

**INHALANT ABUSE IN THE PACIFIC ISLANDS:
GASOLINE SNIFFING IN CHUUK,
FEDERATED STATES OF MICRONESIA**

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Most studies of pharmacologically active substances in Oceania have focused on betel and kava, the two major precontact drugs (for example, Brunton 1989; Burton-Bradley 1978; Lebot, Merlin, and Lindstrom 1992; Lindstrom 1987), and on beverage alcohol and tobacco, the two major introduced substances (for example, Black 1984; Brott 1981; Carucci 1987; Haddon 1947; Marshall 1979, 1982; Pinhey, Workman, and Borja 1992). Little has been published in the professional literature on illegal drugs, and what has mostly has concerned marijuana (Larson 1987; Marshall 1990, 1991a; Sterly 1979). Thus far inhalants have received no attention whatsoever, although they have been the subject of considerable recent research among Australian Aborigines (Brady 1985, 1992).

Over the past twenty-five years, concern over substance abuse in Pacific Islands countries has grown as transportation networks have improved, tourism has increased, and more islanders have traveled to Pacific Rim nations and beyond. Better transportation, more foreigners in their midst, and greater exposure to the fast life abroad all have Played a role in expanding the variety of illegal drugs available in the

islands--particularly in the towns. These relatively new drugs--such as cocaine, heroin, and "ice" (crystal methamphetamine)--have not spread widely so far, and the major drug-related health problems in Oceania continue to be associated with the two major legal drugs: tobacco and alcoholic beverages (Marshall 1987, 1991b, 1993).

Within Oceania, concern over the abuse of illegal drugs has been especially marked in Micronesia, notably on Guam, Saipan, and Palau. These islands continue to have significant problems with marijuana and "ice," and at least until recently Guam and Palau have had to contend with heroin users as well (Duenas 1993; Evans 1987; Mason 1993). Their drug-related concerns include criminal activity associated with the smuggling of illegal drugs into, among, and through the islands to continental destinations, crimes committed by users themselves, potential mental health problems, and broader general health issues. The World Health Organization's Regional Office for the Western Pacific has acknowledged these problems by funding in recent years several short-term consultancies and by convening two conferences in Micronesia, one in Palau in June 1989 and one in Pohnpei in August 1993, the latter cosponsored by the Federated States of Micronesia (FSM) government.

The direct involvement of the FSM government in the FSM/WHO Joint Conference on Alcohol and Drug-Related Problems in Micronesia, held on Pohnpei 9-13 August 1993, is a significant marker of the growing concern in the Federated States over substance abuse. In what follows we address a substance abuse issue there (which we strongly suspect will be found elsewhere in the Pacific) that so far has "fallen through the cracks": the sniffing of volatile inhalants, particularly gasoline. Inhalant abuse has not yet received attention in part because it seems to be a relatively new practice in the islands, but also because the substances that are abused by sniffers are legal, easily obtainable, and normally not viewed as drugs.

Inhalation of volatile solvents for the purpose of getting intoxicated has been recorded for most major world areas, but this practice has not been widely reported in Oceania. We have found few sources in the literature mentioning inhalant use by Pacific Islanders, and these articles all date from the 1980s. The available sources document that benzine¹ sniffing was "widespread" in Kiribati in 1982 (Daniels and Fazakerley 1983) and that sniffing of gasoline fumes, spray paint, and glue vapors all apparently occurred in Chuuk and Palau during the 1980s (Evans 1987; Larson 1987; Marshall 1991a; Oneisom 1985; Rubinstein 1980). It seems likely that inhalant abuse is much more widespread in the

Pacific Islands than the dearth of literature on the subject suggests. Given that gasoline and a number of other volatile solvents are widely used products that are readily available in most Pacific Islands countries, it is reasonable to think that a certain amount of abuse of these inhalants takes place, even if this behavior is not widely observed by foreigners. What we do not know at present is how widespread such abuse may be.

Because of the serious public health consequences of inhalant abuse, especially for youth, one of our goals here is to call attention to the paucity of data on this topic in the Pacific in hopes that researchers will begin to give it the attention it deserves. As a background to what we hope will be further work on this topic, we review the major health risks associated with inhalant abuse and then discuss general patterns of use revealed in the literature for other parts of the world. Finally, we provide some previously unpublished preliminary findings on gasoline sniffing by young people in Chuuk.

