

Inhalant Use, Inhalant-Use Disorders, and Antisocial Behavior: Findings From the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC)*

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ABSTRACT. Objective: Few studies have explored the topography of antisocial behavior in a nationally representative sample of inhalant users. We examined (a) the lifetime prevalence of 20 childhood and adult antisocial behaviors in inhalant users with inhalant-use disorders (IUD+) and without IUDs (IUD-); (b) the nature and strength of associations between inhalant use, IUDs, and specific antisocial behaviors in multivariate analyses; and (c) the relationships between inhalant use, IUDs, and antisocial behaviors in a national sample of adults with antisocial personality disorder. **Method:** The National Epidemiologic Survey on Alcohol and Related Conditions was a multistage national survey of 43,093 U.S. residents. Respondents completed a structured psychiatric interview. **Results:** IUD+ and IUD- respondents were significantly younger and more likely to be unemployed, to be male, to have never married, and to report family and personal histories of alcohol and drug problems than inhalant nonusers. Family histories of alcohol problems and personal histories of drug problems were significantly more prevalent among IUD+ respondents, compared with IUD- respondents. In bivariate analyses, IUD+ and IUD- respondents evidenced significantly

higher lifetime levels of all childhood and adult antisocial behaviors than inhalant nonusers. IUD+ respondents were significantly more likely than their IUD- counterparts to report bullying behavior, starting physical fights, using dangerous weapons, physical cruelty to people, staying out all night without permission, running away, and frequent truancy in childhood, as well as greater deceitfulness, impulsivity, irritability/aggressiveness, recklessness, and irresponsibility in adulthood. Multivariate analyses indicated that IUD+ respondents had a significantly elevated risk for childhood and adult antisocial behaviors, compared with inhalant nonusers, with the strongest effects for using dangerous weapons, physical cruelty to animals, and physical cruelty to people. Similarly, IUD+ respondents differed significantly from their IUD- counterparts primarily across measures of interpersonal violence. Among persons with antisocial personality disorder, inhalant use and IUDs were associated with greater antisocial behavior, albeit with fewer and weaker effects. **Conclusions:** Respondents with IUDs had pervasively elevated levels of antisocial conduct, including diverse forms of early-onset and interpersonally violent behavior. (*J. Stud. Alcohol Drugs, 71, 201-209, 2010*)

CRIMINOLOGICAL AND CLINICAL STUDIES suggest that adolescent and adult inhalant users are disproportionately involved in antisocial acts. Howard et al. (2008) found that 36.7% of 723 youths in residential treatment for antisocial behavior had used inhalants. Inhalant users displayed greater frequency of antisocial behavior in the prior year, earlier onset of offending, and more antisocial attitudes than inhalant nonusers. Howard and Jenson (1999) identified

lifetime inhalant use in 34.3% of 475 juvenile probationers. Inhalant users were significantly more likely than nonusers to report intentions to engage in illegal behavior and more frequent participation in criminal behavior.

Clinical investigations of adolescent inhalant users have yielded results consistent with those involving juvenile offenders. Sakai et al. (2004) assessed 847 adolescents admitted to a treatment program for youths with substance-use and behavior disorders, identifying significantly higher rates of conduct disorder in adolescent inhalant users and adolescents with inhalant-use disorders (IUDs), compared with inhalant nonusers. However, lifetime inhalant users with versus without Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV; American Psychiatric Association, 2000), IUDs did not differ significantly with regard to the percentages diagnosed with conduct disorder, and findings for specific antisocial behaviors were not reported. In a 2-year follow-up of 80 adolescents completing chemical-dependency treatment, Sakai et al. (2006) reported that inhalant users exhibited twice as many conduct-disorder symptoms as inhalant nonusers. The relationship between inhalant use and the number of post-

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treatment conduct-disorder symptoms remained significant in multivariate analyses, when the baseline number of lifetime conduct-disorder symptoms was controlled for.

Few general-population surveys have examined associations of inhalant use or IUDs with adolescent antisocial behavior. Siqueria and Crandall (2007) surveyed 60,345 Floridian 6th-12th graders, reporting that inhalant users were significantly more likely to be truant from school and to have parents with a history of antisocial behavior than inhalant nonusers. Wu et al. (2005) estimated that 9% of 12- to 17-year-olds in the United States had used inhalants and found that inhalant users who had engaged in past-year delinquent behaviors were 5.9 times more likely to be diagnosed with past-year DSM-IV inhalant abuse, compared with inhalant users who had not engaged in past-year delinquent behaviors.

Studies evaluating associations between inhalant use, IUDs, and specific adult antisocial behaviors are infrequently reported. Compton et al. (1994) identified a significant association between inhalant use and antisocial personality disorder (ASPD) in a treatment sample of 545 St. Louis illicit drug users; 64% of lifetime inhalant users met DSM-IV ASPD criteria, compared with 35% of inhalant nonusers. Wu and Ringwalt (2006) reported that 2.6% of total respondents to the 2002/2003 National Survey on Drug Use and Health had been booked or arrested in the prior year, compared with 49.9% of lifetime inhalant users.

