

Original article

Use of nitrite inhalants (“poppers”) among American youth

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Abstract

Purpose: We examined the patterns and correlates of nitrite inhalant use among adolescents aged 12 to 17 years.

Methods: Study data were drawn from the 2000 and 2001 National Household Surveys on Drug Abuse. Logistic regression was used to identify the characteristics associated with nitrite inhalant use.

Results: Among adolescents aged 12 to 17 years, 1.5% reported any lifetime use of nitrite inhalants. The prevalence of lifetime nitrite inhalant use increased to 12% and 14% among adolescents who were dependent on alcohol and any drug in the past year, respectively. Many nitrite inhalant users used at least three other types of inhalants (68%) and also met the criteria for alcohol (33%) and drug (35%) abuse or dependence. Increased odds of nitrite inhalant use were associated with residing in nonmetropolitan areas, recent utilization of mental health services, delinquent behaviors, past year alcohol and drug abuse and dependence, and multi-drug use.

Conclusions: Adolescents who had used nitrite inhalants at least once in their lifetime tend to engage in delinquent activities and report co-occurring multiple drug abuse and mental health problems in the past year. © 2005 Society for Adolescent Medicine. All rights reserved.

Keywords:

Adolescents; Drug abuse; Epidemiology; Nitrite inhalants

Starting in the early 1960s, amyl nitrite or ‘poppers’ have been used by individuals to enhance sexual pleasure or to get high [1,2]. Drug users and gay men have reported a greater use of nitrite inhalants than the general population [3]. Lange et al. [2] found that 69% of gay men reported lifetime use of poppers, and 22% of drug users in treatment reported popper use in the past 6 months.

Amyl, butyl, and isobutyl nitrites (poppers) are all potent vasodilators [4]. Amyl nitrite is a prescription drug used in the treatment of certain cardiovascular problems for heart problems, whereas butyl and isobutyl nitrites are sold as incense or room odorizers [4]. Inhaled nitrites dilate blood vessels, increase the heart rate, and produce a sensation of heat and excitement that may last for several minutes [5].

Current empirical knowledge about nitrite inhalant use

comes primarily from studies of gay or bisexual individuals and illicit drug users. Many studies have suggested that the use of nitrite inhalants is a serious public health concern. First, nitrite inhalant use is associated with a variety of risky sexual behaviors, illicit drug use, and transmission of sexually transmitted diseases (e.g., human immunodeficiency virus [HIV] infection) among gay and bisexual men [6–11]. Second, inhalation of nitrites impairs immune functioning in ways that may suppress resistance to infection and actively promote viral replication and tumor growth [12], as well as trigger hemolysis of red blood cells [13]. Third, daily use of poppers is highly related to overdose mortality among drug users [14]. Further, use of poppers is associated with attempted suicide among gay and bisexual men even after multiple explanatory variables are taken into consideration [15].

Nitrite inhalants appear to be the primary inhalant used by adults [16]. One study has reported a mean age of 25.6 years for first nitrite inhalant use [2]. However, a considerable number of adolescents who use drugs also report using

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nitrite inhalants [17]. A survey of 3000 American high school seniors conducted in 1986 found that 9% of the respondents inhale nitrites to get ‘high’ and 2% are past-month users [18]. Among adolescents in one long-term substance abuse treatment facility, 43% report a history of nitrite inhalant use [17].

The paucity of data on nitrite inhalant use among adolescents, as well as its significant association with risky behaviors and negative medical consequences, prompted us to examine the pattern and correlates of nitrite inhalant use. Among these correlates, our key domains of interest, all of which have been found to be associated with inhalant use, included the use of other types of inhalants, alcohol, and drugs; participation in mental health treatment; delinquent behaviors or conduct problems; and history of foster care placement [19–25]. Our findings concerning these ‘early-onset’ users of nitrite inhalants may help identify subgroups that could benefit from early prevention efforts, and suggest appropriate messages for these populations.