Background

Historically and cross-culturally, the controlled use of intranasally inhaled snuffs, drug powders, and gases to produce trance or elevated perception for religious, recreational, and medical purposes has been widespread among human populations (Kerner 1988). Concern with the uncontrolled abuse of industrially produced inhalants followed the first published report (in Sweden) on sniffing behavior in 1948 (Kerner 1988). Today, inhalant abuse is a worldwide problem, concentrated primarily among children and adolescents (see, e.g., Brady 1992; Dinwiddie, Reich, and Cloninger 1991; Johns 1991; Oetting et al. 1980).

Reports of inhalant abuse and resulting health problems have come from Europe, Africa, Latin America, Australia, and Asia (Kerner 1988). In Mexico, for example, excluding alcohol, the misuse of inhalants ranks second only to marijuana as the most frequent form of substance abuse (Fuente 1983). By the 1960s inhalant abuse was recognized as a major problem among adolescents in the United States, where glue sniffing incidents were reported from California as early as the 1950s (Watson 1980). A recent survey of substance use among a small sample of Brazilian university students discovered nearly all of the respondents to have sporadically inhaled ether and/or chloroform in "lanca-perfume," a spray typically available during carnival (Silva et al. 1989).

Inhalant abuse is defined as the repeated, intentional inhalation ("sniffing," "huffing") of solvent vapors for the purpose of intoxication.

Many of the physiological and behavioral effects of inhalants are similar to those produced by beverage alcohol, except that hallucinations are common with inhalant intoxication (Barnes 1979). For this and other reasons, Brady argues that petrol (gasoline) sniffing leads to an altered state of a quite different order than alcohol intoxication (1985). Gasoline appears to be the most commonly abused substance, although model airplane glue, paint thinner, nail polish remover, butane and propane cigarette lighter fuel, ether, and aerosol propellants also are popular. There are various methods for using these substances: intravenous injections, direct inhalation from the commercial containers, putting the solvent in a large bowl to increase the fumes, filling a bathtub with paint thinner and closing the bathroom door, or drinking solvents in concoctions called "moose milk" and "marsh wine" (Barnes 1979).

Health Risks of Inhalant Use

A wide range of medical problems stem from extended inhalant abuse. For example, benzene depletes bone marrow cells by arresting their maturation, and there is a positive statistical relationship between chronic exposure to benzene and the development of leukemia (Gilman et al. 1985). Tetraethyl (the principal additive in leaded gasoline) has a particular affinity for nervous tissue and has been determined to cause nervous irritability, anorexia, pallor, tremor, nausea, vomiting, and occasional acute toxic delirium (Boeckx, Postl, and Coodin 1977). Prolonged inhalant abuse has caused epidemic mental retardation in various populations throughout the world (Westermeyer 1988). A specific example of such deterioration comes from a Native community in Canada:

Alicia started sniffing gas when she was three years old. She's burnt now [at age six], and the brain damage is permanent. In class, she can't concentrate and she's lost her retention ability. She has lost her sense of balance. She sways all over the place and topples over in her chair. She falls down sixty times a day, like a Raggedy-Ann doll. She has constant bruises on her arms and legs just from falling down on the floor all the time. (Shkilnyk 1985:44)

More immediate harm can come from severe burns due to accidental ignition of volatile solvents during sniffing. Sudden death can occur from respiratory failure as a consequence of central nervous system

depression combined with respiratory irritation and bronchiolar obstruction (Nurcombe et al. 1970). Deaths caused by inhalant abuse have been reported from numerous countries. For example, twelve were reported in Finland in 1973, there were at least forty-five inhalant-related deaths in Great Britain in 1979, and at least thirty-five "sniffing deaths" occurred in Australia during the years 1981-1988 (Brady 1991; Kerner 1988). Johns (1991) cites a report that 963 deaths of young people occurred in the United Kingdom between 1971 and 1989 due to inhaling volatile solvents, with 113 of these in 1989 alone.

The medical effects of inhalant abuse vary and depend upon the type of substance used. Gilman et al. (1985) report that aerosol propellants that contain fluorinated hydrocarbons can produce cardiac arrhythmias, and ketones can produce pulmonary hypertension. Neurological impairment may occur with a variety of solvents. For example, peripheral neuropathies and progressive, fatal neurological deterioration have followed the "huffing" of lacquer thinner. Long-term inhalers of aerosol paints have suffered long-lasting brain damage (Sharp and Brehm 1977; Sharp and Carroll 1978).

A special concern in Oceania is the risk posed from sniffing leaded gasoline, to the extent that leaded, rather than unleaded, gasoline is the fuel available in some island areas.² Both organic and inorganic lead poisoning are problematic. Organic (tetraethyl) lead is a volatile, lipid-soluble compound used as an additive in leaded gasoline. Its toxicity is believed to be due to its metabolic conversion to triethyllead and inorganic lead (Gilman et al. 1985:1610). Tetraethyl is absorbed easily through the gastrointestinal tract and lungs, and is converted eventually to inorganic lead that endangers the brain, kidneys, liver, and peripheral nerves.

