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## Inhalant Use Initiation among U.S. Adolescents: Evidence from the National Survey of Parents and Youth Using Discrete-Time Survival Analysis

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### Abstract

The purpose of this paper is to identify factors associated with initiation to inhalant use among adolescents ages 9 to 18. The data are from the National Survey of Parents and Youth, a longitudinal household survey. Baseline surveys for adolescents and parents were conducted between November 1999 and June 2001 and then annually for three subsequent rounds. The outcome measure is an indicator of a respondent's first use of inhalants. Discrete-time survival analysis was used to model the hazard of initiation. The hazard of inhalant initiation peaks at about 14 years of age (slightly younger than smoking and marijuana initiation). African Americans were less likely than Whites to initiate inhalant use, and higher family income was protective against inhalant initiation. The findings suggest that parenting is associated with initiation of inhalant use: parental drug use was a risk factor for inhalant initiation, and a measure of parental monitoring was protective. The study results also suggest a strong relationship between inhalant use and other problem behaviors and sensation seeking. These results highlight the need to intervene early for youth at risk of or just beginning to engage in risky behaviors including inhalant use.

### Keywords

inhalant use initiation; adolescence; discrete-time survival analysis

## 1. Introduction

Inhalants are the most widely used illicit drug among young adolescents (<8th grade) (Johnston et al., 2005; Wu et al., 2004) and are second to marijuana in terms of use among 8th and 10th graders in the United States (Johnston et al., 2001). Inhalants appear to be among the few drugs showing evidence of stable or even increasing use among adolescents in the United States in the past decade (Johnston et al., 2005, 2009). Among U.S. teenagers, an estimated 2 million have used inhalants to get high at some time in their lives (Wu et al., 2004).

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The literature on inhalants, although not extensive, suggests a number of potential factors associated with adolescent use. African American race (Centers for Disease Control and Prevention [CDC], 2006; Substance Abuse and Mental Health Services Administration [SAMHSA], 2006), parental monitoring (Ramirez et al., 2004), two-parent households (Mackesy-Amiti and Fendrich, 2000), and strong academic performance (Mackesy-Amiti and Fendrich, 2000) are associated with decreased likelihood of using inhalants. Family problems and impaired family functioning (McGarvey et al., 1996, 1999; Morita et al., 1996; Tapia-Conyer et al., 1995), serious problems in school (Oetting and Webb, 1997), and deviant behavior (Mackesy-Amiti and Fendrich, 1999; Mosher et al., 2004), including other drug use and general delinquency, appear to be strongly associated with inhalant use. General parental drug use also has been associated with inhalant use (Mosher et al., 2004).

Literature on adolescent inhalant use has focused on factors associated with current or lifetime inhalant use with little research on the factors influencing a youth's first use of inhalants. In this study, potential factors associated with the first use of inhalants (e.g., initiation) during adolescence are examined.

## 2. Methods

### 2.1 Sample

The National Survey of Parents and Youth (NSPY), a longitudinal household survey designed to evaluate the impact of the National Youth Anti-Drug Media Campaign, was used in this study. A national door-to-door screening methodology identified a nationally representative sample of adolescents and their parents. Among eligible households, 74% to 75% completed a household roster of residents and their ages. Within these households, adolescents were selected in each of three age ranges: 9 to 11, 12 to 13, and 14 to 18. In households with multiple eligible adolescents, up to two adolescents were randomly selected. One selected caregiver of each sampled adolescent also completed an interview.

The NSPY methodology employed a complex survey sampling scheme that included three recruitment waves and four follow-up waves of data collection structured so that each child-parent pair had the opportunity to take part in up to four surveys. Baseline surveys for adolescents and parents were conducted between November 1999 and June 2001 and then annually for three subsequent rounds. A total of 8,117 adolescents completed a baseline survey. Other details of the survey design and data collection procedures have been reported elsewhere (Westat, 2006).

The current analysis includes all respondents (8,184) across all NSPY waves. This includes adolescents who indicated they were between the ages of 9 and 18 during the recruitment (baseline) wave of the survey, as well as respondents whose first completed survey wave was after baseline. Two respondents lacked adequate demographic data and were dropped from the analytic sample. Respondents remained in the sample until they reported using inhalants or were lost to follow-up (right censored). This approach yielded a full sample of 8,182 youth, representing 89,219 person-period observations.

### 2.2 Measures

**2.2.1 Dependent Variable**—The outcome measure is an indicator of a respondent's first use of inhalants. Inhalants are defined in NSPY as "liquids, sprays, or gases that people sniff, huff, or inhale to get high or make [them] feel good." All respondents were asked, "Have you ever used inhalants?" and, if yes, "How old were you when you first used inhalants?" Responses to these questions were used to determine (1) if initiation has taken place and (2) the age at which inhalant use began for those reporting inhalant use prior to the

baseline survey. Initiation is defined as a transition from never using inhalants to ever using inhalants. Respondents who reported first use of inhalants post-baseline and who did not have a valid response for the age at first use question were considered to have initiated inhalant use at the time of the survey wave in which they first reported using inhalants.

