

The Epidemiology, Attitudes, and Pharmacology of LSD Use in the 1990s

Use of LSD, and hallucinogens in general, appears to be increasing, according to surveys of high school students.

by MARK S. GOLD, MD

After years of lying dormant, LSD (lysergic acid diethylamide) use, and hallucinogen use in general, appears to be increasing. We have recently reported data from our annual nationwide survey of 522,328 junior and senior high school students from schools across the United States.¹ This anonymous drug-use prevalence questionnaire was administered to all students in these schools and grades, and results from the past two years were compared. Hallucinogen use increased significantly ($p < 0.01$ chi-square), going from 4.9% to 5.3%. Annual hallucinogen use was 2.4% for eighth graders and 7.1% for 12th graders. These data are consistent with the National Institute on Drug Abuse report published April 13, 1993. The NIDA report found that the percentage of high school seniors reporting cocaine use in the past year had decreased from 7.9% in 1988 to 3.1% in 1992, while LSD use increased from 4.8% to 5.6%.² In addition, seizures of LSD were the third highest among illegal drugs, with over 500,000 LSD dosage units confiscated by the Drug Enforcement Administration in 1990.³

Dr. Gold is a Professor at the Brain Institute, Departments of Neuroscience and Psychiatry, University of Florida, College of Medicine.

Address reprint requests to Mark S. Gold, MD, University of Florida Brain Institute, PO Box 100244, Gainesville, FL 32610-0244.

FACTORS BEHIND THE LSD RESURGENCE

Data from the high school senior survey suggest that many young people believe that cocaine is more dangerous than LSD: only 42.3% of high school seniors report that there is "great risk" associated with LSD experimentation compared to 56.8% for cocaine. NIDA's high school senior survey also indicates an increased acceptance of LSD use among seniors: disapproval of LSD "experimentation" fell from 91.6% in 1987 to 88% in 1992. In our survey, young students appear to believe that LSD is "spiritually uplifting" and 55% of high school seniors believed that trying LSD a few times is not harmful. Perception of danger, which is integral to successful cocaine education and decreased cocaine use,⁴ does not appear to have been applied to LSD (see Figure).

More recently we have analyzed the class of 1993 PRIDE survey data from 236,745 students in 40 states in the United States. Those PRIDE survey data demonstrate that student drug use is accelerating. In 1993, annual and monthly use of marijuana increased significantly in all seven grade levels. Junior high students had significant increases in annual use of hallucinogens as well as for marijuana. Student reports of Ecstasy and/or LSD use associated with a dance club or rave were reported for the first time. Senior high students reported significant increases in cigarette, marijuana, and hallucinogen use when compared to the 1992 survey. LSD and hallucinogen use rose significantly on an annual basis for eight grade (2.4% vs. 2.7%), 11th grade (5.6% vs.

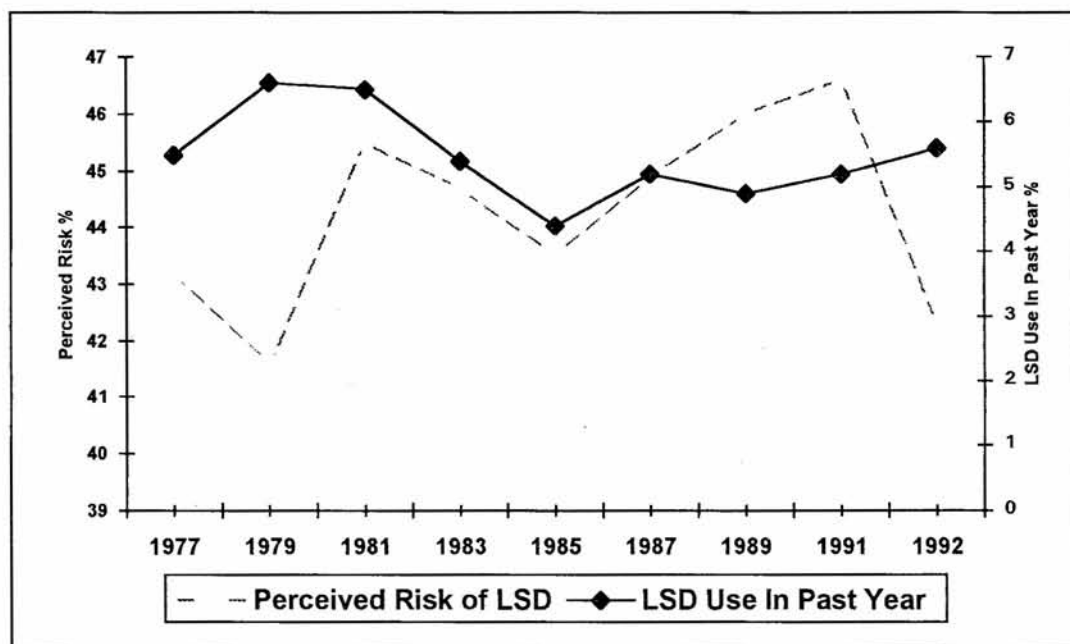


Figure. Perceived risk and use in past year for LSD.²

6.4%), and 12th grade (7.1% vs. 8.0%) with no decreases for any group in annual or monthly use. More students said marijuana was easier to get this year (30% vs. 25.9% last year) and fewer said that none of their friends smoke marijuana (66.8% vs. 71.4%). Perceptions of danger decreased with 77.1% agreeing that marijuana is "very much" harmful to your health. Similarly, more students said hallucinogens are easy to get (15.9% vs. 14.3%) and fewer said that none of their friends used LSD or other hallucinogens (88%). Only 80.3% said that hallucinogens are "very much" harmful to your health.

