

Individual and Social Influences on Progression to Daily Smoking During Adolescence

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KEY WORDS

progression, daily smoking, smoking prevention, smoking predictors, family management

ABBREVIATION

RHC—Raising Healthy Children

Points of view are those of the authors and not the official positions of the funding agency.

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WHAT'S KNOWN ON THIS SUBJECT: Researchers have found mixed results with respect to social influences on smoking escalation. Some indicate a greater role of peer influences, compared with family and school influences, in escalation, whereas others suggest that parental influences are equally or more important.



WHAT THIS STUDY ADDS: This study focused on a sample that had already initiated experimental smoking, using prospective time-varying measures of social factors. We found that parents' and peers' smoking and positive family management practices had overall and unique associations with smoking escalation.

abstract

OBJECTIVES: The goal was to identify individual and social predictors of progression to daily smoking by the end of high school among youths who initiated smoking by grade 8.

METHODS: The analysis sample of 270 adolescent smokers was taken from the Raising Healthy Children project. Data were taken from annual interviews in grades 7 and 12. Daily smoking was defined as having smoked ≥ 1 cigarette per day in the past 30 days at the time of each interview. Discrete-time survival analysis was used to assess associations with individual, family, peer, and school predictors.

RESULTS: A total of 58% ($n = 156$) of the analysis sample made the transition to daily smoking by grade 12. The likelihood of onset of daily smoking among those who had not yet demonstrated onset was smallest in grade 9 (probability: 0.12) and greatest in grade 12 (probability: 0.25). Youth depression, prosocial beliefs, and antisocial behavior had overall associations with risk of smoking escalation. In addition, parents' and peers' smoking, family management, academic grades, and school commitment had significant univariate associations with smoking progression. After adjustment for gender, low-income status, and other potential predictors, youths' antisocial behavior and parents' and peers' smoking predicted greater likelihood of escalation to daily smoking, whereas parental use of positive family management predicted lower likelihood of escalation.

CONCLUSIONS: This study supports preventing escalation in adolescent smoking by targeting parents' and peers' smoking and involvement in other forms of antisocial behavior and working with parents to improve their use of positive family management practices. *Pediatrics* 2009;124:895–902

Smoking is a serious pediatric health issue, because the majority of smokers start using cigarettes and develop nicotine dependence during childhood or adolescence.¹ Approximately 30% of current adolescent smokers use cigarettes daily, and every day >2000 US youths become new daily smokers.²

Previous research identified risk and protective factors for different stages of smoking, including (1) individual influences such as depression,³⁻⁵ beliefs or attitudes about smoking,⁶⁻⁸ and antisocial behavior^{3,4}; (2) family influences such as parents' smoking,⁸⁻¹¹ parent-child conflict⁸ and bonding,^{6,9} and parental monitoring and family rules⁹; and (3) peer and school influences such as peers' smoking,^{6,10,12,13} academic achievement,^{3,7} and school commitment or attachment.³ However, what uniquely predicts smoking escalation varies across studies. Some studies found that parents' smoking was not predictive of daily smoking when other psychosocial factors (eg, delinquency and peers' smoking) were controlled,^{3,4} whereas others showed a unique contribution of parents' smoking.^{8,9,13} The inconsistencies may be attributable to differing smoking progression measures, assessment intervals, youth ages studied, or covariates examined. In addition, previous studies on youth smoking escalation were limited by contrasting daily smokers with all others, including experimental smokers and nonsmokers,^{9,11-13} which might have conflated predictors of initiation and escalation.

The present study attempted to add to the literature by (1) focusing on escalation of smoking among early smoking initiators (before grade 8), (2) analyzing annual assessments of smoking from prospective longitudinal data (grades 8-12), and (3) using time-varying measures of a broad range of potential predictors of smoking escalation from individual, family,

peer, and school domains (grades 7-11). The choice of potential predictors of smoking escalation was guided by previous studies on risk and protective factors for adolescent smoking and other substance use.^{6,8,14} The goals of the present study were to examine hazard rates of progression to daily smoking for early smokers (those who initiated smoking before grade 8) and to identify individual and social factors that predict the progression to daily smoking.

