this topic, we sought to characterize past-year LSD users in the United States and investigate recent demographic evolution within this population. *Methods:* Using National Survey on Drug Use and Health (NSDUH) data from 2015–2019, we investigated correlates of past-year LSD use and associated changes over the study period. *Results:* Past-year LSD use increased by 47% from 2015 to 2019 (0.59%–0.87%). However, among people reporting past-year hallucinogen use disorder there was no significant proportional increase in LSD users. Notable correlates of LSD use on multivariable analysis were: increased LSD access, lower perceived risk of trying LSD, low income, fewer children in the home, being approached by someone selling drugs in the past month, and past-year suicide attempt among people age 18 and older. We found no associations with unemployment, arrest history, or past-year psychological distress. From 2015 to 2019, the proportion of respondents reporting past-year LSD use who were age 26–34 and married increased. Past-year LSD use among lifetime users of methamphetamine also rose. *Conclusions:* Though still uncommonly used in the United States, LSD's societal acceptance may be increasing. Overall, LSD does not appear to contribute significantly to the country's public health problems.

KEYWORDS

lysergic acid, LSD, psychedelics, recreational substance use, epidemiology

INTRODUCTION

In 2019, there were estimated to be more than 27 million lifetime lysergic acid diethylamide (LSD) users in the United States (U.S.) (Center for Behavioral Health Statistics and Quality, 2019a). Use of LSD in the U.S. has more than doubled since the early 2000s (Killion et al., 2021) and past-year use remains on an upward trajectory (R. A. Yockey, Vidourek, & King, 2020). The factors behind this rise are not yet clear, though we speculate that the resurgence of interest in therapeutic applications of psychedelics and associated media coverage may be possible contributors.

Early studies of LSD demonstrated therapeutic promise for its use in alcohol and opioid use disorders, as well as psychological distress associated with cancer (Grof, Goodman, Richards, &

*Corresponding author. Department of Psychiatry, Yale School of Medicine, New Haven, CT, USA.
E-mail: jeremy.weleff@yale.edu

Kurland, 1973; Krebs & Johansen, 2012; Savage & McCabe, 1973), but once LSD possession became illegal in the U.S. in 1971, clinical use and human subjects research assessing its therapeutic potential largely ceased. However, research into therapeutic applications of LSD and other psychedelics has returned to the U.S. in recent decades, despite a lack of federal funding to support this work (Barnett, Parker, & Weleff, 2021). Social acceptability of use of LSD and other psychedelics may be growing, particularly around "wellness" applications of psychedelics. Although most psychedelics remain Schedule I substances in the U.S., a small but growing number of jurisdictions throughout the country have decriminalized or legalized possession of psychedelics (Ponieman, 2020).

Despite sustained growth in LSD use, there have been few recent studies of LSD user demographics (Han, Blanco, Einstein, & Compton, 2022; Killion et al., 2021; A. Yockey, King, & Vidourek, 2019; R. A. Yockey et al., 2020), leaving important gaps in our understanding of who is using LSD and how users might be changing. As a result, we sought to characterize past-year LSD users in the U.S. from 2015 to 2019 and evaluate whether user demography is evolving.

METHODS

Data description

The U.S. National Survey on Drug Use and Health (NSDUH) is conducted annually by the Substance Abuse and Mental Health Services Administration (SAMHSA), in all 50 states and the District of Columbia (Substance Abuse and Mental Health Services Administration, 2020b). NSDUH personnel administer the survey in-person to randomly selected, noninstitutionalized civilians (important excluded populations include people who are imprisoned, hospitalized, or living in nursing homes) at the respondent's place of residence. The survey inquires about substance use, mental health, other health-related issues, and treatments received for mental health conditions and substance use disorders. It also employs a sample-weighted design that includes weight adjustments for demographics, nonresponse, and other factors (Substance Abuse and Mental Health Services Administration, 2020a).

This study uses pooled data from NSDUH survey years 2015–2019 on all respondents (age 12 and older). Although 2020 survey data were available, data collection that year was disrupted due to COVID-19, and NSDUH administrators have advised researchers to avoid comparing 2020 data to those from previous years due to methodological alterations (Substance Abuse and Mental Health Services Administration, 2021). The primary outcome for this study was past-year LSD use, which is an imputed variable in the NSDUH data set. There were no missing data for this outcome.

Statistical analysis

Survey analysis procedures were used for all analyses due to the complex survey design, utilizing the NSDUH respondent weight, replicate, and variance strata. Since this study utilizes five years of survey data, the respondent weight was divided by five for analyses that included all study years as recommended by the NSDUH (Substance Abuse and Mental Health Services Administration, 2019). Significance was assessed at $p < 0.05$. Analysis was conducted in SAS 9.4 (SAS Inc., Cary, NC).

Unweighted frequencies for the primary outcome variable are reported. Continuous factors are summarized as weighted medians and interquartile ranges, and comparisons between LSD use groups were evaluated with log-transformed linear regression. Categorical factors are summarized using weighted percentages and 95% confidence intervals, and comparisons between LSD use groups were evaluated using Rao-Scott chi-square tests.

Univariable associations with LSD use were adjusted for survey year (2015–2019), age group (12–17, 18–25, 26–34, 35–49, 50+), gender (male, female), education (high school but no diploma, high school diploma/GED, some college/no degree, 2-year degree, 4-year degree), employment status (full-time, part-time, unemployed, other), marital status (never been married, married, divorced, widowed), ethnicity/race (White, Black, Asian, Hispanic, other), urbanicity (small, large, non), and criminal arrest history (yes/no). Associations were evaluated within each study year, and across study years for trends using orthogonal polynomial contrasts as suggested by the NSDUH (Substance Abuse and Mental Health Services Administration, 2019) and similar to other studies (Clarke, Black, Stussman, Barnes, & Nahin, 2015; Schauer, Berg, Kegler, Donovan, & Windle, 2016).

Logistic regression was used to calculate adjusted odds ratios for the risk of past-year LSD use. All odds ratios were adjusted for the factors listed above. In addition to evaluating factors individually, three separate multivariable models were constructed: 1) for respondents under the age of 18; 2) for respondents over the age of 18; 3) for respondents of all ages. In the all ages model, questions that were not asked to respondents under the age of 18 or had answers that were nearly universal were recoded to either incorporate ages 12–17 as its own group or combined into the appropriate group (e.g., employment status). The model for respondents over age 18 included questions about mental health that could not be included in the all ages or under age 18 model. Multivariable models were constructed with factors associated with LSD use, after adjusting for the factors listed above. Models were simplified wherever appropriate to reduce complexity and to address multicollinearity and confounding.

Independent variables in our multivariable logistic regression models consisted primarily of factors previously associated with LSD use. For details about variable selection, please see Supplementary material A.

Ethics

This study was approved by the Cleveland Clinic Institutional Review Board.

RESULTS

Demographic characteristics of LSD users

The final unweighted sample size was $N = 282{,}768$, and 3,632 respondents reported past-year LSD use (past-year weighted prevalence 0.77, 95% Confidence Interval: 0.72–0.81%). All investigated respondent factors were significantly associated with past-year LSD use on univariate analysis except for number of religious services attended in the past year. Compared to non-LSD users, past-year LSD users were disproportionately: male (67.9% vs 48.3%), between the ages of 18–25 (56.4% vs 12.3%), White (71.1% vs 62.8%), lesbian, gay, or bisexual (18.0% vs 4.9%), living in a large metropolitan area (59.4% vs 55.9%), never married (85.7% vs 28.1%), without children younger than 18 in the home (92.8% vs 73.3%), unemployed or employed part-time (35.1% vs 17.3% in age 18+), lower income (less than $20,000/year: 25.4% vs 16.1%), and uninsured (85.4% vs 90.7%). LSD users were also disproportionately likely to report experiencing past-year serious psychological distress: (36.3% vs 11.1%), and report attempting suicide in the past year (3.9% vs 0.54%) (all $p < 0.001$). For further details see Table 1.

All respondents who reported drug use were disproportionately represented among past-year LSD users; aside from tobacco, alcohol, marijuana, and cocaine, respondents who had not used LSD in the past year rarely had lifetime experience with other drugs (<10% non-LSD users reported using each of the other drugs assessed). Prevalence of past-year hallucinogen use disorder was disproportionately higher in past-year LSD users than non-users (6.6% vs 0.06%). Past-year LSD users also disproportionately reported that LSD was very easy or fairly easy to obtain (53.0% vs 12.8%). See Supplemental Table 1 for further details.