Using data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), the largest nationally representative comorbidity survey ever conducted, Wu and Howard (2007) identified significantly elevated prevalence rates for ASPD among men (36%) and women (22%) who had used inhalants. Compton et al. (2005) reported that NESARC respondents meeting DSM-IV criteria for inhalant abuse were 18.7 times more likely to meet DSM-IV ASPD criteria than respondents without inhalant abuse, and that the strength of this association exceeded that between any other type of DSM-IV substance abuse and ASPD.

Antisocial behaviors occurring among persons with substance-use disorders are clinically important. Goldstein et al. demonstrated that antisocial behavior syndromes, particularly those occurring in adulthood, are associated with increased severity of substance-use disorders (e.g., Goldstein et al., 2006, 2007). These researchers concluded that childhood antisocial behavior portended greater severity of substance-use disorders in adulthood, primarily for those respondents who continued clinically significant childhood antisocial behavior into adulthood.

Although findings suggest that inhalant use commonly co-occurs with antisocial conduct, many issues relevant to this association remain unresolved. Studies have rarely assessed the prevalence of specific antisocial behaviors occurring across the life course or examined whether childhood and adult antisocial behaviors relate differentially to inhalant

use/IUDs. Greater knowledge of the specific types and patterns of antisocial conduct associated with inhalant use/IUDs could enhance screening, prevention, and treatment interventions targeting inhalant users by identifying the types and optimal locations of services required for this population.

The present investigation also examined whether the prevalence of antisocial behavior increased monotonically with greater levels of problematic involvement with inhalants. A key strength of the reported findings is that they are based on results of a large, nationally representative survey; thus, inferential errors deriving from studies of comorbidity in selected samples of inhalant users are minimized.

Available NESARC data allowed our group to address current gaps in the literature pertaining to inhalant use, IUDs, and antisocial behavior. We examined (a) the comparative prevalence of 20 childhood and adult antisocial behaviors in inhalant nonusers and lifetime inhalant users with (IUD+) and without (IUD-) lifetime IUDs; (b) the nature and strength of associations between inhalant use, IUDs, and childhood and adult antisocial behaviors in controlled multivariate analyses; and (c) associations between inhalant use, IUDs, and childhood and adult antisocial behaviors in adults with ASPD.

We hypothesized that IUD+ respondents would have a significantly greater prevalence of childhood and adult antisocial behaviors, compared with their IUD- counterparts, and that IUD- respondents would, in turn, evidence significantly more prevalent childhood and adult antisocial behaviors than inhalant nonusers. We further hypothesized that these relationships would be most pronounced for severely antisocial behaviors such as interpersonal violence and would be observed even within a national sample with significantly restricted range for antisocial behavior, including only respondents with ASPD.

Method

Subjects, sampling, and interviews

Study findings are based on data from the 2001-2002 NESARC. NESARC includes a representative sample of 43,093 U.S. adults (Grant et al., 2003). The survey gathered information on substance-use disorders and comorbid conditions from individuals living in households and group settings. NESARC used a multistage sampling design and had a response rate of 81%. Data were weighted at the individual and household levels and were adjusted for oversampling, for nonresponse, and to be representative of the U.S. population as assessed by the 2000 census.

U.S. Census Bureau workers administered the Alcohol Use Disorders and Associated Disabilities Interview Schedule-IV (AUDADIS-IV; Grant et al., 2003). AUDADIS is a structured interview designed for administration by lay interviewers. AUDADIS-IV reliably assesses DSM-IV

substance-use disorders (Grant et al., 2003). The NESARC survey, sampling protocol, and codebook are available at <http://niaaa.census.gov>.

Measurement

Inhalant use and inhalant-use disorders. Inhalant users were those respondents who answered affirmatively to the question "Have you ever used inhalants or solvents, for example, amyl nitrite, nitrous oxide, glue, toluene, or gasoline?" An introductory statement informed the respondents that they were to report inhalants used on their own, without a doctor's prescription, and for the purposes of getting high, enjoying themselves, relaxing, feeling better, feeling more alert, or quieting their nerves or to see how the inhalants would work. Inhalant-abuse diagnoses were assigned to inhalant users who met DSM-IV inhalant-abuse criteria but who did not meet inhalant-dependence criteria; inhalant-dependence diagnoses were assigned to subjects who met DSM-IV inhalant-dependence criteria. Respondents were classified as inhalant nonusers if they reported no lifetime inhalant use, were classified as inhalant users without IUDs (IUD-) if they reported inhalant use but had never met DSM-IV inhalant-abuse or inhalant-dependence criteria, or were classified as inhalant users with IUDs (IUD+) if they reported inhalant use and met lifetime criteria for either inhalant abuse or dependence.