METHODS

Sample and Procedures

The study sample consisted of 270 participants in the Raising Healthy Children (RHC) project. In 1993 and 1994, participants were recruited from a pool of 1239 first- or second-grade students in 10 suburban public elementary schools in a school district in the Pacific Northwest. Parents of 1040 students (84%) consented to their families' participation in the study (first grade: 52%; second grade: 48%). Data collection consisted of annual in-person surveys with students, telephone interviews with parents (through age 18), and survey questionnaires for teachers (through eighth grade). Survey completion rates remained at >85% through 12th grade. Procedures were approved by the University of Washington human subjects internal review board. Data reported here were derived from student and parent surveys. Data from the 2 grade cohorts were organized on the basis of grade level, by using data from grades 7 through 12 if participants were progressing in school according to schedule. For the older grade cohort, data were from spring 1999 through spring 2004; for the younger grade cohort, data were from spring 2000 through spring 2005.

To be included in the current analysis, a participant had to report smoking

cigarettes by eighth grade ($N = 316$) but not smoking daily by seventh grade (37 subjects had already progressed to daily smoking at grade 7 and were excluded from the sample). Another 9 participants were excluded because they were missing data at seventh grade and their progression to daily smoking could not be determined. The 9 participants who did not respond to the grade 7 survey did not differ from those interviewed with respect to levels of risk and protective factors examined. The final analysis sample consisted of 270 participants; 51% ($n = 137$) were male, 85% ($n = 229$) were white, 6% ($n = 15$) were black, 4% ($n = 12$) were Hispanic, 3% ($n = 8$) were Native American, and 2% ($n = 6$) were Asian American. Thirty-four percent ($n = 90$) received the free/reduced lunch program at the beginning of the RHC study. The analysis sample ($N = 270$) did not differ from the full sample ($N = 1040$) with respect to measures of gender and low-income status but did differ with respect to ethnic composition; a smaller proportion of the analysis sample was Asian American, compared with the group of participants excluded from the analysis sample (2% vs 7%; $\chi^2 = 13.51$, $P = .009$), because Asian American students were less likely to initiate smoking in adolescence than were students of other ethnic groups.^{2,15}

The RHC project is, in part, an experimental study of a preventive intervention to reduce drug use and other problem behaviors. Schools were assigned to an intervention or control condition, resulting in 562 intervention students and 478 control students. The intervention provided after-school tutoring and group-based youth workshops; youth training in interpersonal and problem-solving skills; parent workshops and in-home visit services to improve parenting skills; and teacher workshops to enhance

classroom management techniques.¹⁶ There is evidence that the intervention reduced levels of risk factors in elementary school and marijuana and alcohol use and risky driving behaviors in high school.^{16–18} However, we found no significant difference according to experimental condition in the means of the predictors and the likelihood of smoking escalation examined in this study. Furthermore, preliminary analyses showed no statistically significant ($P < .05$) interaction effects of intervention condition on the associations between potential predictors and smoking progression, providing evidence of invariant covariance structures among variables in this study. On this basis, participants in the intervention and control conditions were combined in the analyses, and the intervention condition was not included in subsequent analyses.

Measures

Progression to Daily Smoking

At each point (grades 8 through 12), participants were asked, “How many times have you smoked cigarettes in the past month?” The response categories were as follows: 1 = not at all, 2 = <1 cigarette per day, 3 = 1 to 5 cigarettes per day, 4 = approximately one half of a pack per day, and 5 = ≥ 1 pack per day. The first time a participant reported having smoked ≥ 1 cigarette per day in the previous month, the participant was coded as having progressed to daily smoking.