Methods

Data sources

Statistical analyses were based on data from the public use file of the 2000 and 2001 National Household Surveys on Drug Abuse (NHSDAs) [26,27]. The NHSDA, renamed the National Survey on Drug Use and Health in 2002, is an annual survey of the use of licit and illicit substances by Americans aged 12 years or older. To generate national estimates of substance use, it uses multistage area probability sampling methods [28] to select survey respondents. Target populations include residents of noninstitutional group quarters (e.g., shelters, rooming houses, dormitories, and group homes), residents of all 50 states, and civilians residing on military bases. Respondents were interviewed at their place of residence for about an hour. The 2000 and 2001 surveys used a combination of computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI) methodologies. The ACASI was used for sensitive survey items, for which respondents either read the questions silently on a computer screen, or listened to the questions read aloud by the computer through headphones, and then entered their responses directly into the computer.

In 2000–2001, a total of approximately 70,000 individuals aged 12 years or older completed the survey in each year. The weighted response rate for adolescents aged 12 to 17 years was 82% [29]. Each independent, cross-sectional NHSDA sample was representative of the U.S. general population aged 12 or older. NHSDA design and data collection procedures have been reported in detail elsewhere [26,27].

Study sample

Statistical analyses were based on adolescents aged 12 to 17 years. There was little yearly variation in the distribution of age, gender, race/ethnicity, family income, and population density across the 2 survey years. Of this combined sample (N = 36,859), 49% were females, 35% were members of nonwhite minority groups, 43% reported an annual family income of \$40,000 or less, and 23% resided in nonmetropolitan areas.

Study variables

Our primary dependent variable was any lifetime use of nitrite inhalants (i.e., amyl nitrite, poppers, rush, or locker room deodorizers). In addition to nitrites, other inhalant use as defined by the NHSDA included the use of any of the following types of substances ‘for kicks’ or ‘to get high’: (a) correction fluid, degreaser, or cleaning fluid; (b) gasoline or lighter fluid; (c) glue, shoe polish, or toluene; (d) ether, halothane, or other anesthetics; (e) lighter gases, butane, or propane; (f) nitrous oxide or whippets; (g) spray paints; (h) lacquer thinner and other paint solvents; and (i) aerosol sprays. An ‘other’ category was used to include any other inhalants not specified in the above categories.

We also examined the number of different types of inhalants respondents used, years since the first use of any type of inhalant, and the respondent’s age of first use of any inhalants. Data on age of first nitrite inhalant use were not available.

Past-year drug and alcohol abuse and dependence were assessed by criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV), 4th edn. [27,30]. Respondents were defined as drug abusers if they met at least one of the DSM-IV drug abuse criteria for a specified drug in the past year but did not meet the criteria for dependence on that drug. Drug dependence referred to individuals who met at least three DSM-IV dependence criteria for a specified drug in the past year. The same logic applied to past-year alcohol abuse and dependence.

Any drug abuse was defined as reporting a pattern of symptoms that met DSM-IV criteria for abuse of any drug in the past year, including cocaine/crack, marijuana/hashish, heroin, hallucinogens, inhalants, sedatives, tranquilizers, pain relievers, and stimulants. Similarly, any drug dependence referred to reporting a pattern of symptoms that met DSM-IV criteria for dependence on any of these drugs in the past year. We also defined two additional categories to identify adolescents who reported (a) drug-related problems but did not meet the criteria for drug abuse and dependence and (b) any use of a drug but did not report any drug-related problems.

Additionally, we examined the following correlates of nitrite inhalant use: respondents’ demographic characteristics, their lifetime use of any other drugs, their history of foster care placement and incarceration, and their past year

utilization of mental health services and delinquent behaviors or conduct problems.

Demographic characteristics included age, gender, race/ethnicity, total family income, and population density. The NHSDA aggregated population density into large metropolitan areas (with a population ≥ 1 million), small metropolitan areas (with a population < 1 million), and nonmetropolitan areas (outside a metropolitan statistical area).

The number of types of drugs other than inhalants that respondents used in their lifetime (i.e., cocaine/crack, marijuana/hashish, heroin, hallucinogens, sedatives, tranquilizers, pain relievers, and stimulants) was summed and grouped into four categories (i.e., none, 1, 2, ≥ 3 classes of drugs).