Childhood and adult antisocial behaviors/antisocial personality disorder. NESARC respondents answered 59 questions assessing 20 DSM-IV conduct disorder and ASPD diagnostic criteria. Questions assessing conduct-disorder criteria evaluated the presence versus the absence of the following childhood/adolescent behaviors: bullying, threatening, or intimidation; starting physical fights; using dangerous weapons; physical cruelty to people; physical cruelty to animals; stealing with confrontation; forcing someone to have sex; deliberate fire setting; deliberate vandalism; frequent lying for secondary gain; stealing without confrontation; staying out all night without permission; running away at least twice or once without returning; and frequent truancy. Questions assessing ASPD criteria evaluated the presence versus the absence of the following adult behaviors: failure to conform to social norms with respect to lawful behaviors (i.e., repeatedly performing acts that are grounds for arrest); deceitfulness (i.e., repeated lying, use of aliases, or conning others for personal profit or pleasure); impulsivity or failure to plan ahead; irritability and aggressiveness (i.e., repeated physical fights or assaults); reckless disregard for the safety of self or others; and consistent irresponsibility. Respondents were assigned an ASPD diagnosis per DSM-IV guidelines.

Covariates. Lifetime alcohol-use disorder diagnoses (abuse or dependence) and noninhalant drug-use disorder diagnoses (abuse or dependence on heroin, hallucinogens, cocaine/crack, marijuana, stimulants, painkillers, tranquil-

izers, and sedatives) were assigned per DSM-IV guidelines. Response categories for region of residence in United States; race; gender; age; marital, educational, and unemployment status; and annual family income are listed in Table 1. Family histories of alcohol, drug, and antisocial behavior problems, respectively, were recorded as present or absent, based on the respondents' answers to questions assessing whether their "blood or natural father" or "blood or natural mother" had ever "been an alcoholic or problem drinker," had "problems with drugs," or had "behavior problems." A respondent reporting a paternal and/or maternal history of a given problem was regarded as having a family history of that problem.

Analytic plan

Weighted prevalence estimates and 95% confidence intervals were computed using SUDAAN Version 9.0 (Research Triangle Institute, 2004). SUDAAN implements a Taylor series linearization to adjust standard errors of estimates for complex survey sampling design effects involving clustered data. Multivariate logistic regression analyses were conducted via simultaneous entry of the following covariates: sex, age, marital status, education (in years), employment status, annual family income, region of the United States, lifetime history of a DSM-IV alcohol-use disorder, lifetime history of a DSM-IV noninhalant drug-use disorder, family history of antisocial behavior, family history of alcohol problems, and family history of drug problems. Adjusted odds ratios (ORs) and 95% confidence intervals (CIs) are presented to reflect association strength and significance.

Results

Characteristics of inhalant users

IUD+ and IUD- respondents were younger and reported more prevalent family and personal histories of alcohol- and drug-use problems than inhalant nonusers. Larger proportions were White, men, never married, and currently unemployed, relative to inhalant nonusers. IUD+ and IUD- inhalant users differed significantly only with regard to family history of alcohol problems and a lifetime personal history of noninhalant drug-use disorder. Most (93.3%) respondents with IUDs met criteria for at least one additional drug-use disorder, and a majority (62.0%) reported a family history of alcohol problems.

Prevalence of antisocial behaviors among inhalant users in the general population

Childhood antisocial behaviors. Significant differences were observed between inhalant user (i.e., IUD+/IUD-) and nonuser groups for 12 of 14 childhood antisocial behaviors.

TABLE 1. Demographic, family history, and clinical characteristics of NESARC respondents, by lifetime inhalant use status ($N = 41,594$)*

Respondent characteristics	IUD+ ($n = 132$)	IUD- ($n = 509$)	Inhalant nonusers ($n = 40,953$)
Sex, male	76.7 ^a	72.5 ^b	47.2 ^{a,b}
Age, in years	^a	^b	^{a,b}
18-34	48.9	52.3	31.3
35-54	47.3	43.5	39.8
≥55	3.9	4.2	28.9
Race, white	79.0	82.6 ^a	70.8 ^a
Marital status	^a	^b	^{a,b}
Married/cohabitating	40.2	45.0	62.3
Divorced/separated, widowed	17.6	16.4	17.3
Never married	42.2	38.6	20.4
Education			
<High school	21.0	11.4	15.5
High school	29.7	26.7	29.4
>High school	49.4	62.0	55.1
Currently unemployed	20.5 ^a	22.8 ^b	8.5 ^{a,b}
Annual family income, U.S. \$			
0-19,999	32.5	26.8	23.3
20,000-34,999	19.2	18.6	20.1
35,000-69,999	31.3	32.5	32.2
≥70,000	16.9	22.1	24.3
Region of United States		^a	^a
Northeast	18.5	22.9	19.7
Midwest	22.4	20.7	23.2
South	33.1	23.2	35.3
West	25.9	33.4	21.8
Family history of antisocial behavior	31.7 ^a	24.1 ^b	8.7 ^{a,b}
Family history of alcohol problems	62.0 ^{a,b}	47.4 ^{a,c}	22.0 ^{b,c}
Family history of drug problems	22.4 ^a	16.0 ^b	3.7 ^{a,b}
Lifetime personal history of DSM-IV alcohol-use disorder	90.1 ^a	86.7 ^b	29.3 ^{a,b}
Lifetime personal history of DSM-IV noninhalant drug-use disorder	93.3 ^{a,b}	74.2 ^{b,c}	9.2 ^{a,c}