Past-year LSD users disproportionately reported that there was no risk in: smoking marijuana once or twice a week (65.9% vs 18.5%), trying LSD once or twice (34.9% vs 3.2%), using LSD once or twice a week (12.0% vs 1.4%), trying heroin once or twice (2.3% vs 1.2%), using cocaine once or twice a week (1.3% vs 1.04%), or having 5 or more drinks once or twice a week (5.8% vs 3.1%) (all $p < 0.001$). A notable exception was using heroin once or twice a week, which 0.83% of LSD users reported as no risk compared to 0.91% of non-users ($p = 0.002$). See Supplemental Table 2 for further details.

Demographic changes from 2014–2019

Past-year LSD use significantly increased by 47% from 2015 to 2019 (0.59%–0.87%, $p < 0.001$) (Table 2). Yearly relative increases were higher between 2015–2016 (20.3%) and 2016–2017 (14.1%) but were modest between 2017–2018 (3.7%) and 2018–2019 (3.6%). There were strong within-year associations with past-year LSD use for nearly all respondent factors for each study year, $p < 0.001$; an exception was metropolitan area (large metro range: 53.2%–60.9%, $p = 0.002$ to $p = 0.61$). These associations remained consistent across the study period with a few notable exceptions. Past-year LSD users were predominantly between the ages of 18–25 in every year, but the proportion of users aged 26–34 increased nearly every year from 16.3% in 2015 to 26.5% in 2019 ($p < 0.0001$). The proportion of past-year LSD users who were married also increased over the study period from 5.7% in 2015 to 10.1% in 2019 ($p < 0.0001$).

Associations between past-year LSD use with the use of other drugs were consistent across the study period, except for rising past-year LSD use among lifetime users of methamphetamine (22.6% in 2019 vs 14.0% in 2014, $p = 0.04$). There was no statistically significant change in the proportion of people with hallucinogen use disorder reporting past-year LSD use ($p = 0.42$). For more information see Supplemental table 3.

Multivariable modelling of risk for past-year LSD use

In the all ages past-year LSD use multivariable model, factors associated with higher risk of past-year LSD use were: more recent survey year ($p < 0.001$), age 12–17 ($p = 0.007$), part time employment ($p < 0.001$), non-Hispanic Asian race ($p = 0.04$), lifetime use of alcohol, marijuana, stimulant, sedatives or any hallucinogen assessed besides LSD ($p < 0.001$), having been approached by someone selling illegal drugs in the past month ($p < 0.001$), lower perceived risk of trying LSD once or twice ($p < 0.001$), and reported easier access to LSD ($p < 0.001$).

In the under age 18 multivariable model, factors associated with higher risk of past-year LSD use were: overnight stay in a hospital during the past year ($p = 0.01$), lifetime use of tobacco, alcohol, marijuana, stimulant, sedative, or any hallucinogen assessed besides LSD ($p < 0.001$), being approached by someone selling illegal drugs in the past month ($p = 0.02$), lower perceived risk of trying LSD once or twice ($p < 0.001$), and reporting easier access to LSD ($p < 0.001$).

In the over age 18 multivariable model, factors associated with higher risk of past-year LSD use were: more recent survey year ($p = 0.001$ for 2017 and 2018, $p < 0.001$ for 2019), part time employment ($p < 0.001$), non-Hispanic Asian race ($p = 0.02$), having sold illegal drugs at least once ($p < 0.001$), past-year suicide attempt ($p = 0.01$), lifetime use of marijuana, stimulants, sedatives, or any hallucinogen assessed besides LSD ($p < 0.001$), having been approached by someone selling illegal drugs in the past month ($p < 0.001$), lower perceived risk of trying LSD once or twice ($p < 0.001$), and reported easier access to LSD ($p < 0.001$).

Factors associated with decreased risk of past-year LSD use were similar in all models. In the all-age and over-18 models the factors associated with decreased risk were: marriage ($p < 0.001$), female gender ($p < 0.001$), income more than twice the federal poverty threshold ($p < 0.001$), and having children under 18 years old in the home ($p < 0.001$). In the all-ages model, older respondents (age >18, $p < 0.001$) were less likely to try LSD. In the under-18 model, female gender ($p = 0.004$) was associated with decreased risk of LSD use. For details of these models see Table 3.

Table 1. Demographic characteristics for survey respondents by past-year LSD use in NSDUH 2015–2019

Survey question	All respondents (N = 282,768)	No past year use (N = 279,136)	Past year use (N = 3,632)
Survey year			
2015	19.7 (19.4, 20.0)	19.7 (19.4, 20.1)	15.2 (13.6, 16.7)
2016	19.8 (19.5, 20.1)	19.8 (19.6, 20.1)	18.4 (16.2, 20.6)
2017	20.0 (19.8, 20.3)	20.0 (19.8, 20.3)	21.2 (19.0, 23.3)
2018	20.2 (19.9, 20.4)	20.1 (19.9, 20.4)	22.2 (19.7, 24.7)
2019	20.3 (19.9, 20.6)	20.2 (19.9, 20.6)	23.1 (20.9, 25.3)
Gender male	48.5 (48.2, 48.8)	48.3 (48.1, 48.6)	67.9 (65.7, 70.0)
Under age 18 gender male	50.9 (50.4, 51.5)	50.8 (50.3, 51.3)	61.5 (56.8, 66.2)
Age 18+ gender male	48.3 (47.9, 48.6)	48.1 (47.8, 48.4)	68.7 (66.6, 70.8)
Age groups			
1 – age: 12–17	9.2 (9.0, 9.3)	9.1 (9.0, 9.3)	11.7 (10.4, 13.0)
2 – age: 18–25	12.6 (12.5, 12.8)	12.3 (12.1, 12.5)	56.4 (54.1, 58.8)
3 – age: 26–34	14.5 (14.3, 14.7)	14.4 (14.2, 14.7)	22.7 (20.8, 24.6)
4 – age: 35–49	22.4 (22.1, 22.7)	22.5 (22.3, 22.8)	6.6 (5.3, 8.0)
5 – age: 50+	41.3 (40.8, 41.8)	41.6 (41.1, 42.1)	2.6 (1.2, 4.0)
Age groups, over/under age 18			
1 – under18	9.2 (9.0, 9.3)	9.1 (9.0, 9.3)	11.7 (10.4, 13.0)
2 – 18+ yrs	90.8 (90.7, 91.0)	90.9 (90.7, 91.0)	88.3 (87.0, 89.6)
Race/Hispanicity*			
1 – NonHisp White	62.8 (62.3, 63.3)	62.8 (62.3, 63.3)	71.1 (68.7, 73.5)
2 – NonHisp Black/Afr Am	12.0 (11.7, 12.4)	12.1 (11.7, 12.4)	4.5 (3.6, 5.3)
3 – NonHisp Native Am/AK Native	0.56 (0.51, 0.61)	0.56 (0.51, 0.61)	0.44 (0.22, 0.66)
4 – NonHisp Native HI/Other Pac Isl	0.38 (0.33, 0.42)	0.38 (0.33, 0.42)	0.37 (0.16, 0.58)
5 – NonHisp Asian	5.6 (5.4, 5.8)	5.6 (5.4, 5.8)	4.2 (3.1, 5.3)
6 – NonHisp more than one race	1.8 (1.8, 1.9)	1.8 (1.8, 1.9)	3.9 (3.0, 4.7)
7 – Hispanic	16.8 (16.4, 17.2)	16.8 (16.4, 17.2)	15.6 (13.4, 17.7)
Sexual identity, age 18+ only			
1 – Heterosexual, that is, straight	94.3 (94.2, 94.5)	94.4 (94.3, 94.6)	81.3 (79.2, 83.3)
2 – Lesbian or gay	1.9 (1.8, 2.0)	1.9 (1.8, 2.0)	4.2 (3.3, 5.0)
3 – Bisexual	3.1 (3.0, 3.2)	3.0 (2.9, 3.1)	13.8 (12.2, 15.3)
4 – Don't know	0.64 (0.58, 0.70)	0.64 (0.58, 0.70)	0.78 (0.28, 1.3)
County metro/nonmetro status			
1 – Large metro	55.9 (55.4, 56.4)	55.9 (55.4, 56.4)	59.4 (56.9, 61.8)
2 – Small metro	29.9 (29.5, 30.4)	29.9 (29.5, 30.4)	29.3 (27.1, 31.5)
3 – Nonmetro	14.1 (13.8, 14.5)	14.2 (13.8, 14.5)	11.3 (9.7, 12.9)
Education groups*			
Under Age 18			
1 – some HS, no diploma	98.9 (98.8, 99.0)	99.0 (98.9, 99.1)	94.9 (92.5, 97.4)
2 – HS diploma/GED	0.87 (0.78, 0.96)	0.83 (0.74, 0.91)	4.9 (2.5, 7.3)
3 – some college, no degree	0.15 (0.11, 0.20)	0.15 (0.11, 0.19)	0.19 (0.00, 0.57)
4 – 2-year college degree	0.00 (0.00, 0.01)	0.00 (0.00, 0.01)	—
5 – 4-year college degree	0.03 (0.01, 0.05)	0.03 (0.01, 0.05)	—
Age 18+			
1 – some HS, no diploma	12.7 (12.4, 13.0)	12.7 (12.5, 13.0)	8.3 (7.1, 9.6)
2 – HS diploma/GED	24.8 (24.5, 25.1)	24.9 (24.5, 25.2)	23.4 (21.1, 25.8)
3 – some college, no degree	21.6 (21.3, 21.8)	21.4 (21.2, 21.7)	37.1 (34.4, 39.9)
4 – 2-year college degree	9.3 (9.1, 9.5)	9.3 (9.1, 9.5)	7.4 (6.2, 8.7)
5 – 4-year college degree	31.6 (31.1, 32.1)	31.7 (31.2, 32.1)	23.7 (21.2, 26.1)
Marital status*, Age 18+ only			
1 – Married	51.7 (51.3, 52.2)	52.1 (51.6, 52.5)	8.6 (6.5, 10.6)
2 – Widowed	5.9 (5.7, 6.1)	5.9 (5.8, 6.1)	0.57 (0.00, 1.2)
3 – Divorced or Separated	13.8 (13.6, 14.1)	13.9 (13.6, 14.2)	5.1 (3.6, 6.6)
4 – Never Been Married	28.5 (28.2, 28.9)	28.1 (27.7, 28.4)	85.7 (83.4, 88.1)
# Children <18 in household*			
0 – None	73.8 (73.6, 74.1)	73.7 (73.4, 73.9)	92.8 (91.6, 94.1)
1 – One	10.9 (10.8, 11.0)	10.9 (10.8, 11.1)	4.3 (3.4, 5.2)
2 – Two	9.7 (9.6, 9.9)	9.8 (9.6, 9.9)	2.3 (1.4, 3.1)
3 – Three or more	5.6 (5.4, 5.7)	5.6 (5.5, 5.7)	0.62 (0.22, 1.02)

