

Inhalant Abuse

Introduction

Although inhalant use has received more attention recently, it still is considered an understudied phenomenon of drug-taking (Balster, 1993; Dinwiddie, 1994; NIDA, 1994). Nonetheless, in recent years, associations between inhalant use and an array of physical hazards have been documented (Al-Alousi, 1989; Byrne et al., 1991; Chadwick et al., 1991; Esmail et al., 1993; Garriot, 1993). Recognition of these hazards has increased the level of concern about a persisting use of inhalants among adolescents in the US as well as internationally (Johnston, 1993; WHO Report, 1992).

For many youths, use of inhalants seems to be a relatively transient, but potentially hazardous pattern of drug-taking (Edwards and Oetting, 1995).

Of particular concern is that adolescent inhalant users might be at increased risk of progressing in their use of illicit drugs to the point of starting to use heroin and injection drug use. Some early studies found that approximately one-fourth of heroin users in treatment reported a history of inhalant use (Kremer, 1972; Langrod, 1970). Later studies have indicated that those with a history of inhalant use might be a special subgroup of heroin users and part of a 'deviant group within a deviant group' (D'Amanda et al., 1977). For example, D'Amanda et al. (1977) found that among 133 male heroin users in treatment, those who had ever sniffed glue were abusing twice as many different substances, on average, as those who did not.

Inhalant users also were characterized by a more self destructive life-style, including a significantly increased likelihood of having attempted suicide. Similar findings were reported by Altenkirch and Kindermann (1986), who studied 574 injecting opiate users and found that those with a history of inhalant use could be differentiated as a marginal group with particularly unfavorable developmental conditions and a specifically more adverse course of addiction. In a cross-sectional study of 2143 subjects composed of 503 persons in alcohol treatment and 1640 of their relatives, Dinwiddie et al. (1991) found evidence that a history of solvent use might indicate individuals at higher than average risk for IV drug use.

The extensive capillary surface area of the lungs makes inhalation a favored method of administration of many psychoactive drugs, ranging from nicotine to opiates. Indeed, uptake is so rapid that the effect of inhalation can resemble intravenous injection in its intensity. However, while most drugs of abuse may be taken in a variety of ways, a group of psychoactive substances exists for which direct inhalation is virtually the only route of self-administration.

Pharmacology and toxicology of inhalants

Though inhalant abusers may prefer one particular because of odour or taste, individuals may use a variety of different agents, depending on availability and price. In addition, many of these preparations contain several different ingredients. Thus, it is not always possible to delineate the pharmacological properties or toxic effects of these chemicals in habitual users.

Mechanism of action

Once inhaled, blood levels of most inhalants peak within minutes, and are rapidly taken up into fat stores, including lipids within the central nervous system.

While the inhalants have similar behavioural effects (and possibly neurophysiological actions), metabolism and elimination vary depending on their specific chemical properties.

Aliphatic hydrocarbons are more likely to be eliminated unchanged via respiration, whereas aromatic hydrocarbons tend to be metabolized via the hepatic microsomal system then glucuronidated and excreted via the kidneys.

However, it should be kept in mind that many studies of the pharmacokinetics of inhalants have been carried out in industrial workers exposed to low levels of individual compounds and therefore may not be applicable to abusers, who may be exposed acutely to high levels of several substances simultaneously.

Tolerance and withdrawal

Tolerance has been described in humans. Press & Done felt that it occurred in most habitual users, while Evans & Raistrick found "clear evidence" of tolerance among 12 of 12 butane users and 22 of 31 users of toluene studied by them.

A withdrawal syndrome lasting 2-5 days, characterized by sleep disturbance, nausea, tremor, diaphoresis, irritability and abdominal and chest discomfort has also been described among chronic users, and a syndrome resembling delirium tremens following cessation of use has been reported. However, it is possible that most heavy users of inhalants use multiple classes of drugs.

Physical complications

"Sudden sniffing death" most frequently appears to be related to acute cardiac arrhythmia. Inhalants appear to be myocardial depressants as well as possibly sensitizing the myocardium to the action of epinephrine, an effect which may be further enhanced by hypoxia. In this regard, fuel gases and aerosols appear more directly toxic than adhesives. Death may also result acutely from a variety of other causes, such as trauma, asphyxia or aspiration, though the role of inhalants in these fatalities may not always be recognized.

Given the wide variety of inhalants used, it is not surprising to find a tremendous range of acute and chronic physical problems which have been attributed to abuse or occupational exposure. CNS damage based on clinical examination and neuro-imaging studies in 13 of 20 (65%) chronic solvent abusers, and Rosenberg *et al.* found abnormalities based on clinical examination. Cerebellar disease has been most commonly associated with toluene exposure; in one series, cerebellar signs were noted in 11 of 24 toluene abusers referred for drug treatment.