Notes: *Chi-square tests were used for overall comparisons, with adjustments for multiple comparisons. Where differences were observed ($\alpha = .004$), post hoc contrasts were conducted to identify specific group differences; groups with shared superscripts are significantly different from one another. Cell totals may not equal 100% because of rounding. NESARC = National Epidemiologic Survey on Alcohol and Related Conditions; DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; IUD+ = inhalant users with DSM-IV inhalant-use disorders; IUD- = lifetime inhalant users without DSM-IV inhalant-use disorders; inhalant nonusers had no lifetime inhalant use. All n s in column headings are unweighted values; table values are weighted column percentages (SE s).

Lifetime prevalence rates of antisocial behaviors, in relative terms, were low in inhalant nonusers, intermediate in IUD- users, and high in IUD+ respondents (Table 2).

Half of all bivariate comparisons of IUD+ versus IUD- respondents were statistically significant; the largest absolute differences in prevalence rates were for physical cruelty to people, frequent truancy, and starting physical fights. IUD+ respondents evidenced more prevalent antisocial behavior than inhalant nonusers across all measures; the largest absolute differences were for nonconfrontational stealing, truancy, bullying, and physical cruelty to people. IUD- respondents reported significantly greater prevalence rates for antisocial behavior than inhalant nonusers across all measures; the largest differences were for nonconfrontational stealing, vandalism, and bullying.

Adult antisocial behaviors. Adult antisocial behaviors were reported by two thirds to more than four fifths of IUD+

respondents, compared with approximately one half to three quarters of IUD- respondents and one tenth to one fifth of inhalant nonusers.

Differences between IUD+ respondents and inhalant nonusers were large and statistically significant, ranging from 42.5% to 65.6% across antisocial behaviors. Differences between IUD- and inhalant-nonuser prevalence rates for adult antisocial behaviors ranged from 24.9% to 60.5% and were statistically significant. Four of six contrasts between IUD+ and IUD- respondents were statistically significant.

Antisocial behaviors among inhalant users/nonusers with antisocial personality disorder

Childhood antisocial behaviors. A subsample including all respondents with ASPD (3.3%, $n = 1,380$) was drawn from the total NESARC sample. Prevalence rates for child-

TABLE 2. Prevalence of childhood and adult antisocial behaviors in the total NESARC sample and subsample of respondents with antisocial personality disorder, by lifetime inhalant use/inhalant-use disorder status*