(continued)

Table 1. Continued

Survey question	All respondents (N = 282,768)	No past year use (N = 279,136)	Past year use (N = 3,632)
Employment status*			
Under 18			
1 – Employed full time	4.6 (4.3, 4.8)	4.5 (4.2, 4.8)	8.8 (5.9, 11.8)
2 – Employed part time	24.1 (23.6, 24.7)	24.0 (23.4, 24.6)	33.1 (28.1, 38.0)
3 – Unemployed	10.8 (10.4, 11.2)	10.7 (10.3, 11.1)	16.3 (12.8, 19.8)
4 – Other	60.5 (59.8, 61.2)	60.8 (60.1, 61.5)	41.7 (36.4, 47.1)
Age 18+			
1 – Employed full time	49.4 (49.1, 49.8)	49.4 (49.0, 49.8)	50.6 (47.8, 53.3)
2 – Employed part time	13.1 (12.9, 13.3)	13.0 (12.8, 13.2)	25.4 (23.2, 27.7)
3 – Unemployed	4.3 (4.2, 4.5)	4.3 (4.1, 4.4)	9.7 (8.3, 11.2)
4 – Other	33.2 (32.8, 33.5)	33.3 (32.9, 33.7)	14.3 (12.6, 15.9)
Total Family Income*			
1 – Less than $20,000	16.2 (15.9, 16.5)	16.1 (15.8, 16.4)	25.4 (23.3, 27.5)
2 – $20,000 – $49,999	29.3 (28.9, 29.6)	29.3 (28.9, 29.7)	29.7 (27.5, 31.8)
3 – $50,000 – $74,999	15.8 (15.6, 16.1)	15.9 (15.6, 16.1)	14.6 (12.9, 16.4)
4 – $75,000 or More	38.7 (38.1, 39.2)	38.8 (38.2, 39.3)	30.3 (27.6, 33.0)
Poverty level (% of US census poverty threshold)*			
1 – Living in poverty	14.8 (14.5, 15.1)	14.7 (14.4, 15.0)	20.5 (19.0, 22.0)
2 – Income Up to 2X Fed Pov Thresh	20.0 (19.7, 20.3)	20.0 (19.7, 20.2)	22.0 (20.0, 23.9)
3 – Income More Than 2X Fed Pov Thresh	65.2 (64.8, 65.7)	65.3 (64.8, 65.8)	57.6 (55.4, 59.7)
# Religious services past 12 months			
1 – 25 or More	68.1 (67.8, 68.3)	68.0 (67.8, 68.3)	69.8 (67.9, 71.7)
2 – Less than 25	31.9 (31.7, 32.2)	32.0 (31.7, 32.2)	30.2 (28.3, 32.1)
Ever arrested and booked for breaking the law	15.6 (15.4, 15.9)	15.5 (15.3, 15.7)	33.7 (31.2, 36.2)
# Times arrested and booked past 12 months			
None	87.9 (87.5, 88.3)	88.2 (87.8, 88.6)	69.4 (65.0, 73.9)
Once	9.0 (8.6, 9.4)	8.8 (8.4, 9.1)	22.0 (18.3, 25.6)
Twice	2.1 (1.9, 2.3)	2.1 (1.9, 2.3)	6.0 (3.9, 8.1)
Three or more	0.95 (0.83, 1.07)	0.92 (0.80, 1.05)	2.6 (1.4, 3.9)
Stayed overnight as inpnt in hosp past 12 mos	9.5 (9.4, 9.7)	9.6 (9.4, 9.8)	8.1 (6.9, 9.2)
Past year serious psychological distress indicator	11.3 (11.1, 11.5)	11.1 (10.9, 11.3)	36.3 (33.8, 38.8)
Attempted to kill self in past year	0.56 (0.52, 0.60)	0.54 (0.50, 0.58)	3.9 (2.9, 4.9)

Frequencies presented are unweighted counts. Unless otherwise noted, weighted proportions and 95% confidence intervals are reported. *Imputed or recoded variable reported. All associations except for number of religious services were significantly associated with past-year LSD use, $p < 0.01$. SAS Survey Procedures used for all analyses.

DISCUSSION

This study provides a detailed look at past-year LSD users in the U.S. from 2015 to 2019. Our findings support other recent observations indicating growing LSD use in the U.S (Killion et al., 2021; R. A. Yockey et al., 2020), with past-year LSD use increasing by 47% from 0.59% to 0.87% between 2015 and 2019. Considering that the 2019 past-year use prevalence was 65.1% for alcohol, 26.2% for tobacco products, 17.5% for marijuana, 3.7% for opioids, 2.0% for cocaine, 1.9% tranquilizers, and 1.8% for stimulants (Center for Behavioral Health Statistics and Quality, 2019a, 2019b), LSD remains an uncommonly used drug in the United States. Notably, despite recent increases in past-year LSD use, there was not a statistically significant increase in the proportion of past-year LSD users among people with a lifetime history of hallucinogen use disorder. Future studies may explore the possibility that other hallucinogens may be more strongly associated with that diagnosis than LSD.

On multivariable analysis, we found that the people most likely to use LSD in the past year were unmarried, non-Hispanic White or Asian men under the age of 26, with no children in the home, with previous alcohol and other substance use, who are employed part-time, earning less than twice the federal poverty threshold, perceive LSD use to be low risk, and have easier access to LSD. Education level appears unrelated to the risk of LSD use, as does urbanicity and sexual identity. Past-year LSD use's lack of association with previous arrest history, hospitalization, and psychological distress suggests that LSD does not significantly contribute to crime or psychiatric problems in the US,

Table 2. Demographic characteristics for all study respondents by past-year LSD use per study year