Individual and Social Influences

We used items measured from grades 7 through 11 for time-varying predictors, linking predictors to hazard of onset at the subsequent student interview. Predictors were measured with the same items at each time point. Items were combined into scales by calculating means across items, with higher scores indicating more of the

constructs as labeled. All predictors were measured with youth self-report items except for parents’ smoking, which was assessed through parent reports. The α coefficients for scales at grade 7 are reported below for scales based on ≥ 3 items. Individual and social factors included in this study were shown in previous RHC studies to have reliability and validity in examining youth drug use, including smoking.^{18–20} A list of all of the items used for scales is available from the authors.

Three characteristics of individuals were included, that is, (1) youth depressive symptoms (7 items; $\alpha = .76$; sample question: “Do you feel like crying a lot of the time?”), (2) antisocial behavior (7 items; $\alpha = .80$; sample question: “In the past year, how often have you started a fight with someone?”), and (3) prosocial beliefs (3 items; $\alpha = .51$; sample question: “Do you think it’s important to be honest with your parents, even if they become upset or you get punished?”). Potential social influences included 4 family factors, 2 peer factors, and 2 school factors. Family factors were parents’ smoking (parent reports of whether the mother or father used cigarettes in the previous year), family conflict (5 items; $\alpha = .70$; sample question: “Do you and your parents get mad at each other a lot?”), family bonding (8 items; $\alpha = .79$; sample questions: “Do you share your thoughts and feelings with your mother [your father]?”), and positive family management (14 items; $\alpha = .81$; sample questions: “If you drank beer or wine without your parent’s permission, would you get caught and punished?” and “Do your parents know where you are most afternoons after school?”). The family management measure thus included items measuring both appropriate use of consequences for positive and negative behaviors and monitoring of

children’s behavior. Peers’ smoking was assessed as adolescent-perceived peer smoking, which has been shown to be more predictive of youths’ smoking than actual peer cigarette use²¹ (1 item; “How many of your 10 closest friends smoke cigarettes?”). School factors were academic grades (1 item; youth self-report of grades) and school commitment (2 items; “Do you try to do well in school?” and “Do you look forward to going to school?”).

Control Variables

We included 2 control variables that were potential predictors of smoking progression and that might be associated with the predictors described above. Gender was coded 1 for male and 0 for female, and low-income status was defined according to whether, when the youth was in seventh grade, he or she received free/reduced-price school lunch or the youth’s parent reported that the family received food stamps, unemployment assistance, or Temporary Aid to Needy Families. Although studies have found ethnic differences in the epidemiological and etiologic features of youth smoking,^{22,23} ethnicity was not controlled in the analyses because the sample was predominantly white (85%) and there were no more than 15 participants in any other ethnic or racial group.

Analysis

Information on smoking progression was recorded at annual intervals from grade 8 to grade 12. As a first step, we obtained life-table estimates to identify hazard rates of progression to daily smoking in each time interval. Discrete-time survival analysis was used to analyze the risk of progression to daily smoking and the effects of predictors on the risk of progression. Time-varying measures were linked to whether participants had progressed to daily smoking by the subsequent survey (eg, grade 7 measures were

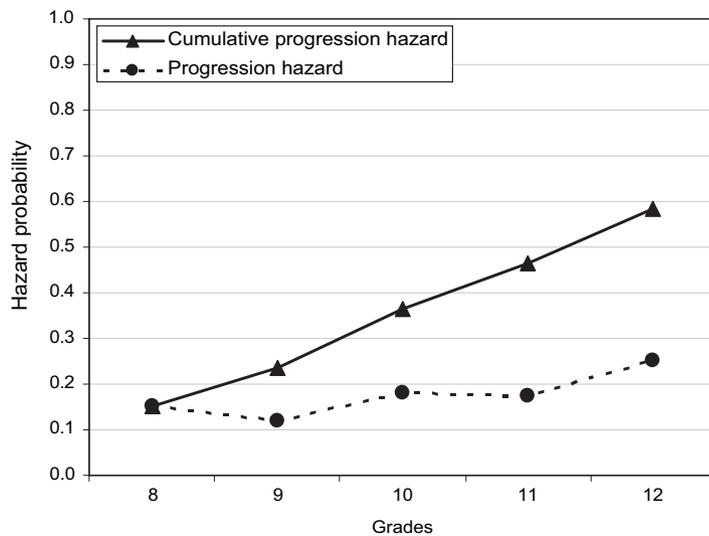


FIGURE 1
Hazard probabilities of progression to daily smoking.