A common effect of tetraethyl poisoning is a central-nervous-system syndrome termed lead encephalopathy, a condition that is much more common in children than adults (Gilman et al. 1985: 1608; cf. Coulehan et al. 1983). Early signs of the syndrome may be clumsiness, vertigo, ataxia, falling, headache, insomnia, restlessness, and irritability. As Gilman et al. report, "Lead poisoning in children is more dangerous than in adults, primarily because of the greater incidence of encephalopathy. The mortality rate of untreated, severe lead encephalopathy may approach 65%, and neurological sequelae are common in survivors" (1985:1610). In a study of Pueblo Indian children, Seshia et al. (1978) reported abnormal neurological signs in forty-six of fifty children and adolescents who chronically sniffed leaded gasoline. Many of the children exhibited exaggerated deep reflexes, postural tremor, and evidence of cerebellar dysfunction.

These findings should be of special concern in Micronesia since it appears that leaded gasoline is one of the major substances being sniffed there. Although their data must be viewed with great caution--because of the small numbers involved and because it is not clear how accurate self-reports by purported schizophrenics might be--Daniels and Fazerley (1983) commented that nine of the fourteen schizophrenics under age 35 they questioned at Tungaru Central Hospital on Tarawa had sniffed benzine "at some time." Given the central-nervous-system damage that can result from tetraethyl in leaded gasoline and from prolonged abuse of other inhalants, this association may be more than fortuitous. Researchers who have studied schizophrenia in parts of Micronesia other than Kiribati have not considered the possibility that some cases seen in the islands may be at least partially related to drug abuse (Dale 1981; Kauders, MacMurray, and Hammond 1982). Although they do not mention inhalants as a possible contributing factor (not surprising in view of the paucity of information on this topic), Hezel and Wylie (1992) do entertain the possibility that alcohol and drug abuse may play a significant role in schizophrenia and other mental health problems in Palau, the Federated States of Micronesia, and the Marshall Islands. Quite clearly, the relationship of substance abuse to mental health in the Pacific calls for greater attention and researchers need to investigate patients' possible history of inhalant use along with other substances.

Populations at Risk

The particular circumstances leading to inhalant abuse are difficult to determine, considering that the practice cuts across racial, cultural, and economic groups. Any kind of uniform assessment of the problem is difficult because of the wide range of research methods and techniques used in inhalant abuse research. Many communities and investigators alike are unaware of inhalant abuse until it is identified in the course of survey research on other, more common drugs (e.g., Dinwiddie, Reich, and Cloninger 1991).

Studies that have targeted inhalant use have shown different and sometimes contradictory use patterns by age and sex. A study of a Pueblo Indian school, for instance, found that among seventy-two children ages 6 to 12, 75 percent of the males had used inhalants compared to only 50 percent of the females (Kaufman 1973). In another Pueblo school, however, a survey of nearly twenty-two hundred junior- and senior-high-school-age students suggested that females were nearly twice as likely to use inhalants as males (Carroll 1977).

Among Murngin Aborigines of Elcho Island, Australia, incidents of gasoline sniffing occurred among males ages 7 to 25 in epidemic proportions, but no females were reported to use inhalants (Nurcombe et al. 1970). By contrast, in other Aboriginal communities, such as Maningrida in the Northern Territory, females reportedly constituted one-quarter to one-third of the children involved in group sniffing outbreaks (Eastwell 1979).

Most studies suggest that inhalants are the only known drug for which use decreases with age. "Inhalant use is the only substance to show greater use among younger students," note the authors of a trend analysis of drug use by students in Ontario from 1977 to 1991 (Smart, Adlaf, and Walsh 1991:46). A survey of public-school children between the ages of 9 and 18 in Sao Paulo, Brazil, found the prevalence of recent solvent use to be highest among those aged 9 to 11, and that it decreased significantly among older students. An opposite tendency was found for marijuana, tobacco, and alcoholic beverages (Carlini-Cotrim and Carlini 1988). A similar study of Toronto schoolchildren found inhalant use peaked around the grade six or seven level (Smart et al. 1969, cited in Barnes 1979).

