

Risk for Inhalant Initiation Among Middle School Students: Understanding Individual, Family, and Peer Risk and Protective Factors

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ABSTRACT. Objective: Because initiation of inhalants at an early age is associated with a range of health and behavioral problems, including an increased likelihood of inhalant dependence (based on criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*), we conducted discrete time survival analyses to determine the role of time-invariant and time-variant (over five waves) risk and protective factors as well as grade in inhalant initiation among middle school students. **Method:** The current study uses data from 3,215 students who were initially surveyed as sixth graders in 2008–2009 and were resurveyed in seventh and eighth grades. Students were part of a larger substance use prevention trial conducted in greater Los Angeles. The sample is racially/ethnically diverse (54% Hispanic/Latino, 16% Asian, 14% White, 3% African American) and 51% male. **Results:** Seventeen percent of youths initiated inhalants during middle school. Higher drug

refusal self-efficacy, familism (i.e., values related to family), and parental respect were associated with decreased odds of inhalant initiation. Having a significant adult or older sibling who used substances was associated with increased risk of initiation, but adult influence declined linearly and by the end of seventh grade was no longer a risk factor. Self-rated popularity was associated with inhalant initiation in seventh grade only, and perceived substance use by peers was associated with inhalant initiation in sixth grade only. **Conclusions:** The influence of adults, siblings, and peers on inhalant use may be strongest in sixth and seventh grade. Interventions to prevent inhalant initiation should target sixth and seventh graders, address influence by family and peers, and provide skills training to improve drug refusal self-efficacy. (*J. Stud. Alcohol Drugs*, 74, 835–840, 2013)

UP TO 15% OF ADOLESCENTS age 12 years and older in the United States report that they have used an inhalant at least once in their lifetime (Eaton et al., 2008; Garland et al., 2011; Johnston et al., 2010; Substance Abuse and Mental Health Services Administration, 2008; Wu et al., 2004). Inhalants are volatile organic substances found in household and industrial products that produce chemical vapors that can be inhaled to induce euphoria followed by an intoxication effect similar to that of alcohol (National Institute on Drug Abuse, 2012). Most youths who initiate inhalant use do so between 6th and 10th grade, with a higher annual prevalence of use among younger adolescents (e.g., 7%–9% of 8th graders vs. 3%–4% of 12th graders report use; Johnston et al., 2010). Inhalant misuse is associated with seizures, trauma, accidents, and burns (Janežič, 1997; National Institute on Drug Abuse, 2012; Steffee et al., 1996) and with delinquency, depression, and suicidal behavior (Borges et al., 2000; Mackesy-Amity and Fendrich, 1999; Perron and Howard, 2009). It also is associated with the use of alcohol and illicit drugs, such as opiates (How-

ard and Perron, 2009; Storr et al., 2005; Wu et al., 2004). Inhalant use before age 16 years has been associated with an increased likelihood of heroin use in adulthood (Johnson et al., 1995; Storr et al., 2005) and a higher likelihood of progression to inhalant dependence based on criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM IV; American Psychiatric Association, 1994) (Wu et al., 2004).

Despite the high prevalence of and the dangers associated with early inhalant use, studies focusing on risk and protective factors specifically associated with the early initiation of inhalants are few (Nonnemaker et al., 2011). Guided by a risk-focused theoretical approach (Catalano et al., 1996; Cleveland et al., 2008; Hawkins et al., 1986), the current study addresses this gap by examining the association between risk and protective factors and inhalant initiation among early adolescents.

From prior research examining risk and protective factors associated with the initiation of alcohol, tobacco, and marijuana use, we know that certain individual, family, and peer factors are consistently associated with use and problems. Some of the individual factors associated with use are drug refusal self-efficacy (DRSE) (Musher-Eizenman et al., 2003; Oei and Jardim, 2007; Schell et al., 2005; Walker et al., 2011) and perceived popularity (Diego et al., 2003; Pirkle and Richter, 2006; Tucker et al., 2011), with lower DRSE and higher perceived popularity associated with greater

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likelihood of use. Peer factors associated with use include perceived peer use (D'Amico and McCarthy, 2006; D'Amico et al., 2001; Ellickson et al., 2003a; Henry et al., 2005), peer approval, and offers of substances by peers (Trucco et al., 2011). Family factors thought to protect against use include higher levels of familism, parental respect (Soto et al., 2011; Unger et al., 2002), and parental education (Bachman et al., 2011), whereas use of substances by a close adult or sibling is associated with increased risk of use by the adolescent (Bauman et al., 1990; Chuang et al., 2009; Nonnemaker et al., 2011; Wu et al., 2009).