Series of patients indicate that repeated inhalant use may be associated with diffuse cerebral involvement, which in some instances may lead to dementia associated with generalized cerebral atrophy and demyelination. Abnormal EEG or evoked potentials may also be seen in chronic abusers. "Delinquent solvent inhalers", found impairments in memory, attention, concentration and non-verbal intelligence.

Abuse of volatile substances may also result in bone marrow suppression. Finally, a pattern of developmental delay, behavioural deficits, microcephaly and minor craniofacial and limb abnormalities has been described in several children prenatally exposed to toluene, although there are other reports of prenatal exposure without apparent sequelae.

Progression to other drug use

Two studies which did not select subjects based on treatment for opiate addiction have also suggested a high rate of polydrug use among those with a history of inhalant use. In the first, a survey from Nova Scotia performed in 1969, 1606 secondary school students were surveyed about their drug use. At that time, 15% of respondents reported use of solvents. As well, these individuals were markedly more likely to report use of other substances: risk for cannabis use was elevated by a factor of three, while for use of barbiturates or hallucinogens the risk was increased eight-fold, and the lifetime rate of opiate use among solvent users was increased almost 14 times over the rate among non-users.

Another study, though not from a general population sample, found similar results. Dinwiddie, Reich & Cloninger, using data from a large family study of alcoholism, found that significant percentages of those who reported any lifetime use of psychoactive substances had used inhalants: 13% of those who had used cannabis, 18% of stimulant users, 26% of sedative-hypnotic users, 27% of hallucinogen users and 31% of opioid users. Of the 130 subjects who reported any inhalant use, 93% had used at least three additional classes of illicit psychoactive drugs; 68% had used substances from every class of drug inquired about. Inhalant users began using other drugs significantly earlier than those without a history of inhalant use, and any history of inhalant use increased odds of using other psychoactive drugs by factors of 5-10 fold.

Inhalants and injecting drug use

Schutz, Chilcoat & Anthony replicated this finding in a general population sample of 9259 subjects, using the 1990 Household Survey on Drug Abuse data. In that analysis, after adjusting for effects of gender, race, economic status, age and history of cannabis use, they found that those with a history of inhalant use were 5.4 times more likely to inject drugs, while the odds of injecting among those who had used both cannabis and inhalants were increased by a factor of 88 relative to those who had used neither.

A third study to investigate this relationship used an extensive structured interview to evaluate 545 treatment-seeking drug users. Again, it was found that the odds of injecting, given a history of inhalant use, were increased by a factor of 3.6, while odds for use of specific drugs such as cocaine, opioids or hallucinogens were increased by factors of 5-10.

Inhalant use and psychiatric co-morbidity

Far more commonly mentioned in association with inhalant use is delinquent behaviour "ranging from truancy and shoplifting to attempted homicide", an observation made repeatedly by researchers since the early 1960s. Reed & May, comparing 100 chronic inhalant abusers to other delinquents, found that the inhalant abusers tended to be arrested at a younger age and had substantially higher rates of arrest for a wide variety of crimes, including status offenses, property crimes and violent offenses. Conversely, inhalant abuse has been reported in 65% of 23 teenage boys residing at a residential facility for delinquents and 43% of 47 admissions to a regional assessment centre for delinquent boys.

Crites & Schuckit studied 757 primarily white, middle-class adolescents referred to counselling because of alcohol-related offenses. Of those, 120 (16%) had a history of inhalant use. Compared to youths who either had used drugs other than cannabis or inhalants or who had used alcohol but no other drugs, the inhalant-using subjects had worse academic performance, more behavioural problems and more drug- and alcohol-related problems. They also were significantly more likely to merit a diagnosis of antisocial personality disorder (ASPD); using standardized diagnostic criteria, 23% of this group could be assigned this diagnosis.

Conclusion

It is clear, for example, that *any* use can- and all too frequently does- lead to sudden death. While it appears that some inhalants (e.g. butane or aerosol propellants) may be associated with higher risk of sudden death.

Clearly the major risk from VSA is that of sudden death. Up to 30 to 40 percent of VSA-related sudden deaths in the United Kingdom occur in first-time or near first-time users. Conversely, experience with VSA does not provide complete protection against the risk of sudden death. In addition, evidence associating repeated VSA with a range of chronic disorders continues to accumulate. The widespread availability of abusable substances, often in pure form and at relatively low cost (petrol, for example), means that it is very difficult to control the practice by limiting supply. Treatment of the chronic abuser and, if possible, prevention through education, counselling and by other means thus assumes great importance. A holistic approach in which volatile substances are considered together with alcohol, tobacco and other drugs seems the best way forward.

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