It is relatively easy for young children to obtain inhalants such as gasoline, considering the fuel's use in automobiles, outboard motors, and farm machinery in most contemporary societies. In addition, the ready availability of glues, paint thinners, butane lighter fuel, and other solvents adds to the accessibility of potentially lethal inhalants. Inhalant use by very young children, and a corresponding decrease in use with age, suggests that inhalants might serve as "gateway drugs" in an escalation toward tobacco, alcohol, or marijuana use (Carlini-Cotrim and Carlini 1988). However, if one accepts the definition of escalation as "the use of a relatively mild mood altering substance early on with the addition of other relatively strong mood altering substances at a later time" (Coombs, Fawzy, and Gerber 1984:63), then viewing inhalants as gateway drugs is problematic. This is because the degree of intoxication, and resulting physical and psychological problems, associated with inhalants can be stronger and more dangerous than with drugs such as alcohol or marijuana. In extreme cases of inhalant abuse a child's mental and physical abilities may be permanently damaged long before "escalation" to another drug.

Methods of the Chuuk Survey

During a one-week period in late April 1985, two college classes comprising schoolteachers from Chuuk, FSM, were briefed by Insko and

then carried out a drug survey in several schools on Weene Island under his general supervision. Despite certain methodological difficulties with this survey (e.g., respondent's sex was not recorded), it represents the only questionnaire-based study for the Pacific Islands that provides data on inhalant abuse (gasoline sniffing) by schoolchildren.

The self-reporting questionnaire was administered to a total of 852 students in fourth, sixth, eighth, tenth, and twelfth grades in six schools. Those who gave the survey to the students were not their regular classroom teachers. (Many students in Chuuk are two to three years older than their counterparts in the United States at the time they enter school. Thus, fourth graders in Chuuk typically are ages 9 to 12.) Fourth and sixth graders were given an anonymous questionnaire to be filled out in class in the local language. Eighth, tenth, and twelfth graders were given the same questionnaire in English on the assumption that their English comprehension skills were better than those of the younger students. After the forms had been filled out and placed face down on the surveyor's desk, the answer sheets were gathered by a class member and shuffled to further assure student anonymity.

The questionnaire included queries on the use of alcoholic beverages, marijuana, tobacco, and gasoline sniffing. Data on the first three substances will be reported elsewhere. For the last of these substances, the specific questions asked were: Have you [ever] sniffed gasoline? How often have you sniffed it in the last week?

Results and Discussion of the Chuuk Survey

The responses to the first of these two questions are summarized in Table 1. Nearly 10 percent of the total sample had sniffed gasoline. Although in the overall percentage of users gasoline was the least used of the four substances surveyed, among the fourth, sixth, and eighth graders who responded to the questionnaire sniffing gasoline was the second most common drug experience after smoking tobacco in rank order of the number of users by grade (Table 2). For tenth and twelfth graders, while gasoline sniffing still occurred, it ranked last among the four drugs in the number of those who used it. This finding suggests that in Chuuk, as in other parts of the world, inhalant use is especially likely to occur in younger age groups and that education and prevention programs should be targeted at them.

With an important qualifier, the Chuuk data also suggest that gasoline sniffing declines with age. Note in Table 1 that the percentage of eighth graders who had ever sniffed is basically the same as the percent-

TABLE 1. Students on Weene Island, Chuuk, Who Had Ever Sniffed Gasoline, by School Grade, April 1985

Grade	No. of Students	Percentage of Total Sample	Percentage Who Sniffed
Four	152	18	3.3 ^a
Six	168	20	11.3 ^a
Eight	147	17	13.6
Ten	136	16	4.4
Twelve	249	29	13.7
Total	852	100	9.9

^aBy comparison, Evans reports that a "study carried out by the Mental Health Programme of the Health Services Bureau . . . in one of Palau's Elementary Schools showed that of 97 children 21% had experimented with alcohol, 10.8% with marijuana and 29.2% with sniffing materials. These children were aged 11 and 12 years" (1987:16).

TABLE 2. Rank Order of Drugs Used by Students on Weene Island, Chuuk, by School Grade, April 1985

Grade	Rank Order			
	Tobacco	Gasoline	Alcohol	Marijuana
Four	1 (N = 13)	2 (N = 5)	4 (N = 0)	3 (N = 4)
Six	1 (N = 24)	2 (N = 19)	3 (N = 9)	4 (N = 7)
Eight	1 (N = 21)	2 (N = 20)	3 (N = 15)	4 (N = 14)
Ten	1 (N = 18)	4 (N = 6)	2 (N = 10)	3 (N = 9)
Twelve	1 (N = 94)	4 (N = 34)	2 (N = 81)	3 (N = 71)
Total Users	170	84	115	105
Percentage Users	19.9	9.9	13.5	12.3

age of twelfth graders who had ever done so. The low reported percentage of tenth graders who ever sniffed (approximately one-third that of eighth and twelfth graders) probably can be accounted for by a flaw in the study design. All grade levels sampled *except* tenth graders included only public-school students. The tenth grade sample comprised students from both a public junior high school and a Protestant mission-sponsored school, and unfortunately there is no way to disaggregate the data. Inclusion of students from a church school, where there was parental, peer, and institutional pressure on students to meet more strict standards of social behavior, is likely to have contaminated the tenth-grade results by leading to an underreporting of substance use.