Demographic characteristics	2015 (N = 57,146)	2016 (N = 56,897)	2017 (N = 56,276)	2018 (N = 56,313)	2019 (N = 56,136)
Past year LSD use	0.59 (0.53, 0.65)	0.71 (0.61, 0.80)	0.81 (0.71, 0.91)	0.84 (0.73, 0.96)	0.87 (0.79, 0.96)
Change from previous year	–	0.12% (20.3%)	0.1% (14.1%)	0.03% (3.7%)	0.03% (3.6%)
Age groups[2,3]					
No LSD use					
age: 12–17	9.3 (9.0, 9.5)	9.2 (9.0, 9.4)	9.1 (8.9, 9.4)	9.1 (8.8, 9.4)	9.0 (8.7, 9.3)
age: 18–25	12.7 (12.4, 13.1)	12.5 (12.1, 12.9)	12.2 (11.8, 12.7)	12.1 (11.8, 12.4)	11.9 (11.6, 12.2)
age: 26–34	14.3 (13.8, 14.8)	14.4 (13.9, 14.8)	14.5 (14.1, 14.9)	14.5 (14.0, 15.0)	14.5 (14.1, 15.0)
age: 35–49	22.7 (22.1, 23.3)	22.7 (22.1, 23.2)	22.5 (22.0, 23.1)	22.5 (22.1, 22.9)	22.3 (21.8, 22.7)
age: 50+	41.0 (40.1, 41.9)	41.3 (40.4, 42.1)	41.6 (40.7, 42.5)	41.8 (41.1, 42.5)	42.3 (41.4, 43.1)
Past year LSD use					
age: 12–17	16.1 (12.9, 19.2)	10.7 (7.9, 13.5)	12.5 (10.0, 14.9)	8.4 (6.6, 10.2)	12.0 (9.4, 14.6)
age: 18–25	63.7 (58.6, 68.7)	61.0 (54.5, 67.4)	57.2 (51.2, 63.2)	52.5 (47.8, 57.2)	51.2 (45.9, 56.5)
age: 26–34	16.3 (11.6, 20.9)	21.3 (15.0, 27.5)	17.9 (12.5, 23.3)	28.8 (23.0, 34.5)	26.5 (21.5, 31.4)
age: 35–49	2.5 (0.50, 4.4)	7.1 (3.4, 10.8)	7.4 (4.5, 10.2)	7.9 (4.3, 11.6)	7.1 (4.5, 9.7)
age: 50+	1.5 (0.00, 3.7)	0	5.1 (0.96, 9.1)	2.4 (0.00, 5.1)	3.3 (0.60, 5.9)
Gender male[1]					
No LSD use	48.3 (47.7, 49.0)	48.3 (47.7, 49.0)	48.4 (47.8, 48.9)	48.3 (47.7, 49.0)	48.3 (47.7, 49.0)
Past year LSD use	67.7 (62.9, 72.5)	69.6 (64.3, 75.0)	65.0 (60.1, 70.0)	68.4 (63.4, 73.5)	68.6 (64.1, 73.2)
Sexual identity[2]					
No LSD Use					
Heterosexual, that is, straight	95.1 (94.8, 95.3)	95.1 (94.7, 95.4)	94.5 (94.2, 94.8)	94.1 (93.8, 94.4)	93.6 (93.3, 93.9)
Lesbian or gay	1.8 (1.6, 2.0)	1.8 (1.6, 2.0)	2.0 (1.7, 2.2)	1.9 (1.7, 2.1)	2.0 (1.8, 2.2)
Bisexual	2.5 (2.4, 2.7)	2.5 (2.2, 2.7)	3.0 (2.8, 3.2)	3.3 (3.1, 3.5)	3.8 (3.6, 4.0)
Don't know	0.60 (0.49, 0.72)	0.65 (0.53, 0.78)	0.57 (0.44, 0.70)	0.71 (0.58, 0.84)	0.66 (0.54, 0.78)
Past year LSD use					
Heterosexual, that is, straight	85.1 (80.0, 90.2)	82.2 (77.4, 86.9)	80.7 (77.0, 84.5)	83.3 (80.0, 86.7)	76.5 (70.7, 82.3)
Lesbian or gay	3.4 (1.4, 5.3)	6.4 (3.2, 9.7)	2.9 (1.5, 4.2)	3.4 (1.2, 5.5)	4.8 (1.5, 8.1)
Bisexual	11.2 (6.9, 15.4)	11.0 (7.8, 14.3)	15.1 (11.5, 18.7)	13.0 (10.3, 15.6)	17.3 (12.5, 22.2)
Don't know	0.34 (0.00, 1.01)	0.38 (0.00, 0.96)	1.3 (0.00, 3.0)	0.33 (0.00, 0.90)	1.3 (0.08, 2.6)
Race[2]					
No LSD use					
NonHisp white	63.7 (62.7, 64.6)	63.3 (62.4, 64.2)	62.7 (61.8, 63.6)	62.3 (61.4, 63.2)	61.9 (60.9, 62.9)
NonHisp Black/Afr Am	12.0 (11.4, 12.6)	12.0 (11.4, 12.6)	12.1 (11.4, 12.8)	12.1 (11.5, 12.7)	12.2 (11.4, 12.9)
NonHisp Asian	5.5 (5.0, 5.9)	5.4 (5.0, 5.8)	5.6 (5.3, 6.0)	5.7 (5.2, 6.1)	5.8 (5.3, 6.3)
Hispanic	16.3 (15.6, 16.9)	16.5 (15.9, 17.1)	16.8 (16.0, 17.6)	17.1 (16.3, 17.9)	17.2 (16.5, 18.0)
Other	2.6 (2.4, 2.8)	2.8 (2.6, 3.0)	2.7 (2.5, 3.0)	2.9 (2.6, 3.1)	2.9 (2.7, 3.1)
Past Year LSD Use					
NonHisp White	71.5 (67.0, 76.0)	71.6 (66.2, 77.1)	72.6 (68.0, 77.1)	70.2 (64.8, 75.6)	69.8 (65.2, 74.5)
NonHisp Black/Afr Am	5.0 (2.9, 7.2)	3.9 (1.8, 6.0)	4.8 (1.8, 7.9)	4.6 (3.0, 6.2)	4.1 (2.3, 5.8)
NonHisp Asian	3.4 (1.6, 5.2)	4.1 (1.7, 6.4)	3.4 (1.2, 5.6)	6.1 (3.7, 8.4)	3.8 (1.8, 5.8)
Hispanic	15.1 (11.2, 19.1)	16.7 (12.1, 21.3)	14.9 (11.6, 18.1)	13.5 (10.3, 16.7)	17.5 (13.6, 21.5)
Other	4.9 (3.0, 6.9)	3.7 (2.3, 5.2)	4.3 (2.2, 6.3)	5.6 (3.1, 8.1)	4.8 (2.3, 7.2)
Marital status[1,2,3]					
No LSD use					
Married	50.4 (49.6, 51.1)	49.4 (48.6, 50.2)	49.6 (48.7, 50.6)	49.4 (48.5, 50.2)	48.8 (48.0, 49.6)
Widowed	6.0 (5.6, 6.4)	5.6 (5.2, 6.1)	5.3 (4.9, 5.6)	5.5 (5.1, 5.8)	6.0 (5.7, 6.3)
Divorced or separated	13.3 (12.8, 13.8)	13.3 (12.8, 13.8)	13.1 (12.6, 13.7)	13.2 (12.7, 13.7)	13.2 (12.6, 13.8)
Never been married	30.3 (29.8, 30.9)	31.6 (30.9, 32.4)	32.0 (31.2, 32.7)	31.9 (31.2, 32.6)	32.0 (31.4, 32.6)
Past year LSD use					
Married	5.7 (3.0, 8.5)	5.6 (2.4, 8.8)	8.2 (5.0, 11.3)	7.9 (4.2, 11.6)	10.1 (5.0, 15.1)
Widowed	1.03 (0.05, 2.0)	0.16 (0.00, 0.47)	1.2 (0.00, 3.6)	0	0.29 (0.00, 0.87)
Divorced or separated	5.3 (1.6, 8.9)	3.3 (1.5, 5.0)	4.5 (1.08, 7.9)	4.0 (1.6, 6.4)	5.8 (3.1, 8.5)
Never been married	88.0 (83.8, 92.1)	91.0 (87.3, 94.6)	86.1 (81.4, 90.8)	88.1 (84.0, 92.2)	83.9 (79.2, 88.5)
Urbanicity					
No LSD use					
Large metro	55.9 (54.8, 57.0)	55.8 (54.9, 56.6)	56.2 (55.5, 56.9)	55.7 (54.7, 56.7)	55.9 (54.9, 56.8)
Small metro	30.4 (29.4, 31.5)	29.9 (28.9, 30.8)	29.2 (28.5, 30.0)	29.9 (28.8, 30.9)	30.3 (29.4, 31.2)
Nonmetro	13.7 (13.0, 14.4)	14.3 (13.5, 15.2)	14.5 (13.8, 15.3)	14.4 (13.6, 15.3)	13.8 (13.0, 14.7)

(continued)

