

an anesthetic agent used in a Mickey Finn, a spiked drink used criminally to anesthetize robbery victims.

Whippets. Whippets are small canisters of nitrous oxide used at soda fountains to make whipped cream. They have been incorporated into various products, such as balloon inflators, carburetor pipes, and other drug paraphernalia (see Nitrous Oxide, above).

See also *Inhalants: Extent of Use and Complications; Monitoring the Future.*

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INHALANTS: EXTENT OF USE AND COMPLICATIONS.

Inhalant abuse first became prevalent in the United States in the 1850s and is in the early twenty-first century endemic among adolescents. One of the most common forms of substance abuse, it is aptly referred to as the *silent epidemic*. Inhalants are also one of the most understudied types of substances. Commonly abused inhalants include acetone, butanone, n-hexane, and toluene, although varied mixtures of chemicals are found in many abused products. Intoxication presents as a general syndrome marked by slurred speech, ataxia, stupor or coma, and other signs similar to alcohol intoxication. Inhalant abusers may inhale vapors from a rag soaked with a substance placed over the mouth or nose, a bag into which a substance has been placed, or directly from a container. Intoxication is rapid in onset and short-lived, although some users repeatedly administer inhalants to maintain a preferred level of intoxication.

The *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)* distinguishes inhalant use disorders (i.e., disorders caused by the inhalation of aliphatic, aromatic, and halogenated hydrocarbons, as well as esters, ketones, and glycols) from disorders related to the abuse of anesthetic gases (e.g., nitrous oxide) or short-acting vasodilators such as amyl or butyl nitrite. Unlike other substance use disorders, withdrawal symptoms are not a criterion used for defining inhalant dependence in *DSM-IV*.

PREVALENCE AND CORRELATES OF INHALANT USE

Results from the 2006 Monitoring the Future (MTF) survey indicated that approximately 16.1 percent of eighth graders reported lifetime inhalant use. This rate of use was slightly higher than the comparable rate of marijuana use (15.7%) and substantially higher than the lifetime prevalence of cocaine use (3.4%) among this age group. Results from the National Survey on Drug Use and Health (NSDUH, 2002–2004) showed that an average of 598,000 youth twelve to seventeen years of age reported initiating inhalant use in the year prior to being surveyed. The NSDUH data also revealed that trends in past year inhalant use among this age group remained stable for males between 2002 and 2005. However, the prevalence of use increased from 4.1 percent to 4.9 percent for girls over this period.

Recreational inhalant use progresses to serious involvement with inhalants for many youth. For example, findings from the National Comorbidity Survey indicated that nearly 8.0 percent of youth fifteen to twenty-four years of age who tried inhalants eventually met *DSM-III-R* criteria for inhalant dependence. Inhalant use is found at epidemic levels in juvenile justice populations, with some estimates as high as approximately 40.0 percent (Howard et al., 2007). While inhalant use appears to be less prevalent among adults, it is important to note that it is problematic among disenfranchised adult populations, such as Native Americans who live on reservations, convicts, and other persons of low socio-economic status.

Asthma inhalers are typically not considered to be a substance of abuse. However, one study involving adolescents in the juvenile justice system found that approximately one-third of the sample had used an asthma inhaler without a prescription. Among youth with an inhaler prescription, approximately 27 percent reported using the inhaler more than prescribed (Perron & Howard, 2008). Coupled with other cases of inhaler misuse and abuse/dependence that are reported in the medical literature, it is likely that misuse and abuse of asthma inhalers is a greater problem than previously considered to be.

CONSEQUENCES OF INHALANT USE

Medical Consequences. Recreational inhalant use results in chemical exposures at levels dramatically higher than those typical of toxic occupational

exposures. Inhalant intoxication can lead to emergencies, including sudden sniffing death and serious accidents. Recurrent inhalant intoxication is associated with conditions, including Parkinsonism and other brain, liver, and kidney disorders. Neurological findings in inhalant abusers include cerebral atrophy, thinning of the corpus callosum, and lesions of the white matter. Brain imaging studies (e.g., fMRI and SPECT) indicate that regional decrements in cerebral blood flow can be observed after one year of inhalant abuse, whereas white matter changes may take years to develop (Okada et al., 2000). Such studies have found inhalant abusers to exhibit hypoperfusion foci and nonhomogeneous uptake of radiopharmaceuticals (Kucuk et al., 2000).

Legal and Social Consequences. Use of inhalants is associated with a wide range of adverse legal and social consequences. Inhalant users have higher rates of aggressive behavior, criminal offending, school problems, conduct disorder, substance abuse, and involvement in high-risk behaviors (including unprotected casual sex and IV-drug use) than other drug users/nonusers. Inhalant users in juvenile justice settings are more likely to commit a crime while intoxicated, sell drugs, or steal to acquire money with which to buy drugs than their inhalant-nonusing peers. Research on juvenile offenders has also revealed a wide variety of deleterious consequences attributable to inhalant use, including fistfights, property crime, and failure to meet social and vocational obligations.