Behavior	Total sample				Antisocial personality disorder subsample			
	Overall (N = 41,364)	IUD+ (n = 128)	IUD- (n = 505)	Inhalant nonusers (n = 40,731)	Overall (N = 1,380)	IUD+ (n = 132)	IUD- (n = 61)	Inhalant nonusers (n = 1,187)
Childhood antisocial behaviors								
Bullying/threatening/intimidation	4.3 (0.16)	30.0 ^{a,b} (4.62)	18.2 ^{b,c} (2.14)	4.0 ^{a,c} (0.15)	46.5 (1.68)	55.3 (7.38)	45.4 (5.82)	46.2 (1.82)
Starting physical fights	2.9 (0.12)	23.4 ^{a,b} (5.01)	9.9 ^{b,c} (1.59)	2.7 ^{a,c} (0.11)	35.2 (1.57)	40.8 (7.91)	28.0 (4.52)	35.8 (1.61)
Using dangerous weapons	0.9 (0.06)	12.0 ^{a,b} (3.61)	2.7 ^{b,c} (0.75)	0.8 ^{a,c} (0.06)	14.1 (1.19)	25.2 (6.75)	9.6 (2.57)	14.1 (1.30)
Physical cruelty to people	3.3 (0.13)	28.3 ^{a,b} (4.74)	12.2 ^{b,c} (1.80)	3.0 ^{a,c} (0.12)	37.5 (1.74)	52.2 (7.21)	30.6 (4.74)	37.6 (1.90)
Physical cruelty to animals	1.3 (0.07)	13.0 ^a (3.74)	7.5 ^a (1.21)	1.1 ^{a,b} (0.07)	14.6 (1.14)	24.2 (6.58)	15.3 (3.46)	14.0 (1.19)
Stealing with confrontation**	0.1 (0.02)	4.9 (2.75)	0.4 (0.27)	0.1 (0.01)	1.7 (0.38)	10.4 (5.47)	1.4 (0.96)	1.3 (0.32)
Forcing someone into sex**	0.0 (0.01)	0.9 (0.62)	0.6 (0.39)	0.0 (0.01)	0.2 (0.13)	1.0 (0.95)	1.0 (1.00)	0.1 (0.08)
Deliberate fire setting	0.9 (0.06)	9.4 ^a (2.79)	7.8 ^b (1.88)	0.7 ^{a,b} (0.06)	12.7 (1.19)	18.5 (5.57)	25.4 (5.65)	10.8 (1.13)
Deliberate vandalism	1.8 (0.10)	19.9 ^a (4.27)	16.4 ^b (2.37)	1.5 ^{a,b} (0.09)	32.3 (1.55)	39.7 (7.33)	48.4 (6.01)	29.8 (1.51)
Frequent lying for secondary gain	3.2 (0.12)	25.6 ^a (4.91)	16.9 ^b (1.97)	3.0 ^{a,b} (0.11)	42.5 (1.60)	46.5 (7.63)	50.5 (4.97)	41.3 (1.79)
Nonconfrontational stealing	11.8 (0.38)	56.2 ^a (5.26)	53.7 ^b (2.58)	11.0 ^{a,b} (0.35)	75.6 (1.40)	83.7 (5.62)	92.7 ^a (2.53)	73.0 ^a (1.54)
Staying out all night without parental permission	2.6 (0.12)	23.1 ^{a,b} (4.73)	10.7 ^{b,c} (1.65)	2.4 ^{a,c} (0.11)	28.2 (1.53)	47.3 (7.80)	29.8 (4.55)	27.0 (1.58)
Running away at least twice or once without returning	2.6 (0.12)	22.8 ^{a,b} (4.58)	12.6 ^{b,c} (1.78)	2.4 ^{a,c} (0.11)	30.3 (1.48)	38.1 (7.18)	34.4 (4.80)	29.3 (1.59)
Frequent truancy	3.0 (0.12)	29.2 ^{a,b} (4.60)	14.8 ^{b,c} (1.89)	2.8 ^{a,c} (0.11)	30.6 (1.41)	56.5 (7.09)	32.0 (5.22)	29.1 (1.53)
Adult antisocial behaviors								
Repeated unlawful behaviors	17.3 (0.49)	81.9 ^a (4.06)	76.8 ^b (2.49)	16.3 ^{a,b} (0.46)	82.3 (1.19)	91.0 ^a (4.38)	92.7 ^b (3.02)	80. ^{a,b} (1.371)
Deceitfulness	5.9 (0.17)	47.9 ^{a,b} (5.37)	30.3 ^{b,c} (2.42)	5.4 ^{a,c} (0.15)	48.7 (1.72)	61.6 (7.32)	56.7 (5.60)	47.1 (1.76)
Impulsivity/failure to plan ahead	20.8 (0.46)	72.4 ^{a,b} (4.11)	55.6 ^{b,c} (2.72)	20.2 ^{a,c} (0.45)	72.9 (1.52)	87.9 (4.46)	75.2 (4.67)	71.8 (1.66)
Irritability/aggressiveness	14.2 (0.37)	69.7 ^{a,b} (4.77)	46.1 ^{b,c} (2.64)	13.6 ^{a,c} (0.35)	77.4 (1.45)	89.6 (4.41)	72.4 (5.16)	77.5 (1.55)
Recklessness	22.1 (0.67)	76.6 ^a (4.32)	66.9 ^b (2.56)	21.3 ^{a,b} (0.65)	71.1 (1.63)	83.7 (5.88)	82.1 (5.13)	69.1 (1.80)
Consistent irresponsibility	16.6 (0.35)	68.0 ^{a,b} (4.65)	53.0 ^{b,c} (2.82)	15.9 ^{a,c} (0.33)	67.6 (1.58)	82.4 (5.53)	70.1 (4.82)	66.6 (1.74)

Notes: Chi-square tests were used for overall comparisons, with adjustments for multiple comparisons. Where differences were observed ($\alpha = .0025$), post hoc contrasts were conducted to identify specific group differences; groups with shared superscripts are significantly different. NESARC = National Epidemiologic Survey on Alcohol and Related Conditions; IUD+ = inhalant users with Diagnostic and Statistical Manual of Mental Disorder, Fourth Edition (DSM-IV), inhalant-use disorders; IUD- = lifetime inhalant users without lifetime DSM-IV inhalant-use disorders; inhalant nonusers reported no lifetime inhalant use. *Values are column percentages (SEs) unless otherwise specified; **test statistic was not reported because of low cell counts.

hood antisocial behaviors were higher for IUD+ respondents, compared with inhalant nonusers, in all cases. For 10 of 14 contrasts, prevalence rates for childhood antisocial behaviors were lower among inhalant nonusers than among IUD- respondents. However, only the contrast for nonconfrontational stealing was statistically significant at the Bonferroni-adjusted *p* value.