**2.2.2 Independent Variables**—To control for other drug use, we included measures of substance use status at baseline for adolescents and their parents. For adolescents, variables included “ever smoked a cigarette,” “ever drank alcohol,” and “ever used marijuana.” For parents, we created an index that included the parents’ measures of illicit drug use at baseline. The index was based on parents’ responses to questions regarding whether they had ever used marijuana, inhalants, or other illicit drugs. Parents responding affirmatively to any drug use question were coded as 1, whereas nonusers (for all drugs) were coded as 0.

Two variables assessed the context in which youth spend their free time. First, the amount of unsupervised time youth spend with friends was assessed. Unsupervised time was described as time spent with friends without adult supervision. Next, youth reported the amount of time they spend with friends who smoke.

To control for potential peer effects on adolescent inhalant use, a measure of how frequently the respondent discussed drug use with their friends in the past 6 months was included.

Two items assessed parent’s familiarity with their children’s activities by asking youth the frequency that their parents “know what they are doing when away from home” and “have a pretty good idea of plans for the coming day.”

We included a measure reported by youth on how often they fought or argued with their parents in the past 30 days. Also, two items measured positive family experiences (i.e., “how often did you enjoy being with parents in the past 30 days,” and “how often did you experience feelings of togetherness in your family in the past 30 days”). A measure of peer delinquency was constructed from three variables asking respondents about the number of times in the past 7 days they spent time with peers who engaged in antisocial activities (i.e., times with friends who “get in trouble a lot,” “fight a lot,” and “take things that don’t belong to them”).

A sensation-seeking scale was created that included four items related to a youth’s potential engagement in novel and risk-taking behaviors (i.e., “like to explore strange places,” “like to do frightening things,” “like new and exciting experiences, even if they break the rules,” and “prefer friends who are exciting and unpredictable”).

Each scale was dichotomized based on the median average score for all respondents with scores greater than the median equal to 1 and 0 otherwise.

Demographic characteristics were also included as controls. The respondent’s race/ethnicity was derived from the child’s survey, whereas the respondent’s gender, age, highest level of education attained by parents in the household, family structure, total annual household income, average academic achievement (i.e., grade point average), and frequency of attending a church or other religious services were taken from the parent-linked survey.

### 2.3 Analysis methods

To examine correlates of inhalant initiation, a person-period dataset based on the age at which each youth initiated inhalant use was created. The retrospective recall of the age of initiation allows the analysis to be extended from ages 9 to 18 to ages 5 to 18. Discrete-time survival analysis begins with all sample members who never used inhalants (the risk pool, at

risk of the event occurring) and then estimates the risk of inhalant initiation as the sample of youth ages. Once the event in question (i.e., inhalant use) occurs, the sample member is dropped from subsequent time periods. This allows for calculation of the probability that an individual will initiate inhalant use for each age represented in the sample, given that they did not previously begin using inhalants. The hazard shows the proportion of the sample that experiences the event among all those who are still at risk of experiencing the event.

### 3. Results

Figure 1 presents a hazard plot of inhalant initiation by age. As shown, the period of greatest hazard of inhalant use is between the ages of 12 and 16 with the greatest risk of initiation at age 14.

#### 3.2 Discrete-time analyses

Table 1 presents adjusted odds ratios (ORs) for the full discrete-time survival model of inhalant initiation. The adjusted odds of reporting inhalant use were lower for African American respondents than for White respondents (OR = 0.33). Lifetime alcohol, cigarette, and marijuana use also were associated with significantly increased odds of inhalant use (OR = 1.46; CI [1.12, 1.89]; OR = 1.29; CI [1.00, 1.67]; and OR = 1.83; CI [1.40, 2.39], respectively).

Higher reported levels of sensation seeking (OR = 1.37; CI [1.08, 1.74], delinquency (OR = 1.39; CI [1.12, 1.72]), and frequency of talking about drugs with friends (OR = 1.10; CI [1.03, 1.18]) are associated with a significant increase in the odds of inhalant initiation, whereas parents knowing the adolescent's plans for the coming day (OR = 0.73; CI [0.55, 0.97]) is associated with a decrease in the odds of inhalant use. Odds of inhalant use were significantly lower for respondents in the highest income category compared to those in the lowest income category with no significant differences in the middle income categories.

No significant associations were found with regard to parental education, frequency of attending religious services, and positive family experiences scale.