We examined the association of each of these factors with risk for inhalant initiation among a large and diverse sample of middle school youths. Because early adolescence is associated with increased susceptibility to risk-taking and influence from peers in particular (Rubin et al., 2006; Steinberg, 2004), we also assessed whether these risk and protective factors differentially affected initiation between sixth and eighth grade.

Method

Participants in the current study were part of CHOICE (D'Amico et al., 2012), a large survey and voluntary afterschool substance use prevention trial conducted in the greater Los Angeles area. (See D'Amico et al., 2012, for a full description of study methods.) Students in sixth to eighth grade from 16 middle schools were enrolled in the study and completed five in-school surveys: fall 2008, spring 2009, fall 2009, spring 2010, and spring 2011. The present study is based on 3,215 respondents who completed a survey when they were beginning sixth grade in fall 2008 and who were then followed up over four more waves (spring of sixth grade, fall and spring of seventh grade, and spring of eighth grade). Response rates for Waves 2–5, respectively, were as follows: 84%, 74%, 70%, and 65%.

Our binary dependent variable was inhalant initiation at one of five possible time points: fall of sixth grade, spring of sixth grade, fall of seventh grade, spring of seventh grade, or spring of eighth grade. Three categories of predictor variables were considered: (a) individual factors, (b) family factors, and (c) peer factors. We controlled for age, race/ethnicity, gender, and for whether CHOICE was conducted at the school.

Individual factors were (a) DRSE for cigarette, alcohol, and marijuana use and (b) perceived popularity. DRSE was assessed by asking students to rate their likelihood of using substances in certain situations, such as, "Suppose you are offered alcohol/marijuana/cigarettes and you do not want to use them. What would you do in these situations?" (Ellickson et al., 2003b) (Cronbach's α ranged from .76 to .83). Perceived popularity was assessed with a five-item scale asking students on a scale from 1 (*strongly disagree*) to 4 (*strongly agree*) about their beliefs about their own popular-

ity (Jarvinen and Nicholls, 1996) (Cronbach's α ranged from .89 to .92).

Family factors were (a) mother's education, (b) familism, (c) parental respect, (d) use of substances by a significant adult, (e) having an older sibling, and (f) older sibling substance use. To measure familism (Cuéllar et al., 1995) and parental respect (Ho, 1994), we used two scales developed by Unger et al. (2002) and recently updated by Soto et al. (2011). Both scales had four items that were rated on a 4-point scale and averaged ($\alpha = .77$ for familism and $\alpha = .89$ for parental respect). For family substance use, students reported how often the adult most important to them and with whom they spend time used either alcohol or marijuana. Students also reported whether they had an older sibling and, if so, whether their older sibling used either alcohol or marijuana.

Peer factors were (a) perceived use of cigarettes, alcohol, or marijuana by peers; (b) offers of these substances by peers; and (c) perceived peer approval of the use of these substances. Perceived use among peers at school was a continuous variable that asked students to think about a group of 100 students in their grade and estimate how many had smoked cigarettes at least once a month, drank alcohol at least once a month, or ever tried marijuana (WestEd, 2008). Responses were recorded on a scale of 1–11, where 0 or no students out of 100 was coded as "1," 10 students of 100 was coded as "2," and so forth. Offers of substances by peers were measured through questions about the frequency of offers of cigarettes, marijuana, and alcohol by peers in the past 30 days. These were coded to dichotomous variables and then averaged across substances. A single peer approval of substance use score was derived by averaging across peer approval items for all three substances (Orlando et al., 2005; $\alpha = .95$ –.96).

We controlled for age at wave, gender, race/ethnicity, and school attended. The school variable controlled for whether youths received CHOICE and for other school-level differences. We used full information maximum likelihood estimation, which provides unbiased and consistent parameter estimates in the presence of data that are missing at random or missing completely at random, to control for any attrition effects (Arbuckle, 1996).