Mental health service utilization, a proxy for mental health problems, was defined as participation in the previous year in treatment or counseling at any service location for emotional or behavioral problems that were *not* caused by alcohol or drug use. Treatment service locations included hospitals, private doctor's offices, mental health clinics or programs, general medical settings, or schools. History of foster care placement was assessed by the question, 'Have you ever been in foster care?' History of incarceration was assessed by the question, 'Have you ever been in a jail or detention center?'

Past year delinquent behaviors or conduct problems were assessed by six questions: (a) getting into a serious fight at school or work, (b) taking part in a group fight against another group, (c) carrying a handgun, (d) selling illicit drugs, (e) stealing anything worth more than \$50, and (f) attacking someone with the intent to seriously hurt him or her. These six types of delinquent behaviors were aggregated into three categories (none, 1–2, ≥ 3).

Data analysis

To ensure the representativeness of the NHSDA sample, analysis weights were developed to adjust for variation in household selection, nonresponse, and poststratification of the selected sample to census data. Data were weighted and analyzed by SUDAAN software [31], which applies a Taylor series linearization method to account for the effects of the complex NHSDA design features (i.e., by differential weighting). All percentages reported in this article are weighted estimates, whereas sample sizes are unweighted.

We first explored the bivariate association between lifetime use of nitrite inhalants and study variables. We then examined the characteristics of all nitrite inhalant users. Finally, we conducted logistic regression procedures to identify the characteristics associated with nitrite inhalant use, while controlling for variations in sociodemographic characteristics.

Results

Prevalence of lifetime nitrite inhalant use

Among adolescents aged 12 to 17 years ($N = 36,859$), 1.5% reported lifetime use of any nitrite inhalant. Bivariate analyses found that adolescents who had used nitrite inhalants were more likely than nonusers to report that they were aged 14 years or older (1.8%), white (1.8%), of more than one race/ethnicity (2.4%), and they resided in nonmetropolitan areas (1.9%). Neither gender nor family income was related to nitrite inhalant use.

Bivariate analyses also revealed that nitrite inhalant use was highly associated with recent utilization of mental health services, history of incarceration, history of foster care placement, delinquent behaviors, and the use of alcohol and other drugs. For example, 3% of those who received mental health services had used nitrite inhalants, compared with 1% of those who did not receive any mental health service in the past year. An estimated 8% of adolescents who reported engaging in three or more types of delinquent activities had used nitrite inhalants, compared with only 0.7% of those who did not engage in any of these delinquent activities.

The number of drugs used other than inhalants was positively associated with nitrite inhalant use. About 15% of adolescents who reported having used three or more classes of other drugs used nitrite inhalants, compared with 0.4% of those who reported no use of other classes of drugs. Respondents' nitrite inhalant use also was closely related to the severity of their alcohol and drug abuse or dependence. Reporting the highest prevalence of nitrite inhalant use were those who met the criteria for alcohol or drug dependence in the past year, 12% and 14%, respectively.

Demographic and substance use characteristics of nitrite inhalant users

Demographic and substance use characteristics of nitrite inhalant users are summarized in Table 1. A high proportion of nitrite inhalant users were aged 14 to 17 (79%), white (75%), had a family income between \$40,000 and \$74,999 (35%), resided in small metropolitan areas (38%), received mental health services in the past year (35%), engaged in delinquent activities (68%), and used other classes of illicit drugs (81%). Many nitrite inhalant users also met the criteria for alcohol (33%) and drug (35%) abuse or dependence in the past year.

Of these nitrite inhalant users, females were more likely than males to receive mental health services recently (40% vs. 29%), whereas males were more likely to report delinquent or antisocial behaviors (75% vs. 61%).