Table 2. Continued

Demographic characteristics	2015 (N = 57,146)	2016 (N = 56,897)	2017 (N = 56,276)	2018 (N = 56,313)	2019 (N = 56,136)
Past year LSD use					
Large metro	60.4 (54.9, 66.0)	60.9 (55.2, 66.6)	60.9 (55.7, 66.2)	62.3 (57.4, 67.2)	53.2 (48.1, 58.3)
Small metro	29.2 (24.7, 33.7)	28.9 (23.1, 34.7)	27.4 (22.6, 32.2)	28.5 (24.2, 32.7)	32.3 (27.7, 36.9)
Nonmetro	10.3 (6.9, 13.8)	10.2 (7.3, 13.1)	11.6 (8.8, 14.4)	9.2 (6.5, 12.0)	14.5 (10.3, 18.7)
Education groups[1,2]					
No LSD use					
Some HS, no diploma	22.0 (21.5, 22.5)	20.8 (20.3, 21.3)	20.2 (19.5, 20.9)	20.3 (19.8, 20.8)	19.9 (19.3, 20.4)
HS diploma/GED	23.1 (22.4, 23.9)	23.0 (22.5, 23.6)	22.2 (21.6, 22.8)	22.7 (22.1, 23.3)	22.2 (21.7, 22.8)
Some college, no de	19.2 (18.6, 19.7)	19.6 (19.1, 20.0)	19.7 (19.1, 20.2)	19.7 (19.2, 20.2)	19.4 (18.8, 19.9)
2-year college degr	8.5 (8.1, 8.8)	8.4 (7.9, 8.8)	8.5 (8.1, 8.9)	8.4 (8.0, 8.7)	8.5 (8.1, 8.9)
4-year college degr	27.2 (26.4, 28.0)	28.2 (27.4, 29.0)	29.4 (28.4, 30.3)	28.9 (28.0, 29.9)	30.1 (29.3, 30.8)
Past year LSD use					
Some HS, no diploma	24.5 (20.2, 28.9)	19.9 (16.0, 23.9)	18.5 (15.4, 21.5)	14.0 (10.9, 17.0)	17.4 (14.0, 20.9)
HS diploma/GED	21.7 (18.0, 25.4)	22.4 (16.7, 28.1)	22.5 (17.7, 27.3)	17.6 (13.9, 21.2)	22.6 (18.0, 27.1)
Some college, no de	33.2 (27.9, 38.5)	37.0 (31.0, 43.1)	32.6 (27.3, 37.9)	33.1 (28.6, 37.7)	29.2 (24.5, 33.8)
2-year college degr	5.4 (3.0, 7.8)	7.0 (4.1, 9.8)	5.3 (3.4, 7.2)	6.9 (4.2, 9.5)	7.9 (5.4, 10.4)
4-year college degr	15.1 (11.4, 18.8)	13.6 (9.5, 17.8)	21.2 (16.1, 26.3)	28.5 (23.3, 33.7)	22.9 (18.2, 27.7)
Employment Status[1,2]					
No LSD use					
Employed full time	46.6 (45.9, 47.3)	47.0 (46.3, 47.7)	47.6 (46.9, 48.3)	47.5 (46.7, 48.3)	47.5 (46.7, 48.3)
Employed part time	13.8 (13.4, 14.2)	13.5 (12.9, 14.1)	13.5 (13.1, 13.9)	13.4 (13.0, 13.8)	13.4 (13.0, 13.9)
Unemployed	5.0 (4.7, 5.2)	4.8 (4.5, 5.1)	4.6 (4.4, 4.9)	4.3 (4.0, 4.6)	4.2 (4.0, 4.5)
Other	34.6 (33.8, 35.5)	34.7 (34.0, 35.3)	34.3 (33.5, 35.1)	34.7 (33.9, 35.5)	34.8 (34.0, 35.6)
Past year LSD use					
Employed full time	44.5 (39.2, 49.8)	42.6 (36.5, 48.6)	47.9 (42.3, 53.4)	50.3 (46.1, 54.6)	45.0 (39.5, 50.4)
Employed part time	27.4 (22.1, 32.7)	29.8 (24.2, 35.3)	22.5 (17.8, 27.2)	25.8 (21.3, 30.2)	26.4 (22.0, 30.8)
Unemployed	8.0 (5.4, 10.6)	11.8 (8.3, 15.4)	11.5 (7.7, 15.4)	9.6 (6.4, 12.7)	10.7 (7.6, 13.7)
Other	20.1 (16.0, 24.1)	15.8 (12.1, 19.6)	18.1 (14.6, 21.6)	14.4 (11.4, 17.3)	18.0 (14.0, 22.0)
Total family income[1,2]					
No LSD use					
Less than $20,000	17.7 (17.1, 18.3)	16.8 (16.1, 17.4)	16.0 (15.3, 16.7)	15.6 (15.0, 16.2)	14.6 (14.1, 15.1)
$20,000 – $49,999	29.8 (29.1, 30.6)	29.8 (29.1, 30.6)	29.3 (28.5, 30.0)	29.2 (28.5, 29.8)	28.3 (27.4, 29.1)
$50,000 – $74,999	16.5 (15.9, 17.0)	15.8 (15.2, 16.4)	15.7 (15.2, 16.2)	15.4 (15.0, 15.9)	15.8 (15.3, 16.3)
$75,000 or More	36.0 (35.1, 36.9)	37.6 (36.6, 38.5)	39.0 (38.1, 40.0)	39.8 (38.9, 40.8)	41.3 (40.3, 42.3)
Past year LSD use					
Less than $20,000	23.9 (19.2, 28.6)	27.5 (22.3, 32.6)	28.8 (23.6, 33.9)	24.4 (19.6, 29.1)	22.8 (18.3, 27.2)
$20,000 – $49,999	33.3 (28.7, 38.0)	27.7 (23.5, 32.0)	24.8 (21.1, 28.4)	32.7 (28.5, 36.8)	30.4 (25.9, 34.8)
$50,000 – $74,999	12.9 (8.6, 17.1)	17.3 (13.1, 21.4)	16.5 (12.8, 20.2)	11.6 (8.2, 15.0)	14.9 (11.5, 18.3)
$75,000 or More	29.9 (24.7, 35.1)	27.6 (22.1, 33.0)	30.0 (25.3, 34.7)	31.4 (26.4, 36.3)	32.0 (26.5, 37.5)
Poverty level (% of US census poverty threshold)[1,2]					
No LSD use					
Living in poverty	15.9 (15.4, 16.4)	15.1 (14.6, 15.7)	14.5 (13.9, 15.1)	14.6 (14.1, 15.1)	13.6 (13.2, 14.1)
Income Up to 2X Fed Pov Thresh	20.4 (19.7, 21.1)	20.4 (19.8, 21.0)	20.1 (19.4, 20.7)	19.9 (19.3, 20.4)	19.2 (18.6, 19.8)
Income More Than 2X Fed Pov Thresh	63.7 (62.9, 64.6)	64.5 (63.7, 65.3)	65.5 (64.5, 66.5)	65.6 (64.7, 66.4)	67.2 (66.3, 68.1)
Past year LSD use					
Living in poverty	18.4 (14.6, 22.1)	21.3 (17.3, 25.4)	23.5 (19.0, 28.0)	19.7 (15.8, 23.6)	19.2 (15.2, 23.1)
Income Up to 2X Fed Pov Thresh	22.4 (17.7, 27.1)	22.2 (17.0, 27.3)	19.4 (15.7, 23.1)	23.8 (19.3, 28.2)	22.1 (18.1, 26.1)
Income More Than 2X Fed Pov Thresh	59.2 (54.0, 64.4)	56.5 (51.9, 61.1)	57.1 (51.3, 62.9)	56.5 (50.4, 62.7)	58.7 (53.4, 64.1)
# Religious services past 12 months[2]					
No LSD use					
25 or More	67.3 (66.7, 67.9)	67.5 (66.9, 68.0)	68.3 (67.5, 69.1)	68.7 (67.9, 69.4)	68.5 (67.8, 69.2)
Less than 25	32.7 (32.1, 33.3)	32.5 (32.0, 33.1)	31.7 (30.9, 32.5)	31.3 (30.6, 32.1)	31.5 (30.8, 32.2)

(continued)

Table 2. Continued

Demographic characteristics	2015 (N = 57,146)	2016 (N = 56,897)	2017 (N = 56,276)	2018 (N = 56,313)	2019 (N = 56,136)
Past year LSD use					
25 or More	66.3 (61.4, 71.2)	69.5 (64.7, 74.2)	68.8 (64.7, 72.9)	71.2 (66.4, 76.0)	71.9 (67.1, 76.8)
Less than 25	33.7 (28.8, 38.6)	30.5 (25.8, 35.3)	31.2 (27.1, 35.3)	28.8 (24.0, 33.6)	28.1 (23.2, 32.9)

Frequencies presented are unweighted counts Weighted proportions and 95% confidence intervals are reported. [1]Imputed or recoded variable reported p-values: a = linear regression; b = linear regression with log transformation; c = Rao-Scott chi-square test. The association between past-Year LSD use and urbanicity was only significant in 2018. All other covariates were significantly associated with LSD use within each survey year ($p < 0.001$). [2]There was significant difference in LSD use in 2015 vs 2019. [3]There was a significant increasing in trend in LSD use across the survey interval. All associations are adjusted for survey year, age, employment, education, race, and urbanicity. SAS Survey procedures used for all analysis.

though an important exception requiring further exploration was the association between past-year LSD use and past-year suicide attempt in people 18 and older. While we are unaware of reports of suicide attempts in recent clinical trials of LSD (Gasser et al., 2014, 2015; Holze et al., 2020; MindMed, 2022), a large survey of clinicians and researchers treating patients with LSD reported no suicide attempts in research subjects, but 1.2 for every 1,000 patients treated in the community (Cohen, 1960). While no conclusion can be made about causality from the data, it is possible that some individuals using LSD may be vulnerable to suicide attempts following use. However, it is also possible that people prone to suicide attempts or who have recently had one are using LSD to self-treat mental illness (Kopra et al., 2023), perhaps due to recent favorable media coverage of psychedelic-assisted therapy clinical trials. Unfortunately, information about the temporal relationship between past-year LSD use and suicide attempts, as well as motivators for LSD use, are not collected by the NSDUH, preventing clarification on this topic.