Cognitive Consequences. Studies of occupationally exposed workers form the basis of much of what is known about cognitive deficits in inhalant-exposed persons (Hoek et al., 2000). Inhalant-related cognitive problems are slow to resolve in many patients, and even a single occupational exposure leading to inhalant intoxication can produce long-term memory problems and processing speed impairments (Stolley, 1996). This finding is ominous given that inhalant abuse is often characterized by repeated exposures to neurotoxins at levels that greatly exceed those of occupational exposures. The most common deficits found in this line of research include learning problems, auditory and visual abnormalities, memory and attentional deficits, and errors in recall and judgment. Cognitive impairment may be the most disabling consequence of inhalant abuse and the earliest sign of neurological damage.

Psychiatric Dysfunction. Inhalant users display high rates of multiple-drug use and conduct disorder as youth and substance dependence and antisocial personality disorder in adulthood. Inhalant users tend to exhibit an earlier onset of behavior problems and greater diversity in antisocial conduct than non-inhalant abusers. Prior reports have identified higher rates of mood disorders, particularly major depression, in inhalant exposed workers than controls. For example, journeyman painters were significantly more likely than controls (41.0% vs. 16.0%) to meet lifetime *DSM-IV* criteria for major depression, and eleven of twelve painters who met criteria for a mood disorder experienced their first episode of mood disorder after they had commenced their painting careers (Condray et al., 2000). Various studies also show an association of inhalant use with suicidal ideation, suicide attempts, paranoia, psychosis, impulse control disorders, and anxiety disorders among antisocial youth and other adolescent populations.

An important gap in the research is on the temporal ordering of psychiatric dysfunction and inhalant use. Specifically, it is unknown whether inhalants are used to alleviate psychiatric dysfunction (i.e., self-medication hypothesis) or if inhalants cause or exacerbate psychiatric dysfunction (i.e., super-sensitivity hypothesis). Most likely, there are heterogeneous causal mechanisms within the population of inhalant abusers. A reciprocal relationship is probably at play.

TREATMENT AND PREVENTION

Research on treatment and prevention of inhalant use and abuse remained undeveloped in the first decade of the twenty-first century. As of 2008, no clinical trial of inhalant treatment had ever been funded by the National Institute of Drug Abuse, and no freestanding treatment facilities specializing in inhalant treatment existed in the United States. Moreover, inhalants are very rarely screened for in the United States, even within the substance abuse treatment service delivery system. Significant efforts are needed to effectively and efficiently identify persons who use inhalants. The identification of characteristic patterns of early cognitive dysfunction in inhalant users would contribute to future efforts to prevent inhalant-related brain damage. Psychiatric and substance abuse treatment providers should have knowledge about inhalants,

including risk factors for, and consequences of, inhalant abuse. Despite the absence of empirically supported treatments for inhalant use disorders, this knowledge can be beneficial in structuring treatment modalities to meet individual needs.

The most successful treatment approaches would likely focus on issues of psychosocial functioning. Attention would be directed toward social influences related to use, including identifying and avoiding risky situations, developing skills to manage peer influence, building social networks that do not include inhalant users, and creating opportunities for meaningful social engagement.

Prior research involving youth in the juvenile justice system indicate that adolescents used inhalants due to curiosity about their effects, feelings of boredom, ease of access, and enjoyment (Perron, Vaughn, & Howard, 2007). These reasons suggest that social marketing campaigns that heighten awareness of adverse consequences are needed to dispel myths that recreational inhalant use is an innocuous activity. Although current research shows that adolescents involved in the juvenile justice system are at elevated risk of inhalant use, further epidemiological research is needed in order to more effectively target social marketing campaigns. Other prevention efforts can occur with the manufacturing of substances that are commonly abused, such as changing formulas to reduce toxicity and adding irritants.

See also Complications.

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INJECTING DRUG USERS AND HIV.

One of the major risk behaviors for infection by the human immunodeficiency virus (HIV) is the multi-person use (sharing) of needles and syringes for injecting drugs; the other risk behavior is unprotected sexual intercourse with an HIV-infected partner. The National Institute on Drug Abuse (NIDA) estimated that there were between 1.1 and 1.3 million injecting drug users (IDUs) in the United States in the late 1980s (Centers for Disease Control, 1987). The number of injecting drug users has probably declined somewhat since then because fewer people are injecting, people are transitioning to non-injecting drug use, and more people are dying due to AIDS and other causes.

BACKGROUND

In 2006, 22 percent of the estimated 433,000 people in the United States living with the HIV infection reported injecting drug use as their primary risk, and an additional 3 percent reported both male-with-male sexual behavior and injecting drug use as risk. Injecting drug use has been declining as a route of HIV transmission in the United States (Santibanez et al., 2006) and in Western Europe (European Monitoring Centre for Drugs and Drug Addiction [EMCDDA], 2007) but has been increasing dramatically in Eastern Europe and Asia. Approximately one-third of new cases of HIV infection outside of sub-Saharan Africa are related to injecting drug use (UNAIDS, 2007).