used to predict escalation by grade 8). A complementary logarithmic-logarithmic model²⁴ was used, that is, $\log[-\log(1 - P_{it})] = \alpha_t + \beta X_{it}$, where P_{it} is the conditional probability that an event occurs at time t to an individual i , given that the individual has not already experienced the event at time $t - 1$. Estimates for α_t represent the probability of the event occurring at time t , and β represents the effect of predictor X , with this effect being treated as constant over time (ie, the effect of X is the same at different intervals).

We examined the overall association between potential predictors and the

hazard of progressing to daily smoking by entering each predictor variable separately. Next, we analyzed a multivariate model that included all predictors simultaneously. This multivariate model identified the unique predictors of smoking escalation.

RESULTS

The yearly hazard rate for daily smoking onset and the cumulative rate of onset are shown in Fig 1. A total of 58% ($n = 156$) of the analysis sample made the transition to daily smoking by grade 12. The chance of onset of daily smoking among those who had not yet demonstrated onset was smallest for

grade 9 (probability: 0.12) and greatest for grade 12 (probability: 0.25).

Correlations among predictor variables are presented in Table 1, which shows the averages of correlations across time points for pairs of variables in which ≥ 1 of the variables is time varying. These correlations indicate substantial overlap between some predictors. For example, the average correlations between prosocial beliefs and positive family management and between family bonding and positive family management were >0.5 .

Results from single-predictor and multivariate models are shown in Table 2. Neither of the control variables had a significant overall association with risk of smoking progression. Gender, however, had a significant unique association with smoking escalation in the multivariate model after adjustment for other predictors, with boys being less likely to make the progression to daily smoking.

Among individual factors, a higher level of youth depression predicted a significantly higher risk of progression to daily smoking and prosocial beliefs predicted a lower risk of escalation, although these relationships were not statistically significant after adjustment for other predictors in the multivariate model. Antisocial behav-

TABLE 1 Correlations Among Independent Variables in Grades 7 to 11

	Correlation Coefficient, Mean										
	Male	Low Income	Depression	Antisocial Behavior	Prosocial Beliefs	Parents' Smoking	Conflict	Bonding	Positive Management	Peers' Smoking	Grades
Low income	.12										
Youth depressive symptoms	-.22	-.04									
Antisocial behavior	.12	.01	.24								
Prosocial beliefs	-.11	.05	-.23	-.41							
Parents' smoking	.08	.10	.04	.05	.02						
Family conflict	-.09	-.03	.39	.27	-.28	-.06					
Family bonding	.12	.02	-.27	-.24	.39	-.06	-.34				
Positive family management	-.04	.06	-.23	-.39	.54	.01	-.29	.57			
Peers' smoking	-.09	.01	.18	.33	-.19	.08	.15	-.16	-.22		
Academic grades	-.13	-.10	-.21	-.25	.19	-.07	-.23	.12	.15	-.20	
School commitment	-.10	.06	-.20	-.27	.37	-.01	-.23	.20	.29	-.20	.34

Low income status was measured at grade 7, while time-varying individual and social influence predictors were measured in grades 7 through 11.