We found that people more likely to use LSD have considerable lifetime drug experience, regardless of age. Notably, the proportion of people who had not used LSD in the past year who believed that using LSD once or twice a week was a "great risk" was more than twice as high as the proportion who believed that using marijuana or having five or more alcoholic drinks once or twice a week was a "great risk." Only a slightly smaller proportion of non-LSD users believed that using LSD once or twice a week was a "great risk" compared to the proportions believing that using cocaine or heroin twice a week was a "great risk." These findings suggest that LSD is still considered a "hard" drug by most of the population despite users only rarely needing emergency medical treatment following use (Kopra et al., 2022). Interestingly, while the perceived risk of LSD was predictably lower in users, most users still considered using LSD once or twice a week to be a "moderate" or "great" risk. This might speak to the sometimes-unpredictable nature of the psychedelic experience, which may contribute to LSD's low addictive potential.

While we found a decreased risk of LSD use among Black participants on univariate analysis, we found no statistically significant association between being Black and LSD use on multivariate analysis, suggesting confounding factors may explain this previous finding. Previous research has found that Black people may be less likely to use LSD and other psychedelics than White people (Jahn, Lopez, de la Salle, Faber, & Williams, 2021), though that study did not control for confounders. Increased risk for lifetime psilocybin use was observed in bisexual participants of a recent study also employing NSDUH data (A. Yockey & King, 2021), possibly secondary to efforts by bisexual users to employ psilocybin as a means of coping with the effects of minority stress. In contrast, we identified no relationship between past-year LSD use and sexual identity on multivariable analysis. Regarding another aspect of sexual health, we found no association between past-year LSD use and past-year sexually transmitted infections (STIs). Notably, a 2010 study using NSDUH data found that the duration of hallucinogen use was positively associated with the risk of lifetime STI diagnosis (Han, Gfroerer, & Colliver, 2010).

The differences in correlates between our under age 18 and our 18+ models included increased odds of LSD use among participants under 18 who reported overnight stays in a hospital during the past year or lifetime tobacco use. Unlike in adults, there were no associations with LSD use among participants under 18 who were non-Hispanic Asian race, had higher income, or had children in the home.

Finally, we observed a small number of demographic changes in past-year LSD users from 2015–2019. The proportion of LSD users among lifetime users of all substances analyzed remained unchanged during the study period, except for methamphetamine. Methamphetamine use grew during the study period, and its use is associated with polysubstance use, including growing co-occurring opioid use (Jones, Compton, & Mustaquim, 2020, 2022) and use among people who use LSD (Palamar, Han, & Keyes, 2020). It is unknown whether our finding represents increase simultaneous use of methamphetamine and LSD. Combining LSD with 3,4- Methylenedioxy methamphetamine (MDMA) for synergistic MDMA effects is well known and referred to as "candyflipping" (Chary, Yi, & Manini, 2018; Schechter, 1998). However, combining LSD and other stimulants appears to be less common (Licht et al., 2012). In the case of methamphetamine, this may be due to an increased risk of "bad trips" (Smith & Rose, 1968) or diminution of LSD's effects (Passie, Halpern, Stichtenoth, Emrich, & Hintzen, 2008). As observed in another

Table 3. Univariable and multivariable odds ratios for the risk of past-year LSD use among all respondents and stratified by age

Factor	Univariable AOR	Multivariable AOR		
		All Ages (n = 265,187)	Age 18+ yrs (n = 198,295)	Under Age 18 (n = 59,315)
Age groups – reference: age: 18–25				
age: 12–17	0.43 (0.39, 0.48)***	1.39 (1.09, 1.76)*		
age: 26–34	1.04 (0.97, 1.11)	0.40 (0.36, 0.45)***	0.41 (0.36, 0.46)***	
age: 35–49	1.80 (1.66, 1.95)***	0.16 (0.12, 0.21)***	0.16 (0.12, 0.22)***	
age: 50+	1.73 (1.57, 1.91)***	0.05 (0.03, 0.09)***	0.06 (0.03, 0.10)***	
Education – reference: 4-year college degree				
Some HS, no diploma	0.75 (0.69, 0.82)***	1.12 (0.87, 1.44)	1.11 (0.87, 1.41)	
HS diploma/GED	0.94 (0.88, 1.00)	1.12 (0.92, 1.36)	1.11 (0.90, 1.36)	
Some college, no degree	1.24 (1.16, 1.32)***	1.12 (0.90, 1.38)	1.12 (0.90, 1.40)	
2-year college degree	1.18 (1.09, 1.28)***	0.90 (0.69, 1.18)	0.91 (0.69, 1.20)	
Employment status				
Employed part time	1.10 (1.01, 1.19)*	1.32 (1.11, 1.55)*	1.30 (1.09, 1.55)*	
Unemployed	1.08 (0.97, 1.20)	1.13 (0.92, 1.39)	1.15 (0.92, 1.44)	
Other	0.72 (0.68, 0.76)***	0.96 (0.80, 1.14)	0.92 (0.76, 1.11)	
Under age 18	0.16 (0.12, 0.20)***	0.95 (0.60, 1.49)		
Marital status – reference: never been married				
Married	0.58 (0.54, 0.61)***	0.65 (0.49, 0.87)*	0.65 (0.49, 0.87)*	
Widowed	0.45 (0.39, 0.53)***	0.89 (0.25, 3.22)	0.95 (0.26, 3.38)	
Divorced/separated	0.92 (0.85, 0.99)*	1.00 (0.72, 1.38)	0.98 (0.71, 1.37)	
Gender: female vs male	0.74 (0.70, 0.77)***	0.81 (0.73, 0.90)***	0.77 (0.67, 0.89)***	0.68 (0.53, 0.89)*
Sexual identity – reference: heterosexual, that is, straight				
Lesbian or gay	1.22 (0.95, 1.56)	not asked of <18 yrs	0.86 (0.65, 1.15)	
Bisexual	2.21 (1.88, 2.61)***		1.21 (0.99, 1.49)	
Don't know	1.90 (0.90, 4.01)		2.23 (0.95, 5.23)	
Race – reference: non-hispanic white				
Other	0.86 (0.76, 0.96)*	1.10 (0.84, 1.44)	1.05 (0.78, 1.43)	1.46 (0.99, 2.15)
Non-Hispanic black	0.17 (0.15, 0.19)***	0.91 (0.70, 1.19)	0.91 (0.69, 1.20)	0.76 (0.38, 1.50)
Non-Hispanic Asian	0.26 (0.22, 0.31)***	1.40 (1.02, 1.92)*	1.47 (1.06, 2.03)*	0.56 (0.17, 1.86)
Hispanic	0.43 (0.39, 0.46)***	0.96 (0.81, 1.14)	0.96 (0.77, 1.19)	1.04 (0.74, 1.46)
County metro/non-metro status – reference: large metro				
Small metro	0.89 (0.84, 0.94)***	0.97 (0.87, 1.09)	0.98 (0.86, 1.11)	0.90 (0.71, 1.15)
Nonmetro	0.71 (0.66, 0.76)***	1.14 (0.93, 1.41)	1.13 (0.91, 1.41)	1.11 (0.71, 1.73)
Poverty level – reference: living in poverty				
Income Up to 2X Fed Pov Threshold	0.94 (0.82, 1.08)	0.92 (0.78, 1.09)	0.92 (0.76, 1.10)	1.34 (0.94, 1.92)
Income >2X Fed Pov Thresh	0.83 (0.74, 0.92)***	0.72 (0.62, 0.83)***	0.69 (0.59, 0.82)***	1.36 (0.97, 1.90)
Number of children in the home – reference: none				
One child	0.45 (0.36, 0.58)***	0.51 (0.41, 0.64)***	0.52 (0.42, 0.66)***	0.36 (0.02, 6.67)
2 children	0.35 (0.23, 0.53)***	0.44 (0.29, 0.65)***	0.45 (0.30, 0.67)***	low sample size
3 or more children	0.18 (0.09, 0.34)***	0.23 (0.12, 0.46)***	0.24 (0.12, 0.47)***	low sample size
Ever been arrested	4.89 (4.66, 5.13)***	1.08 (0.91, 1.27)	1.07 (0.89, 1.27)	1.39 (1.00, 1.94)
Mental health				
Inpatient overnight stay	1.45 (1.21, 1.74)***	1.18 (0.97, 1.44)	0.92 (0.73, 1.16)	1.55 (1.13, 2.12)*
Past-year serious psych distress	2.00 (1.78, 2.26)	not asked of <18 yrs	1.04 (0.90, 1.20)	
Attempted to kill self in the last year	2.88 (2.12, 3.93)	not asked of <18 yrs	1.65 (1.11, 2.47)*	
Lifetime drug use				
Tobacco use	11.20 (9.34, 13.43)***	1.23 (0.98, 1.55)	0.99 (0.77, 1.26)	2.25 (1.48, 3.42)***
Alcohol use	22.42 (15.79, 31.83)***	1.83 (1.25, 2.69)*	1.51 (0.84, 2.72)	1.92 (1.14, 3.23)*
Marijuana use	61.39 (42.37, 88.97)***	7.75 (5.12, 11.73)***	7.79 (4.61, 13.17)***	7.26 (4.21, 12.51)***
Any stimulant use	14.21 (12.26, 16.46)***	2.02 (1.74, 2.35)***	2.03 (1.70, 2.41)***	2.29 (1.72, 3.07)***
Any sedative use	7.15 (6.28, 8.13)***	1.50 (1.31, 1.71)***	1.41 (1.24, 1.61)***	2.12 (1.60, 2.80)***
Any hallucinogen use	21.76 (18.67, 25.36)***	4.36 (3.65, 5.20)***	4.27 (3.45, 5.27)***	4.87 (3.81, 6.23)***
Approached by drug seller	4.55 (4.13, 5.02)***	1.33 (1.17, 1.52)***	1.34 (1.16, 1.55)***	1.36 (1.06, 1.76)*