The largest absolute differences in lifetime prevalence rates between IUD+ and IUD- respondents with ASPD were for frequent truancy, physical cruelty to people, staying out

all night, using dangerous weapons, and starting physical fights. Absolute differences between IUD+ and inhalant nonusers were generally modest but were largest for frequent truancy, staying out all night, and physical cruelty to people. The largest absolute differences for IUD- versus inhalant nonuser comparisons were for nonconfrontational stealing, vandalism, and fire setting.

Adult antisocial behaviors. Group differences were observed for repeated unlawful behaviors at the Bonferroni-adjusted *p* value of .0025, where IUD+ and IUD- respondents

had the highest rates of this behavior. For all other ASPD indicators, trends were observed where IUD+ respondents had the highest rates of antisocial behavior; inhalant nonusers reported the lowest rates of antisocial behavior. The largest differences in absolute terms for IUD+ versus IUD- contrasts were for irritability/aggressiveness, impulsivity, and consistent irresponsibility; only the contrast for irritability/aggressiveness was statistically significant. IUD+ versus inhalant nonuser differences in prevalence rates ranged from 10.5% (repeated unlawful behaviors) to 16.1% (impulsivity); all such contrasts were statistically significant except that for deceitfulness. Differences between IUD- and inhalant nonuser groups generally were not large. It should be noted, however, that these trends were not statistically significant.

Multivariate logistic regression analyses of inhalant use, inhalant-use disorders, and childhood and adult antisocial behaviors

Total NESARC sample. Multivariate logistic regression analyses with simultaneous entry of covariates (see Method section for a listing) were conducted across each antisocial behavior measure. In the total NESARC sample, 10 of 12 ORs for comparisons of IUD+ adults versus inhalant nonusers across childhood antisocial behaviors and 8 of 12 such ORs for IUD- respondents versus inhalant nonusers were statistically significant. These results indicated that inhalant users were significantly more likely to engage in most childhood antisocial behaviors than nonusers.

For 10 of 12 childhood antisocial behaviors, differences with inhalant nonusers were larger for IUD+ than IUD- adults. The largest ORs for IUD+ versus inhalant nonuser contrasts were for interpersonally violent behaviors, including using dangerous weapons, physical cruelty to animals, and physical cruelty to people. The largest ORs for IUD- versus inhalant nonuser contrasts were for nonconfrontational stealing and fire setting.

IUD+ respondents were significantly more likely than inhalant nonusers to evidence five of six adult antisocial behaviors. Likewise, ORs were statistically significant for five of six IUD- versus inhalant nonuser group contrasts for adult antisocial behaviors. For five of six adult antisocial behavior group contrasts, ORs for comparisons with inhalant nonusers were larger for IUD+ than for IUD- adults. Even with the extensive set of covariates employed, IUD+ respondents were 1.8 to 2.9 times and IUD- respondents were 1.2 to 2.9 times more likely than inhalant nonusers to report adult antisocial behaviors. The largest effects for IUD+ respondents versus inhalant nonusers were for deceitfulness, irritability/aggressiveness, and impulsivity. The largest effects for IUD- versus inhalant nonusers were for repeated unlawful behaviors, consistent irresponsibility, and deceitfulness.

Whereas the findings in Table 3 present comparisons of IUD+ and IUD- respondents with inhalant nonusers, direct comparisons of IUD+ and IUD- respondents in controlled multivariate logistic regressions indicated that IUD+ respondents were significantly more likely than IUD- respondents to report physical cruelty to people (OR = 2.85, 95% CI [1.3, 6.1]) and using dangerous weapons (OR = 4.8, 95% CI [1.6, 14.2]) in childhood, and irritability/aggressiveness (OR = 2.2, 95% CI [1.24, 4.1]) and impulsivity (OR = 1.92, 95% CI [1.1, 3.5]) in adulthood.

Antisocial personality disorder subsample. Within the subsample of respondents meeting ASPD criteria, 3 of 12 IUD+ versus inhalant-nonuser group contrasts were significant for childhood antisocial behaviors. IUD+ respondents exhibited higher levels of physical cruelty to people, truancy, and staying out all night than inhalant nonusers. Two of 12 IUD- versus inhalant-nonuser group contrasts for childhood antisocial behaviors were statistically significant. IUD- respondents were more likely to report stealing without confrontation and illegal fire setting, compared with inhalant nonusers. None of the six IUD+ versus inhalant nonuser or six IUD- versus inhalant-nonuser group contrasts was statistically significant for adult antisocial behaviors. However, the OR for the IUD+ versus the inhalant-nonuser group comparison was elevated at 3.1 (95% CI [0.75, 12.6]) for irritability/aggressiveness.

Direct comparisons of IUD+ versus IUD- respondents with ASPD indicated that IUD+ respondents were significantly more likely to report physical cruelty to people (OR = 3.2, 95% CI [1.2, 8.6]), using dangerous weapons (OR = 3.1, 95% CI [1.0, 9.1]), and frequent truancy (OR = 3.2, 95% CI [1.2, 8.6]) in childhood, and they did not differ significantly from IUD- respondents across any adult antisocial behavior, although the difference for irritability/aggressiveness approached significance (OR = 3.8, 95% CI [0.90, 15.8]).