Use of other inhalants among nitrite inhalant users

Table 2 describes the characteristics of other types of inhalants used by adolescent nitrite inhalant users ($n =$

Table 1
Sociodemographic and substance use characteristics of adolescent nitrite inhalant users

Variables	Total n = 593 %	Male n = 273 %	Female n = 320 %	χ^2 (df) P Value ^a
Age group				
12–13	21.1	23.3	19.2	NS
14–15	40.2	39.6	40.7	
16–17	38.7	37.1	40.1	
Race/ethnicity ^b				
White	74.5	75.5	73.6	NS
African-American	6.8	7.4	6.2	
Hispanic	12.5	12.7	12.3	
Native American	0.7	0.5	0.8	
Asian	3.2	1.4	4.7	
More than one race	2.5	2.5	2.4	
Family income				
\$0–\$19,999	16.9	11.9	21.3	NS
\$20,000–\$39,999	27.8	31.4	24.7	
\$40,000–\$74,999	35.0	36.3	33.8	
\$75,000 or more	20.3	20.4	20.2	
Population density				
Large metro areas	33.5	34.1	32.9	NS
Small metro areas	37.8	38.8	36.9	
Nonmetro areas	28.7	27.1	30.2	
Receiving mental health services in the past year				
Yes	35.0	29.1	40.2	6.8 (1)
No	65.0	70.9	59.8	0.009
Ever in a jail or a detention center				
Yes	17.3	20.9	14.2	NS
No	82.7	79.1	85.8	
Ever in foster care				
Yes	7.5	9.4	5.9	NS
No	92.5	90.6	94.1	
Number of delinquent behaviors				
None	32.1	24.7	38.5	12.5 (2)
1–2	41.9	43.8	40.2	0.002
≥ 3	26.0	31.6	21.2	
Lifetime use of other drugs				
None	19.2	21.2	17.5	NS
1 drug	21.4	22.7	20.3	
2 drugs	14.8	17.3	12.6	
≥ 3 drugs	44.6	38.8	49.6	
Past year alcohol use				
Alcohol dependence	15.1	15.6	14.6	NS
Alcohol abuse	17.8	14.0	21.1	
Alcohol-related problems	16.8	15.6	17.7	
Alcohol use without problems	28.4	31.1	26.0	
No use	22.0	23.7	20.5	
Past year drug use				
Drug dependence	21.9	22.0	21.8	NS
Drug abuse	13.4	11.4	15.1	
Drug-related problems	17.1	15.8	18.3	
Drug use without problems	27.7	31.4	24.5	
No use	19.9	19.5	20.3	
Survey year				
2000	53.9	56.3	51.8	NS
2001	46.1	43.7	48.2	

^a NS: *p* values > .05.

^b Native American includes American Indians and Alaska Natives. Asian includes Asians, Pacific Islanders, and Native Hawaiians.

Table 2
Inhalant use characteristic among adolescent nitrite inhalant users

Type of inhalant use	Total N = 593	Male n = 273	Female n = 320	χ^2 (df) p Value ^a
Most recent use of inhalants				
Past year use	48.7	48.9	48.5	NS
Prior to past year use	51.3	51.1	51.5	
Use of glue, shoe polish, toluene				
Yes	45.5	40.8	49.6	NS
No	54.5	59.2	50.4	
Use of gasoline, lighter fluid				
Yes	46.6	48.0	45.3	NS
No	53.4	52.0	54.7	
Use of spray paints				
Yes	38.2	33.3	42.5	3.75 (1)
No	61.8	66.7	57.5	0.053
Use of correction fluid, degreaser				
Yes	44.1	37.2	50.1	6.58 (1)
No	55.9	62.8	49.9	0.010
Use of nitrous oxide, whippets				
Yes	25.9	27.9	24.2	NS
No	74.1	72.1	75.8	
Use of aerosol sprays				
Yes	32.6	28.2	36.4	NS
No	67.4	71.8	63.6	
Use of paint solvents, lacquer thinner				
Yes	28.9	26.2	33.0	NS
No	70.1	73.8	67.0	
Use of lighter gases, butane, propane				
Yes	19.1	20.2	18.1	NS
No	80.9	79.8	81.9	
Ether, halothane, anesthetic				
Yes	12.2	12.2	12.2	NS
No	87.8	87.8	87.8	
Use of other inhalants				
Yes	10.0	7.5	12.2	NS
No	90.0	92.5	87.8	
Past year weekly use of any inhalant				
Yes	15.6	14.5	16.6	NS
No	84.4	85.5	83.4	
Number of different types of inhalants used				
Nitrite inhalants only	11.9	9.6	14.0	7.23 (2)
2	20.1	25.0	15.8	0.027
≥ 3	68.0	65.4	70.2	
Age of first any inhalant use				
< 13	43.3	43.2	43.5	NS
13–14	38.4	37.0	39.7	
15–17	18.3	19.9	16.9	
Years since first inhalant use				
1	43.6	45.2	42.2	NS
2	24.0	25.1	23.0	
≥ 3	32.4	29.7	34.8	
Past year inhalant use				
Inhalant dependence	4.4	5.0	4.0	NS
Inhalant abuse	4.7	3.1	6.0	
Inhalant-related problems	9.6	6.3	12.4	
Inhalant use without problems	30.4	34.5	26.1	
No use in the past year	51.3	51.1	51.5	