(continued)

Table 3. Continued

Factor	Univariable AOR	Multivariable AOR		
		All Ages (n = 265,187)	Age 18+ yrs (n = 198,295)	Under Age 18 (n = 59,315)
Difficulty of getting LSD – reference: Probably impossible/don't know				
Very difficult	5.20 (3.65, 7.41)***	2.64 (1.84, 3.78)***	2.59 (1.76, 3.83)***	3.82 (1.93, 7.54)***
Fairly difficult	13.13 (9.33, 18.48)***	4.23 (3.04, 5.89)***	4.26 (2.94, 6.17)***	4.80 (2.80, 8.22)***
Fairly easy	28.47 (19.59, 41.39)***	7.21 (4.95, 10.50)***	7.29 (4.84, 10.99)***	7.43 (3.80, 14.50)***
Very easy	42.91 (28.75, 64.04)***	9.63 (6.26, 14.83)***	9.30 (5.80, 14.93)***	11.14 (5.28, 23.47)***
Risk of trying LSD once or twice – reference: Great risk				
No risk	39.99 (33.08, 48.34)***	11.43 (9.37, 13.93)***	12.86 (10.12, 16.35)***	6.68 (4.46, 10.00)***
Slight risk	15.54 (12.86, 18.77)***	5.70 (4.56, 7.13)***	6.35 (4.84, 8.33)***	3.44 (2.31, 5.12)***
Moderate risk	3.90 (3.17, 4.79)***	2.34 (1.89, 2.91)***	2.49 (1.91, 3.26)***	1.84 (1.31, 2.57)***

Univariable adjusted odds ratios (AOR) were adjusted for survey year, age groups, gender, race, employment status, marital status, education, criminal arrest, and county metro area. SAS survey procedures were used for all analysis to adjust for the complex survey design.

recent study (Killion et al., 2021), we found that marriage may be a protective factor against LSD use, though this correlation could be due to confounders such as stage of life, personality, or lifestyle. It is also possible that problematic LSD use or associated drug use produces this finding by contributing to divorce. Notably, the proportion of married LSD users nearly doubled from 5.7% 2015 to 10.1% in 2019. Though most LSD users remain between the ages of 18 and 25, the proportion of LSD users aged 26-34 grew from 16.3 to 26.5% over the study period. Coupled with an overall increase in past-year LSD use during the study period, growth in use among married people and people aged 26-34 suggests that though LSD remains uncommonly used, societal acceptance of LSD use may be growing in the US.

Strengths and limitations

The primary strength of this study is its use of data from multiple administrations of a large, rigorously conducted survey employing a nationally representative survey sample. Limitations include the NSDUH's use of retrospective self-report by participants, which could result in underreporting of LSD and other substance use. However, the NSDUH's substance use self-report measures have high concordance with drug testing results (Harrison, Martin, Enev, & Acknowledgments, 2007). NSDUH participation restriction to the civilian non-institutionalized population is another important limitation. While this represents 97% of the US population (Substance Abuse and Mental Health Services Administration, 2021), the NSDUH excludes people living in institutional group quarters such as hospitals, prisons, nursing homes, and addiction treatment centers, who are likely to have important differences in past-year LSD use and demographics. The major limitation is that causation cannot be determined by this sort of data, and other study designs are needed to probe remaining questions on this topic as we have raised above. Further limitations include the fact that the NSDUH does not report number of LSD exposures, doses of LSD used, setting of use, or reasons for LSD use.

CONCLUSIONS

Past-year LSD use rose 47% from 2015–2019 in the US, though LSD continues to be used by only a sliver of the US population each year. Use is strongly associated with decreased risk perception around LSD and increased ease of access. Non-users of LSD still consider regular use of LSD to be much riskier than regular use of alcohol or marijuana, though slightly less risky than regular use of cocaine or heroin. With increases in the proportion of past-year LSD users aged 26–34 and married, we may be seeing the early stages of increased social acceptance of LSD use. We found no associations on multivariable analysis with unemployment, arrest history, past-year psychological distress, or STIs, suggesting that LSD does not significantly contribute significantly to public health problems in the US.

Funding: This work was unfunded.

Authors' contribution: Jeremy Weleff: conceptualization, methodology, writing- original draft writing, writing-review and editing. Elizabeth Dewey: data curation, methodology, formal analysis. Akhil Anand: conceptualization, writing-review and editing. Brian Barnett: conceptualization, methodology, writing- original draft writing, writing-review and editing, supervision.

Conflict of interest: Dr. Barnett has received stock options from CB Therapeutics as compensation for advisory services and monetary compensation for editorial work for DynaMed Plus (EBSCO Industries, Inc) and consulting services for Cerebral. The other authors report no potential conflicts of interest.

Data availability: Data are publicly available.

Disclosure of relationships and activities: BSB holds stock options for CB Therapeutics. He also serves on the advisory board of CB Therapeutics and Compass Pathways. He receives monetary compensation for editorial work for

DynaMed Plus (EBSCO Industries, Inc). He has received research funding from Compass Pathways and MindMed. He is a consultant for Janssen Pharmaceuticals and within the last two years he has consulted for Cerebral. The other authors report no potential conflicts of interest.

ACKNOWLEDGEMENTS

This work was supported by a non-monetary scientific collaboration award from the Cleveland Clinic Center for Populations Health Research awarded to Dr. Barnett.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1556/2054.2024.00309.

REFERENCES

Barnett, B. S., Parker, S. E., & Weleff, J. (2021). United States National Institutes of Health grant funding for psychedelic-assisted therapy clinical trials from 2006-2020. *International Journal of Drug Policy*, *99*, 103473. https://doi.org/10.1016/j.drugpo.2021.103473. Epub 2021 Oct 6. PMID: 34624734.

Center for Behavioral Health Statistics and Quality (2019a). *Section 1: Illicit drug use/misuse tables—1.1 to 1.123*. National Survey on Drug Use and Health. https://www.samhsa.gov/data/sites/default/files/reports/rpt29394/NSDUHDetailedTabs2019/NSDUHDetTabsSect1pe2019.htm.

Center for Behavioral Health Statistics and Quality (2019b). *Section 2: Tobacco product and alcohol use tables—2.1 to 2.35*. National Survey on Drug Use and Health. https://www.samhsa.gov/data/sites/default/files/reports/rpt29394/NSDUHDetailedTabs2019/NSDUHDetTabsSect2pe2019.htm.

Chary, M., Yi, D., & Manini, A. F. (2018). Candyflipping and other combinations: Identifying drug-drug combinations from an online forum. *Frontiers in Psychiatry*, *9*, 135. https://doi.org/10.3389/fpsyt.2018.00135.