Discussion

Summary of findings

Inhalant users were significantly younger, and larger percentages were men, White, unmarried, and unemployed and had family histories of alcohol problems, drug problems, and antisocial behavior problems and personal histories of alcohol and noninhalant drug-use problems, compared with inhalant nonusers. Significantly larger percentages of IUD+ respondents reported family histories of alcohol problems and personal histories of DSM-IV noninhalant drug-use disorders, compared with IUD- respondents.

Lifetime prevalence rates for childhood antisocial behavior were high in IUD+ respondents (>20% for eight behaviors), compared with those for inhalant nonusers (>5% for only one behavior); rates of IUD- respondents were intermediate to those of IUD+ respondents and inhalant nonusers.

TABLE 3. Adjusted odds of childhood and adult antisocial behaviors in lifetime inhalant users with (IUD+) and without (IUD-) lifetime IUDs compared with inhalant nonusers, in the total NESARC sample and the subsample of respondents with antisocial personality disorder*

Antisocial behaviors	Total sample (N = 37,048)		Antisocial personality disorder subsample (n = 1,119)	
	AOR	[95% CI]	AOR	[95% CI]
Childhood antisocial behaviors				
Bullying/threatening/intimidation				
IUD+	2.47	[1.37, 4.47]	1.81	[0.77, 4.22]
IUD-	1.72	[1.22, 2.42]	1.18	[0.66, 2.10]
Starting physical fights				
IUD+	2.63	[1.26, 5.46]	1.06	[0.48, 2.36]
IUD-	1.25	[0.84, 1.88]	0.90	[0.56, 1.44]
Using dangerous weapons				
IUD+	4.03	[1.55, 10.50]	2.48	[0.93, 6.63]
IUD-	0.84	[0.41, 1.74]	0.68	[0.32, 1.45]
Physical cruelty to people				
IUD+	3.42	[1.71, 6.83]	2.79	[1.20, 6.51]
IUD-	1.20	[0.80, 1.81]	0.87	[0.51, 1.51]
Physical cruelty to animals				
IUD+	3.71	[1.56, 8.82]	2.15	[0.78, 5.88]
IUD-	1.93	[1.18, 3.14]	0.70	[0.31, 1.56]
Stealing with confrontation				
IUD+	**	**	**	**
IUD-				
Forcing someone into sex				
IUD+	**	**	**	**
IUD-				
Deliberate fire setting				
IUD+	2.11	[0.85, 5.22]	1.25	[0.39, 3.95]
IUD-	2.69	[1.61, 4.48]	2.29	[1.27, 4.12]
Deliberate vandalism				
IUD+	2.64	[1.30, 5.36]	1.17	[0.53, 2.56]
IUD-	2.46	[1.59, 3.80]	1.41	[0.78, 2.52]
Frequent lying for secondary gain				
IUD+	1.52	[0.72, 3.21]	0.80	[0.34, 1.88]
IUD-	1.47	[1.00, 2.17]	1.23	[0.71, 2.13]
Nonconfrontational stealing				
IUD+	2.04	[1.12, 3.69]	1.87	[0.64, 5.45]
IUD-	2.72	[2.12, 3.50]	3.51	[1.47, 8.38]
Staying out all night without parental permission				
IUD+	3.32	[1.68, 6.56]	2.27	[0.99, 5.20]
IUD-	1.63	[1.02, 2.61]	1.19	[0.68, 2.07]
Running away at least twice, or once without returning				
IUD+	2.75	[1.29, 5.84]	1.69	[0.69, 4.11]
IUD-	2.02	[1.27, 3.20]	1.67	[0.97, 2.89]
Frequent truancy				
IUD+	3.17	[1.67, 6.00]	3.50	[1.53, 8.01]
IUD-	1.79	[1.22, 2.62]	1.08	[0.64, 1.82]
Adult antisocial behaviors				
Repeated unlawful behaviors				
IUD+	2.25	[1.10, 4.61]	2.30	[0.41, 13.00]
IUD-	2.86	[2.01, 4.05]	1.45	[0.62, 3.37]
Deceitfulness				
IUD+	2.88	[1.63, 5.08]	1.13	[0.49, 2.61]
IUD-	1.60	[1.18, 2.17]	1.18	[0.71, 1.97]
Impulsivity/failure to plan ahead				
IUD+	2.63	[1.59, 4.35]	1.41	[0.55, 3.59]
IUD-	1.37	[1.02, 1.84]	0.86	[0.46, 1.61]
Irritability/aggressiveness				
IUD+	2.64	[1.49, 4.67]	3.08	[0.75, 12.57]
IUD-	1.18	[0.90, 1.53]	0.82	[0.47, 1.43]
Recklessness				
IUD+	1.81	[0.98, 3.34]	1.81	[0.55, 5.98]
IUD-	1.45	[1.09, 1.93]	1.05	[0.49, 2.26]
Consistent irresponsibility				
IUD+	2.46	[1.50, 4.03]	1.44	[0.58, 3.58]
IUD-	1.65	[1.24, 2.18]	1.07	[0.59, 1.95]