Data from the Drug Enforcement Administration suggest that LSD appears to have been reformulated at a lower dose, 20 to 80 micrograms per dose today, compared with 100 to 200 micrograms in the 1960s.³ This decrease in dosage strength coincides with an increase of 160% in the THC potency of marijuana. Apparently, LSD has been reformulated in order to make the drug more appealing to younger and first-time users. Reformulation may decrease the incidence of single-dose-related "bad trips" or emergency room visits by naive users. However, total LSD dose may be increasing as students report taking enough LSD to become "bombed": 83% of hallucinogen users reported most often getting "very high," "bombed," or "stoned" when they used LSD as compared to 24% of beer drinkers, 66% of marijuana smokers, and 74% of cocaine users. Also, data from animals suggest that LSD is exceptionally potent with low doses producing long-lasting effects on important neuronal systems.⁵ Already, emergency room visits for LSD are increasing in the United States.⁶

LSD'S PSYCHOPHARMACOLOGY

Lysergic acid diethylamide is considered the prototypical hallucinogen or psychotomimetic because of its ability to produce perceptual distortions, hallucinations, and delusions that are naturally occurring in psychotic states such as schizophrenia. It is generally considered in the nitrogen or alkaloid group of empirically detected plant derivative hallucinogens, which includes peyote, mescaline, psilocybin, and harmine, as well as the synthetic hallucinogens such as the veterinary tranquilizer PCP (phencyclidine) and the methoxylated amphetamine derivatives STP (dimethoxymethylamphetamine) and MDA (methylene dioxymphetamine).

While nearly three-quarters of a million plant species are known in the world, approximately 50 have been found to be hallucinogens through what is believed to be an extensive process of trial and error (see Table). LSD is synthesized from lysergic acid and diethylamine with the lysergic acid found in the ergot fungus *Claviceps purpurea*. LSD is only psychoactive in the d-LSD isomer. Its precursor lysergic acid occurs naturally as an ergot alkaloid in grains infested by *C purpurea* and also in the morning glory seed. LSD is colorless and odorless, and is generally sold impregnated on a blotting paper, stamp, or cube.

LSD is well absorbed orally from the gastrointestinal tract and other mucous membranes with peak LSD levels occurring within 60 minutes after ingestion. LSD is slowly eliminated in the urine, and metabolites may be detected for three or four days. However, the very small dose necessary to produce psychosis-like effects makes detection quite difficult.

TABLE
Hallucinogenic Plants and Their Major Psychoactive Compounds

Major Hallucinogenic Plants	Major Psychoactive Component
<i>Amanita muscaria</i>	Pantherine, ibotenic acid
<i>Banisteria</i> species	Harmaline, harmine
<i>Cannabis sativa</i>	delta-9-THC
<i>Datura</i> species	Scopolamine
<i>Ipomoea violacea</i>	d-Lysergic acid amide
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<i>Mimosa</i> species	tryptamines
<i>Psilocybe mexicana</i>	Psilocybin
<i>Lophophora williamsii</i>	Mescaline
<i>Tabernanthe iboga</i>	Ibogaine

A dose of 50 micrograms produces LSD-related psychotomimetic effects mainly through specific interactions with serotonergic systems in the brain. Effects may be reported with a dose of only 1 microgram within one hour of ingestion and lasting for up to six hours.

Sympathetic stimulation with increased heart rate and respiration and some cholinergic effects with lacrimation, salivation, and nausea may occur while the user is reporting marked alterations in visual perceptions. LSD's interaction with the 5-HT₂ receptors is highly correlated with hallucinogenicity. However, LSD has marked effects on the so-called 5-HT_{1A} or presynaptic autoreceptors in the Raphe nucleus and elsewhere. Other effects include delusions of persecution and grandiosity with hallucinations, alteration of body image, changes in hearing, synesthesia (seeing smells, hearing colors), magnification of touch and distortion of time. Flashbacks of previous LSD experience may be quite problematic and occur in many ex-users. These flashbacks may be triggered by marijuana or other drug use. Emotions and emotional responses become intensified, labile, and difficult to control.

Responses to LSD may be described as positive or extremely negative. While the lethal dose of LSD is not known, acute psychotic states with hallucinations and paranoia, judgment and perceptual problems, mood lability, and depression may be associated with unusual and dangerous behaviors.

CONCLUSION

The recent increase in LSD use may be related to a decrease in perceived danger and decreased social stigma associated with LSD experimentation. This increase may indicate that the lessons learned from the recent cocaine "epidemic" have been overly specific to cocaine and crack and apparently not applied to all drugs.⁷ To confront the increased LSD use, and drug use in general, national prevention and educational efforts need to be refocused, less drug-specific, and more consistent with the concept of the drug-free, healthy mind.

REFERENCES

1. Gold MS, Schuchard K, Gleaton T. LSD use among US high school students. *JAMA*. 1994; 271:426-427. Letter to the Editor.
2. National Institute on Drug Abuse. Annual National High School Senior Survey. Rockville, Md: NIDA; April 13, 1993.
3. National Narcotics Intelligence Consumers Committee (NNICC). *The NNICC report 1990: the supply of illicit drugs to the United States*. Washington, DC: Drug Enforcement Administration; June 1991.
4. Gold MS. Prevention, education and drug therapy in cocaine abuse and dependence. *Biol Psychiatry*. 1991; 2:60-62.
5. Garratt JC, Alreja M, Aghajanian GK. LSD has high efficacy relative to serotonin in enhancing the cationic current I_h: intracellular studies in rat facial motoneurons. *Synapse*. 1993; 13:123-134.
6. National drug control strategy. Washington, DC: The White House; January 1992.
7. Gold MS. Cocaine. In: Gold MS, ed. *Drugs of abuse: A comprehensive series for clinicians*. Vol III. New York, NY: Plenum Publishing; 1993.