^a NS: p values > 0.05.

593). Among these users, only 12% had used nitrite inhalants exclusively, whereas 68% had used three or more types of other inhalants. Close to one half of nitrite inhalant users reported also using glue (46%), gasoline (47%), or correction fluid (44%).

Most nitrite inhalant users (82%) reported that they began to use inhalants before age 15. Approximately 16% of nitrite inhalant users reported using any inhalant at least weekly in the past year. Overall, 9% of nitrite inhalant users met the criteria for any inhalant abuse (5%) or dependence (4%) in the past year.

Logistic regression of nitrite inhalant use

We conducted multiple logistic regression analyses to estimate the strength of the associations of nitrite inhalant use with socio-demographic characteristics and other suspected correlates of nitrite inhalant use, including mental health service utilization, history of incarceration, history of foster care placement, delinquent behaviors, and the use of alcohol and other drugs. The results of our adjusted logistic regression, which held constant the potentially confounding influence of social and demographic variables, are reported in Table 3. We found that age, population density, mental health service utilization, delinquent behaviors, use of multiple drugs, and both alcohol and drug abuse and dependence were each independently associated with nitrite inhalant use. Adolescents who resided in large metropolitan areas were less likely than those who resided in nonmetropolitan areas to use nitrite inhalants (adjusted odds ratio [AOR] 0.68, 95% confidence interval [CI] 0.51–0.91). Compared with those who did not receive mental health services in the past year, those who did were slightly more likely to use nitrite inhalants (AOR 1.28, 95% CI 1.03–1.59). Adolescents who reported delinquent behaviors in the past year were twice as likely as those who reported no such behaviors to use nitrite inhalants. Past year alcohol use, abuse, and dependence were all associated with increased odds of nitrite inhalant use.

The results of our adjusted logistic regression, which controlled for drug use variables, yielded an unexpected finding that appears to contradict our descriptive analysis: Older adolescents were *less* likely than younger adolescents to use nitrite inhalants. This finding prompted us to conduct an exploratory analysis to examine the interaction of nitrite inhalant use with age group. We found significant interactions between respondents' age group with both the number of other drugs they used in their lifetime and their reports of past year drug abuse and dependence (Table 4). Respondents' reports of the number of other drugs they had used in their lifetime were positively associated with nitrite inhalant use for adolescents aged 15 to 17, but were not significant for younger adolescents aged 12 to 14. Adolescents aged 15

Table 3

Adjusted odds ratios (AOR) of lifetime use of nitrite inhalants among adolescents aged 12 to 17 (N = 36,859)