### 4. Discussion

Sensation seeking and other drug use were significantly associated with initiation of inhalant use. Several studies have found a relationship between inhalant use and other problem behaviors (e.g., Dinwiddie et al., 1991; Fleschler et al., 2002; Schutz et al., 1994), and the finding of a strong relationship between inhalant use and other drug use is consistent with many prominent behavioral theories, including Problem Behavior Theory (Jessor, 1991). A growing body of evidence suggests a clear and consistent association between the use of inhalants and the use of other drugs. Several studies have suggested that inhalant use serves as an early marker for other serious drug problems, such as cocaine, heroin, and intravenous drug use (Bennett et al., 2000; Dinwiddie et al., 1991; Johnson et al., 1995; Novins and Baron, 2004; Schutz et al., 1994) and for general problematic behavior (Borges et al., 2000; Howard and Jenson, 1999; Kelder et al., 2001; Mackesy-Amity and Fendrich, 2000; Sakai et al., 2004; Wu et al., 2004).

As with any study, a number of limitations should be considered along with the results. For instance, the NSPY employed a very general question for inhalant use. It has been proposed that broad questions about inhalant use may lead to substantial underreporting of actual use (Howard et al., 1999) because of the extremely broad number of substances this term entails. The overall prevalence of inhalant use in our sample was low relative to other national estimates (6% vs. 11% to 17%), due perhaps in part to the question wording.

This study is the first to examine initiation of inhalant use among a national U.S. sample of young adolescents. The study results suggest a strong relationship between inhalant use and other problem behaviors and sensation seeking. It is clear that inhalant use begins at a relatively young age and co-occurs with initiation to other substances and other problem behaviors. Given the apparent correlation of inhalant use with other harder substances (e.g. heroin) later in life (Dinwiddie et al., 1991; Wu and Howard, 2007) these results highlight the need to intervene early for youth at risk of or just beginning to engage in risky behaviors. In this regard, it is important to identify risk factors that precede initiation to inhalants and other substances.

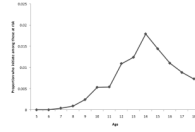
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**Figure 1.**  
Estimated hazard of inhalant use by age of initiation

TABLE 1

## Discrete-time survival analysis of inhalant initiation

| Characteristics   | Odd Ratio<br>[95% CI]                              |
|---|--|
| Male  | 0.99<br>[0.822, 1.212]                             |
| Race/ethnicity (ref = White)  |  |
| African-American  | <b>0.33<sup>***</sup></b><br><b>[0.215, 0.513]</b> |
| Hispanic  | 0.96<br>[0.715, 1.301]                             |
| Other race  | 1.04<br>[0.615, 1.774]                             |
| Highest level of education by either parent (ref = dropout/missing) |  |
| High school or above, no college                                    | 1.02<br>[0.756, 1.372]                             |
| College or more   | 0.91<br>[0.632, 1.311]                             |
| Other adult sharing parenting in the household                      | 0.99<br>[0.777, 1.251]                             |
| Total household income (ref = <\$25k)                               |  |
| \$25–\$49.9K  | 0.83<br>[0.637, 1.082]                             |
| \$50–\$74.9K  | 0.81<br>[0.59, 1.114]                              |
| >\$75K  | <b>0.54<sup>***</sup></b><br><b>[0.378, 0.779]</b> |
| Ever smoked a cigarette   | <b>1.29<sup>**</sup></b><br><b>[1.002, 1.665]</b>  |
| Ever drank alcohol  | <b>1.46<sup>***</sup></b><br><b>[1.121, 1.894]</b> |
| Ever smoked marijuana   | <b>1.83<sup>***</sup></b><br><b>[1.399, 2.387]</b> |
| Parental ever-use of drugs  | <b>1.22<sup>*</sup></b><br><b>[0.983, 1.502]</b>   |
| Average grades in school  | <b>0.99<sup>**</sup></b><br><b>[0.974, 0.998]</b>  |
| Frequency attending a church or other religious services            | 1.05<br>[0.964, 1.153]                             |
| How often parents know what you are doing when away from home       | 0.83<br>[0.657, 1.052]                             |
| How often parents know plans for the coming day                     | <b>0.73<sup>**</sup></b><br><b>[0.554, 0.972]</b>  |
| How many times friends smoke cigarettes in past 7 days              | 0.99<br>[0.943, 1.045]                             |
| How often talked with friends about drugs in the past 6 months      | <b>1.10<sup>***</sup></b><br><b>[1.034, 1.179]</b> |
| How often hang out with friends without adults around               | 1.00<br>[0.911, 1.093]                             |
| How often fought or argued with family in last 30 days              | 1.03<br>[0.952, 1.114]                             |



| <b>Characteristics</b>            | <b>Odd Ratio<br/>[95% CI]</b>    |
|-----------------------------------|----------------------------------|
| Sensation-seeking scale           | <b>1.37**</b><br>[1.076, 1.739]  |
| Positive Family Experiences scale | 1.02<br>[0.807, 1.295]           |
| Delinquency scale                 | <b>1.39***</b><br>[1.125, 1.723] |

\* Notes: = p<0.1;

\*\* = p<0.05;

\*\*\* = p<0.01