The percentages of those sixth, eighth, and twelfth graders from Chuuk who have ever sniffed gasoline are very similar to findings reported for two different populations of schoolchildren in the United States. Johnson et al, (1971) surveyed 2,752 Oregon high school students and reported that between 12.3 and 18.7 percent of the boys and 2.0 and 10.5 percent of the girls had ever used inhalants. More recently, Chavez and Swaim (1992) compared 3,384 Mexican-American and 3,790 white non-Hispanic eighth and twelfth graders regarding "lifetime prevalences" of substance use. The percentage of students who had ever used inhalants of any sort ranged from 12.1 to 16.5.

Preventive measures used in various parts of the world to try to halt inhalant abuse include legislating against the sale of solvents to children. For example, a recent childcare bill in Ireland includes a one-year jail sentence and a \$2000 fine for shopkeepers who knowingly sell products to youth such as butane and propane cigarette lighters, paint thinner, nail polish remover, solvent-based glues and adhesives, and most products in aerosol containers (Birchard 1989). In Mexico, measures have been taken to replace the benzene in thinners with less-toxic ingredients (Kerner 1988). Also, educational campaigns that target parents, children, manufacturers, and retailers have been instituted. Other measures include doctoring products to make sniffing unappealing, or altogether eliminating the intoxicating elements in commercial solvents. Legislation against the sale of such things as paint thinner or nail polish remover may be effective, but similar efforts to regulate the purchase and use of gasoline would be well nigh impossible from a practical point of view. In the case of gasoline, the best form of prevention may involve educating parents and children about its potentially harmful effects so that inhaling its fumes becomes recognized as a dangerous and possibly lethal practice. Presently, there are no educational programs for either parents or children in Chuuk that provide information about the serious health risks posed by gasoline sniffing.

Conclusions

Inhalant abuse is a worldwide problem found especially among pre-adolescent and early adolescent youth. Recurrent inhalation of volatile solvents, including unleaded or leaded gasoline, poses serious immediate physical and mental health risks, and may lead to long-term health care costs due to permanent impairment. Based upon our literature review and the survey of schoolchildren in Chuuk, there is strong reason to believe that inhalant abuse is a problem among Pacific Islands youth, as it is in most other parts of the world.

The limited data that we report on gasoline sniffing by schoolchildren in Chuuk suggest that the general pattern of abuse found in other populations holds for Chuuk as well. This pattern involves experiments with inhalants by preadolescent children with substitution of other psychoactive substances (e.g., alcohol, tobacco, marijuana) as they mature. Unfortunately, given the neurotoxicity and other potential problems posed by the abuse of most inhalants, young people who regularly use these substances run a serious risk of permanently damaging themselves and adding to the physical and mental health burden of their societies. It is imperative that we obtain more and better data on inhalant use in Pacific Islands societies that can be used to develop effective community-based public health prevention programs. Future researchers are strongly urged to explore this topic along with the related issues of drug studies, mental health, pediatrics, and juvenile and adolescent social problems.

NOTES

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1. Benzine and benzene are both colorless, inflammable liquids obtained by fractional distillation of petroleum (benzine) and coal tar (benzene). Benzine is used as a motor fuel and a solvent for fats and oils in dry cleaning. Benzene is used as a solvent for fats and in making lacquers, varnishes, many dyes, and other organic compounds. A natural constituent of auto fuels, benzene is very toxic.

2. During Marshall's visit to Pohnpei and Chuuk to attend the FSM/WHO Joint Conference on Alcohol and Drug-Related Problems in Micronesia in August 1993, he learned that most gasoline used for outboard motors in the Federated States of Micronesia is leaded rather than unleaded. He was also told by reliable sources of a miniepidemic of gasoline sniffing on Pingelap Atoll, and of recent sniffing incidents on Romonum Island and Namoluk Atoll. This suggests that gasoline sniffing in the Federated States of Micronesia is more widespread than has been recognized and that it occurs in communities away from the urban areas as well as in the towns.

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