Adjusted Logistic Regression Model	Full Model AOR (95% CI)
Age group (yrs)	
14–15 vs. 12–13	0.71 (0.52–0.97)*
16–17 vs. 12–13	0.43 (0.31–0.60)***
Gender	
Male vs. female	0.81 (0.65–1.00)
Race/ethnicity ^b	
White vs. African-American	1.41 (0.94–2.12)
Hispanic vs. African-American	1.28 (0.81–2.04)
Native American vs. African-American	0.57 (0.21–1.54)
Asian vs. African-American	2.17 (0.88–5.00)
More one race vs. African-American	1.74 (0.88–3.46)
Family income	
\$0–\$19,999 vs. \$75,000 or more	1.04 (0.69–1.56)
\$20,000–\$39,999 vs. \$75,000 or more	1.06 (0.76–1.46)
\$40,000–\$74,999 vs. \$75,000 or more	1.12 (0.86–1.47)
Population density	
Large metro vs. nonmetro	0.68 (0.51–0.91)**
Small metro vs. nonmetro	0.87 (0.67–1.13)
Receiving mental health services in the past year	
Yes vs. no	1.28 (1.03–1.59)*
Ever in a jail or a detention center	
Yes vs. no	1.21 (0.91–1.61)
Ever in foster care	
Yes vs. no	1.31 (0.86–1.99)
Number of delinquent behaviors	
1–2 vs. none	1.77 (1.40–2.42)***
≥ 3 vs. none	2.10 (1.53–2.86)***
Lifetime use of other drugs	
1 drug vs. none	1.38 (0.47–4.07)
2 drugs vs. none	1.99 (0.63–6.35)
≥ 3 drugs vs. none	5.07 (1.49–17.25)**
Past year alcohol use	
Alcohol dependence vs. no use	2.39 (1.57–3.64)***
Alcohol abuse vs. no use	2.14 (1.38–3.32)***
Alcohol-related problems vs. no use	1.71 (1.16–2.53)**
Alcohol use without problems vs. no use	1.57 (1.09–2.26)*
Past year drug use	
Drug dependence vs. no use	6.21 (1.88–20.47)**
Drug abuse vs. no use	5.64 (1.74–18.28)**
Drug-related problems vs. no use	4.55 (1.40–14.78)**
Drug use without problems vs. no use	4.95 (1.61–15.26)**
Survey year	
2000 vs. 2001	1.27 (1.03–1.57)*

95% CI: 95 percent confidence intervals.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

to 17 who had used at least three drugs other than inhalants were 18 times as likely to use nitrite inhalants as those who had never used other drugs. By comparison, past year drug use, abuse, and dependence were each associated with increased odds of nitrite inhalant use for adolescents aged 12 to 14, but they were not significant for older adolescents. Young adolescents aged 12–14 who were drug dependent in the past year were 31 times as likely as those who reported no drug use in the past year to use nitrite inhalants in their lifetime.

Table 4
Adjusted odds ratios (AOR) of lifetime use of nitrite inhalants: interaction between age group and drug use variables (N = 36,859)

	AOR (95% CI)	
	Adolescents aged 12–14 n = 18,845	Adolescents aged 15–17 n = 18,014
Lifetime use of other drugs		
1 drug vs. None	0.50 (0.25–1.00)	3.59 (1.46–8.77)**
2 drugs vs. None	0.55 (0.24–1.28)	7.05 (2.59–19.18)***
≥3 drugs vs. None	1.68 (0.78–3.61)	18.16 (6.02–54.81)***
Past year drug use		
Drug dependence vs. No use	31.04 (11.21–85.94)***	1.77 (0.76–4.11)
Drug abuse vs. No use	22.31 (8.30–59.97)***	1.67 (0.72–3.87)
Drug-related problems vs. No use	22.43 (9.56–52.63)***	1.18 (0.50–2.78)
Drug use without problems vs. No use	20.32 (9.55–43.21)***	1.38 (0.61–3.12)

95% CI: 95 percent confidence intervals.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$.

Discussion

We have provided new epidemiological findings on the use of nitrite inhalants among a nationally representative sample of adolescents aged 12 to 17. Overall, 1.5% of adolescents aged 12 to 17 reported lifetime use of these nitrite inhalants. This estimate appears similar to that of the Monitoring the Future (MTF) study, which reported that, among 12th graders, 0.8% in 2000 and 1.9% in 2001 reported lifetime use of nitrite inhalants [32]. We found that the prevalence of nitrite inhalant use increased to 8% among adolescents who engaged in three or more types of delinquent activities in the past year, to 12% among alcohol-dependent adolescents, and to 14% among drug-dependent adolescents.