We used discrete time survival analysis to assess the predictors of initiating inhalants across five time points. We examined two types of covariates: time-invariant covariates and time-variant covariates. Time-invariant covariates (age, gender, race, and mother's education), assessed at the first wave, predict the overall risk of initiation such that the change in risk associated with a time-invariant covariate is assumed to be constant over time (Watson, 2005). Time-variant covariates (all remaining variables), assessed at all five waves, predict initiation at each wave.

We first conducted three types of tests for each of the time-variant covariates. In the first test, we assessed the

TABLE 1. Bivariate and multivariate discrete time survival analysis models predicting the risk of initiating inhalants: Main effects ($n = 3,215$)

Variable	Bivariate discrete time survival analysis models			Multivariate discrete time survival analysis models		
	OR	[95% CI]	<i>p</i>	OR	[95% CI]	<i>p</i>
Time-invariant covariates						
Age				1.43	[1.11, 1.59]	<.001
Female				0.98	[0.68, 1.40]	.904
Race (ref. = White)						
African American				1.38	[0.48, 3.96]	.548
Hispanic				1.24	[0.68, 2.25]	.476
Asian				0.82	[0.40, 1.66]	.598
Other				1.03	[0.51, 2.07]	.927
Mother's education				0.80	[0.65, 0.99]	.045
Individual time-variant covariates						
Drug refusal self-efficacy	0.75	[0.66, 0.84]	<.001	0.32	[0.25, 0.40]	<.001
Self-rated popularity	1.48 ^a	[1.20, 1.82]	<.001	1.34	[1.08, 1.65]	.007
Family time-variant covariates						
Familism	0.71	[0.62, 0.82]	.017	0.85	[0.52, 1.38]	.511
Parental respect	0.84	[0.73, 0.96]	.010	0.63	[0.37, 1.08]	.094
Adult substance use	1.24 ^b	[1.11, 1.39]	<.001	1.81	[1.17, 2.78]	.007
Have an older sibling	1.37 ^b	[0.90, 2.08]	.142	2.40	[1.17, 4.96]	.018
Have an older sibling who uses alcohol or marijuana	6.38	[3.22, 12.65]	.001	3.61	[1.40, 9.27]	.008
Peer time-variant covariates						
Perceived substance use						
among peers	1.08 ^a	[1.03, 1.14]	.005	1.25	[1.12, 1.40]	<.001
Offers of substances by peers	16.93	[10.62, 29.97]	<.001	7.71	[4.16, 14.31]	<.001
Peer approval of substance use	2.07	[1.53, 3.91]	<.001	1.74	[1.35, 2.23]	<.001

Notes: OR = odds ratio; CI = confidence interval; ref. = reference. ^aSignificant interaction with time; ^bsignificant linear change in effect over time.

effects of time-variant covariates separately for each wave. Second, we tested the interaction between time and the time-variant covariate. In the third test, we constrained the effects across time to change in a linear manner. This tested whether the effect of DRSE, for example, changed over time in a consistent fashion. Next, we tested three multivariate models, one for each domain of time-variant covariates: individual factors, family factors, and peer factors. Finally, we tested a multivariate model with only the time-invariant covariates.

Results

In bivariate models, individual time-variant factors associated with initiating inhalants at any of the five waves were DRSE and self-rated popularity, with lower DRSE and higher self-rated popularity associated with increased odds of initiating (Table 1). The interaction between self-rated popularity and time was significant, with popularity associated with increased odds of initiating only at Waves 3 and 4 (i.e., the beginning and end of seventh grade). Family factors with significant main effects were familism, parental respect, use of alcohol or marijuana by a significant adult, and having an older sibling who uses alcohol or marijuana. Increased familism and parental respect scores were associated with decreased odds of initiating inhalants, whereas substance use by a significant adult and use of substances by an older sibling were associated with increased odds of initiating. Hav-

ing an older sibling (regardless of substance use), although not showing any main effects, had a significant linear change in effect over time. Having an older sibling had the largest effect on initiation of inhalants at the beginning of sixth grade, a smaller effect at the end of sixth grade, and no effect after sixth grade. The use of substances by an important adult also had a significant linear change in effect over time, with the most significant effect at the beginning of sixth grade, effects decreasing through the end of sixth grade and the beginning of seventh grade, and diminishing by the end of seventh grade (Wave 4). Peer factors associated with initiating inhalants were perceived substance use by peers, offers of substances by peers, and peer approval of substance use, with all factors associated with increased odds of initiating inhalants. The interaction between perceived substance use and time was significant, with significant effects at Waves 1 and 2.