Notes: *Inhalant nonusers were the reference group. Each model adjusted for sex; current age; marital status; education; employment status; annual family income; region of the United States; lifetime history of Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV), alcohol-use disorder and lifetime history of a noninhalant drug-use disorder; and family history of antisocial behavior, alcohol problems, and drug problems. Values in **bold** are statistically significant based on a 95% confidence interval [CI] that does not bound 1.0. IUD+ = inhalant users with lifetime DSM-IV inhalant use-disorders; IUD- = lifetime inhalant users without lifetime DSM-IV inhalant-use disorders; inhalant nonusers had no lifetime inhalant use; NESARC = National Epidemiologic Survey on Alcohol and Related Conditions; AOR = adjusted odds ratio; **AORs were not reported because of small cell count.

Prevalence rates for adult antisocial behaviors were much higher than those reported for childhood behaviors and also revealed evidence of a strongly positive association between severity of problematic involvement with inhalants and lifetime prevalence of antisocial behavior.

Multivariate analyses consistently identified greater antisociality in inhalant users, compared with nonusers, and in inhalant users with IUDs, compared with those without IUDs. As hypothesized, many of the largest differences were for the most serious antisocial offenses, including physical cruelty to people and using dangerous weapons in childhood, as well as irritability/aggressiveness in adulthood as reflected in recurrent physical fighting. Comparisons of inhalant nonusers, IUD-, and IUD+ users within the subsample of respondents with ASPD also revealed significantly greater antisociality among inhalant users (especially those with IUDs), albeit with fewer and weaker effects than in the total NESARC sample.

Implications

What, then, is the significance of the association between inhalant use, IUDs, and antisocial behavior? It is possible that the willingness to seek intoxication via the inhalation of toxic products merely indexes traits such as novelty seeking, low fear, impulsivity, and other "third variables" that may give rise to both antisocial conduct and inhalant use (Howard et al., 1997, 2001). Inhalant users exhibit high rates of impulsivity and risk taking and may be prone to impulsive antisocial behaviors, including inhalant use and interpersonal violence (Wu and Howard, 2007). It is also conceivable that inhalants could disinhibit behavior through their actions on prefrontal cortical areas involved in behavioral inhibition and thereby increase the probability that antisocial behavior is expressed, particularly displays of aggression (Blair et al., 2005). Because many inhalants are neurotoxins (Finch and Lobo, 2005), the risk for disinhibition-related aggression may increase over time with greater inhalant use and might account, in part, for the higher rates of antisocial behavior observed in adulthood, compared with childhood, among inhalant users in this study. It is also possible that prevalence rates for adult antisocial behavior were higher because these behaviors were more recent and therefore more easily recalled.

Regarding clinical and other practice recommendations, results clearly indicate that respondents with IUDs evidence early onset of severe and varied antisocial behaviors that are likely to bring them to the attention of school, social service, health care, and juvenile justice-system service providers. Screening for inhalant use is currently rare in these settings and should be more broadly implemented, because inhalant use at any level appears to be a reliable marker of risk for later behavioral, health, and mental health problems. Unfortunately, there is currently little to offer practitioners in the

way of evidence-based prevention or treatment interventions for IUDs. Therefore, early identification of youth at risk for inhalant use and IUDs might provide practitioners with a better opportunity to help prevent or ameliorate the serious harm associated with repeated use of these toxic agents.

Limitations

The results reported here are based on self-report data and are subject to possible unreliable recall and/or social-desirability bias. Furthermore, the use of a single omnibus inhalant-assessment question may have underestimated the actual level of inhalant use and may have captured a heterogeneous group of inhalant users that included respondents (e.g., nitrite users) who are not considered inhalant users under the current DSM-IV nosology. Rates of nitrite use, however, are very low nationally, and current findings are consistent with recent reports documenting high levels of psychiatric (Wu and Howard, 2007) and substance-use (Wu et al., 2008) disorders, suicidal ideation and attempts (Freedenthal et al., 2007), and other deleterious health and social conditions (Howard et al., 2008) in inhalant users and persons with IUDs.

A notable strength of this study, however, is that it examined the prevalence and correlates of specific childhood and adult antisocial behaviors in a large, nationally representative sample of lifetime inhalant users and persons with IUDs (assessed via structured psychiatric interviews), and it is the first to have assessed the associations of inhalant use and IUDs with specific antisocial behaviors in a national sample of persons with ASPD. Further etiological and epidemiological research is needed to inform nascent and ongoing efforts to prevent, detect, and treat IUDs in adolescents and adults at elevated risk for the development of these specific antisocial behaviors.

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