Notably, 9% of lifetime nitrite inhalant users met the criteria for any inhalant abuse or dependence in the past year. Many more users also met the criteria for past-year alcohol (33%) or drug (35%) abuse or dependence and reported that they received mental health services in the same year (35%).

Our findings suggest that nitrite inhalant use in adolescence deserves greater research and clinical attention than it has received to date. Studies have suggested that inhalant use, in general, is a marker for other serious drug abuse problems, such as heroin and injection drug use [19,20,33,34]. However, it is not clear whether inhalants serve as a 'gateway' or simply a marker for drug addiction [35].

We found that, among adolescents, at least one-third of lifetime nitrite inhalant users met criteria for alcohol or drug abuse and dependence in the past year. The interactions between drug use variables and age groupings further imply a strong relationship between early nitrite use and severe drug abuse. Young, recent drug users aged 12 to 14, regardless of abuse or dependence, were more than 20 times as likely to use nitrite inhalants as those who did not use any drug in the past year. Likewise, among older drug users aged 15 to 17, nitrite inhalant use manifests a gradient

relationship with the number of drugs they have used in their lifetime. These findings suggest that adolescents who once have used nitrite inhalants also tend to use, or continue to use, other substances and progress to drug abuse or dependence. In light of the high prevalence of alcohol and drug abuse or dependence among adolescents reporting a history of nitrite inhalant use, whether and how the use of nitrites functions as a gateway to drug dependency or injection drug use merits investigation.

Several studies have found that gay or bisexual individuals who use nitrite inhalants tend to engage in unprotected sexual practices that greatly increase their risk of contracting and spreading sexually transmitted diseases, including HIV infection [6–11]. Given that at least one-half of all new HIV infections in the United States are now among young people under age 25, and that the majority of young people are infected as a result of unprotected sexual contacts [36], the relationship between adolescent nitrite inhalant use and risky sexual behaviors also warrants further investigation.

Several limitations to our study deserve mention. First, our findings are based on adolescent self-reports, which are subject to a variety of recall errors and reporting biases (e.g., lack of either candor or understanding of the type of drugs used). Even so, investigators have found that self-reported substance use data are generally valid and that the reports of respondents with substance-related problems, or who use multiple drugs, tend to be more valid than those who report lower levels of drug use [37,38]. Yet we should assume some degree of underreporting of all types of drugs, given the survey's household setting and the potential for respondents' concerns of lack of confidentiality on the part of interviewers [39]. Second, the cross-sectional nature of the NHSDA design precludes any interpretation of causality for our findings. Third, the lack of data on age of first nitrite inhalant use, as well as the quantity and frequency of its use, constrains our understanding of these characteristics and their relationship to other drug use and its consequences.

Lastly, a small but high-risk group of inhalant users (e.g., incarcerated, homeless, and transient adolescents) [23] was not included in the NHSDA. Hence, it seems likely that we have underestimated the prevalence of nitrite inhalant use in the general population.

In conclusion, this nationally representative sample of adolescent nitrite inhalant users suggests that most used multiple types of inhalants and initiated their first use of any inhalant before age 15. They also tended to report coexisting delinquent behaviors, multi-drug use, substance abuse and dependence, and recent utilization of mental health services for other emotional or behavioral problems. These young nitrite inhalant users appear to represent a subgroup of highly troubled youths in need of help. The early identification and the provision of treatment services to young users by pediatricians and mental health professionals may help reduce the severity of any subsequent problems. However, owing to the frequent use of multiple inhalants or other drugs by abusers, treatment of inhalant abuse typically is difficult, expensive, and not highly effective [35,40]. Education (e.g., by means of a school-based drug abuse curriculum) is considered the key to primary prevention of inhalant abuse [35,40]. Informing parents and youth about the specific effects and dangers of nitrite inhalants may help decrease its use.

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