Both of the individual time-variant variables—DRSE and self-rated popularity—were significant in the multivariate model, with higher DRSE associated with decreased odds of initiating inhalants and higher self-rated popularity associated with increased odds of initiating (Table 1). Of the family variables, substance use by a significant adult, having an older sibling, and having an older sibling who used alcohol or marijuana all were significantly associated with increased odds of initiating. Having an older sibling who used alcohol or marijuana had the largest effects of the family variables in

this model, followed by simply having an older sibling and then by having a significant adult who used substances. All three of the time-variant peer variables—perceived substance use among peers, offers of substances by peers, and peer approval of substance use—were associated with increased odds of initiating inhalants, with offers of substances by peers having the largest effect.

Discussion

This study examined individual, family, and peer risk and protective factors associated with inhalant initiation during middle school and whether being in sixth, seventh, or eighth grade affected these associations. As expected, we found that most risk and protective factors associated with initiation of other substances were also related to the risk of initiating inhalants; unique findings are that some of these factors may be more likely to influence youths early, in sixth and seventh grades, compared with eighth grade.

Consistent with previous findings for alcohol and marijuana (Tucker et al., 2011; Walker et al., 2011), lower DRSE and higher self-rated popularity were both associated with increased risk of inhalant use. We found an interaction between wave and popularity, with popularity associated with increased odds of initiating inhalants only in seventh grade, and the largest effect at the end of seventh grade. Our findings highlight the need for interventions in early adolescence that focus on increasing DRSE and providing normative feedback to youths about substance use among their peers, both of which could help with the peer pressure that youths may feel during this time.

Multiple family factors were significantly related to inhalant initiation. Low familism and parental respect were associated with inhalant initiation, and our findings are consistent with prior research on other substances (Soto et al., 2011; Unger et al., 2002). Findings for important adult and older sibling use of alcohol and marijuana in inhalant use also replicate the literature in this area (Bauman et al., 1990; Gfroerer, 1987; Li et al., 2002; White et al., 2000). One novel finding was that the influence of adult substance use and having an older sibling were both more strongly related to initiation for younger adolescents. That is, the effects of an adult's substance use were greatest at the start of sixth grade, less at the end of sixth grade, and lowest at the start of seventh grade. Effects disappeared by the end of seventh grade. Similarly, having an older sibling increased the risk of inhalant initiation and is greatest at the start of sixth grade, less at the end of sixth grade, and not associated with initiation at all after sixth grade. Having an older sibling who uses substances superseded all other family factors in influencing inhalants initiation. Thus, early prevention efforts must address substance use by family members and, in particular, focus on the role that an older sibling may play in introducing a younger sibling to substances.

Similar to prior literature on the influence of peers on use of other substances (D'Amico and McCarthy, 2006; D'Amico et al., 2001; Ellickson et al., 2003a; Henry et al., 2005), we found that the perceived prevalence of use, offers of use, and perceptions of peer approval were all associated with increased risk of inhalant initiation. We also found an interaction between perceived substance use by peers and time, with perceived substance use significant at both time points in the sixth grade but not after sixth grade. This emphasizes the importance of focusing on peers and peer use in prevention and intervention programs for this age group and highlights the importance of providing normative feedback to this age group so that they have a more realistic understanding of substance use among peers their age, which can help them make healthy decisions (Borsari and Carey, 2000; D'Amico et al., 2012; Spirito et al., 2004; Walters et al., 2009).

Although our study contributes new and important findings to the small amount of literature on inhalant initiation among middle school students, the study has limitations. For example, our study only covers initiation of inhalants and does not examine whether and to what extent inhalant use continues after initiation. Further, we chose to focus on inhalants and therefore did not examine whether initiation of other substances might affect the predictors of inhalant initiation. Nevertheless, our study sheds light on the individual, peer, and family factors that may contribute to inhalant initiation and emphasizes the importance of prevention for this particular substance among this younger age group.

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