Clarke, T. C., Black, L. I., Stussman, B. J., Barnes, P. M., & Nahin, R. L. (2015). Trends in the use of complementary health approaches among adults: United States, 2002-2012. *National Health Statistics Reports*, *79*, 1–16.

Cohen, S. (1960). Lysergic acid diethylamide: Side effects and complications. *The Journal of Nervous and Mental Disease*, *130*, 30–40. https://doi.org/10.1097/00005053-196001000-00005.

Gasser, P., Holstein, D., Michel, Y., Doblin, R., Yazar-Klosinski, B., Passie, T., & Brenneisen, R. (2014). Safety and efficacy of lysergic acid diethylamide-assisted psychotherapy for anxiety associated with life-threatening diseases. *The Journal of Nervous and Mental Disease*, *202*(7), 513–520. https://doi.org/10.1097/NMD.0000000000000113.

Gasser, P., Kirchner, K., & Passie, T. (2015). LSD-assisted psychotherapy for anxiety associated with a life-threatening disease: A qualitative study of acute and sustained subjective effects. *Journal of Psychopharmacology (Oxford, England)*, *29*(1), 57–68. https://doi.org/10.1177/0269881114555249.

Grof, S., Goodman, L. E., Richards, W. A., & Kurland, A. A. (1973). LSD-assisted psychotherapy in patients with terminal cancer. *International Pharmacopsychiatry*, *8*(3), 129–144. https://doi.org/10.1159/000467984.

Han, B., Blanco, C., Einstein, E. B., & Compton, W. M. (2022). Mental health conditions and receipt of mental health care by illicit lysergic acid diethylamide (LSD) use status among young adults in the United States. Addiction (Abingdon, England). https://doi.org/10.1111/add.15789.

Han, B., Gfroerer, J. C., & Colliver, J. D. (2010). Associations between duration of illicit drug use and health conditions: Results from the 2005–2007 national surveys on drug use and health. *Annals of Epidemiology*, *20*(4), 289–297. https://doi.org/10.1016/j.annepidem.2010.01.003.

Harrison, L., Martin, S., Enev, T., & Acknowledgments, D. (2007). *Comparing drug testing and self-report of drug use among youths and young adults in the general population*. https://doi.org/10.1037/e637122007-001.

Holze, F., Vizeli, P., Müller, F., Ley, L., Duerig, R., Varghese, N., et al. (2020). Distinct acute effects of LSD, MDMA, and D-amphetamine in healthy subjects. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology*, *45*(3), 462–471. https://doi.org/10.1038/s41386-019-0569-3.

Jahn, Z. W., Lopez, J., de la Salle, S., Faber, S., & Williams, M. T. (2021). Racial/ethnic differences in prevalence of hallucinogen use by age cohort: Findings from the 2018 National Survey on Drug Use and Health. *Journal of Psychedelic Studies*, *5*(2), 69–82. https://doi.org/10.1556/2054.2021.00166.

Jones, C. M., Compton, W. M., & Mustaquim, D. (2020). Patterns and characteristics of methamphetamine use among adults—United States, 2015–2018. *MMWR. Morbidity and Mortality Weekly Report*, *69*(12), 317–323. https://doi.org/10.15585/mmwr.mm6912a1.

Jones, C. M., Houry, D., Han, B., Baldwin, G., Vivolo-Kantor, A., & Compton, W. M. (2022). Methamphetamine use in the United States: Epidemiological update and implications for prevention, treatment, and harm reduction. *Annals of the New York Academy of Sciences*, *1508*(1), 3–22. https://doi.org/10.1111/nyas.14688.

Killion, B., Hai, A. H., Alsolami, A., Vaughn, M. G., Sehun Oh, P., & Salas-Wright, C. P. (2021). LSD use in the United States: Trends, correlates, and a typology of us. *Drug and Alcohol Dependence*, *223*, 108715. https://doi.org/10.1016/j.drugalcdep.2021.108715.

Kopra, E. I., Ferris, J. A., Rucker, J. J., McClure, B., Young, A. H., Copeland, C. S., et al. (2022). Adverse experiences resulting in emergency medical treatment seeking following the use of lysergic acid diethylamide (LSD). *Journal of Psychopharmacology (Oxford, England)*, *36*(8), 956–964. https://doi.org/10.1177/02698811221099650.

Kopra, E. I., Ferris, J. A., Winstock, A. R., Kuypers, K. P., Young, A. H., & Rucker, J. J. (2023). Investigation of self-treatment with lysergic acid diethylamide and psilocybin mushrooms: Findings from the Global Drug Survey 2020.

Journal of Psychopharmacology, *37*(7), 733–748. https://doi.org/10.1177/02698811231158245.

Krebs, T. S., & Johansen, P.-O. (2012). Lysergic acid diethylamide (LSD) for alcoholism: Meta-analysis of randomized controlled trials. *Journal of Psychopharmacology (Oxford, England)*, *26*(7), 994–1002. https://doi.org/10.1177/0269881112439253.

Licht, C. L., Christoffersen, M., Okholm, M., Damgaard, L., Fink-Jensen, A., Knudsen, G. M., et al. (2012). Simultaneous polysubstance use among Danish 3,4-methylenedioxymethamphetamine and hallucinogen users: Combination patterns and proposed biological bases. *Human Psychopharmacology*, *27*(4), 352–363. https://doi.org/10.1002/hup.2234.

MindMed (2022). *MindMed collaborators announce positive topline data from phase 2 trial evaluating LSD in anxiety disorders*. https://mindmed.co/news/press-release/mindmed-collaborators-announce-positive-topline-data-from-phase-2-trial-evaluating-lsd-in-anxiety-disorders/.

Palamar, J. J., Han, B. H., & Keyes, K. M. (2020). Trends in characteristics of individuals who use methamphetamine in the United States, 2015-2018. *Drug and Alcohol Dependence*, *213*, 108089. https://doi.org/10.1016/j.drugalcdep.2020.108089.

Passie, T., Halpern, J. H., Stichtenoth, D. O., Emrich, H. M., & Hintzen, A. (2008). The pharmacology of lysergic acid diethylamide: A review. *CNS Neuroscience & Therapeutics*, *14*(4), 295–314. https://doi.org/10.1111/j.1755-5949.2008.00059.x.

Ponieman, N. (2020). *Oregon becomes first US state to decriminalize drug possession, begins psilocybin program*. Benzinga. https://www.benzinga.com/markets/cannabis/20/11/18204455/oregon-becomes-first-us-state-to-decriminalize-drug-possession-begins-psilocybin-program.

Savage, C., & McCabe, O. L. (1973). Residential psychedelic (LSD) therapy for the narcotic addict. A controlled study. *Archives of General Psychiatry*, *28*(6), 808–814. https://doi.org/10.1001/archpsyc.1973.01750360040005.

Schauer, G. L., Berg, C. J., Kegler, M. C., Donovan, D. M., & Windle, M. (2016). Differences in tobacco product use among past month adult marijuana users and nonusers: Findings from the 2003–2012 national survey on drug use and health. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, *18*(3), 281–288. https://doi.org/10.1093/ntr/ntv093.

Schechter, M. D. (1998). "Candyflipping": Synergistic discriminative effect of LSD and MDMA. *European Journal of Pharmacology*, *341*(2–3), 131–134. https://doi.org/10.1016/s0014-2999(97)01473-8.

Smith, D. E., & Rose, A. J. (1968). The use and abuse of LSD in Haight-Ashbury (observations by the Haight-Ashbury medical clinic). *Clinical Pediatrics*, *7*(6), 317–322. https://doi.org/10.1177/000992286800700605.

Substance Abuse and Mental Health Services Administration (2019). *An overview of trend testing methods and applications in NSDUH and other studies*.

Substance Abuse and Mental Health Services Administration (2020a). *2019 National Survey on Drug Use and Health (NSDUH) methodological resource book: Section 2: Sample design report.*

Substance Abuse and Mental Health Services Administration (2020b). *2019 National Survey on Drug Use and Health (NSDUH): Methodological resource book, section 8, data collection final report*.

Substance Abuse and Mental Health Services Administration (2021). *2020 National Survey on Drug Use and Health Public Use File Codebook*.

Yockey, A., & King, K. (2021). Use of psilocybin ("mushrooms") among US adults: 2015–2018. *Journal of Psychedelic Studies*, *5*(1), 17–21. https://doi.org/10.1556/2054.2020.00159.

Yockey, A., King, K., & Vidourek, R. (2019). *Go Ask Alice, When She's 10 Feet Tall": Psychosocial correlates to lifetime LSD use among a national sample of adults*.

Yockey, R. A., Vidourek, R. A., & King, K. A. (2020). Trends in LSD use among US adults: 2015–2018. *Drug and Alcohol Dependence*, *212*, 108071. https://doi.org/10.1016/j.drugalcdep.2020.108071.