TABLE 2 Sociodemographic, Individual, and Social Influences on Progression to Daily Smoking in Grades 8 Through 12, in Complementary Logarithmic-Logarithmic Models

Domains and Time-Varying Predictors (Grades 7–11)	B, Estimate ± SE	
	Single-Predictor Models	Multivariate Model
Control variables (grade 7)		
Male	−0.23 ± 0.16	−0.40 ± 0.19 ^a
Low income	−0.13 ± 0.19	−0.10 ± 0.20
Individual domain		
Youth depressive symptoms	0.45 ± 0.15 ^a	0.29 ± 0.18
Antisocial behavior	0.73 ± 0.15 ^a	0.45 ± 0.21 ^a
Prosocial beliefs	−0.43 ± 0.17 ^a	0.14 ± 0.24
Family domain		
Parents' smoking	0.50 ± 0.17 ^a	0.54 ± 0.19 ^a
Family conflict	0.12 ± 0.14	−0.19 ± 0.16
Family bonding	−0.19 ± 0.15	0.41 ± 0.22
Positive family management	−0.73 ± 0.18 ^a	−0.66 ± 0.29 ^a
Peer and school domain		
Peers' smoking	0.34 ± 0.07 ^a	0.21 ± 0.08 ^a
Academic grades	−0.19 ± 0.08 ^a	−0.09 ± 0.09
School commitment	−0.48 ± 0.15 ^a	−0.19 ± 0.19

Control variables were measured in grade 7, whereas time-varying individual and social influence predictors were measured in grades 7 through 11.

^a $P < .05$ or better.

ior was a significant predictor of higher risk of smoking escalation individually and in the multivariate model. Of family factors, parents' smoking and parents' use of positive family management practices were significant and remained significant unique predictors of smoking progression in the multivariate model. Neither family conflict nor family bonding was significant in either the single-predictor or multivariate model.

Similar to parents' smoking, peers' cigarette use predicted a significantly higher risk of progression to daily smoking, with both individual and unique associations. Academic grades and school commitment were associated with less risk of smoking progression but were not unique predictors after adjustment for variables in the multivariate model.

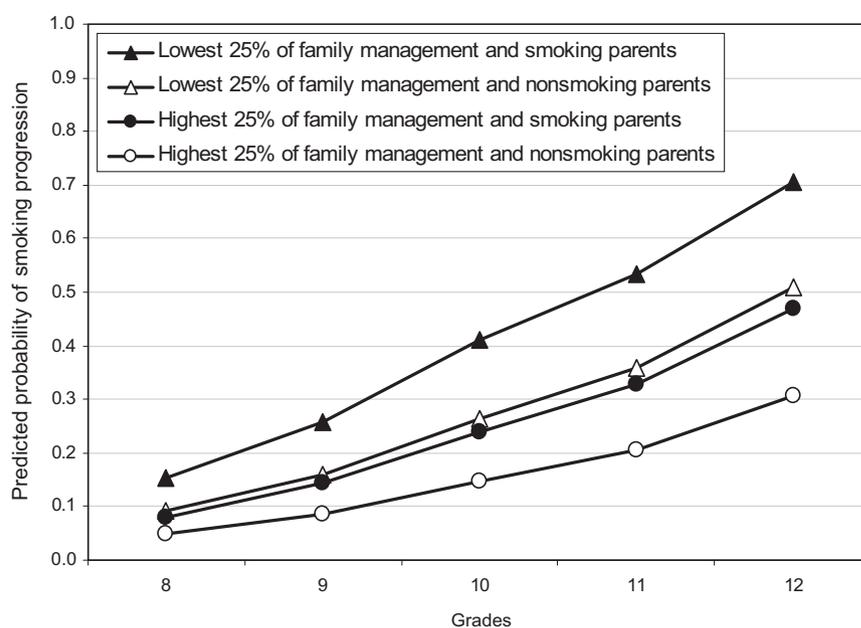
As an illustration of the associations between family factors and smoking progression, Fig 2 shows predicted probabilities of smoking progression for youths involved in antisocial behavior and with smoking peers, according to whether they were exposed

to parents' smoking and whether they were below or above the 25th percentile for exposure to positive family management. With other influences being the same, the probability of progressing to daily smoking by grade 12 was >2 times greater for

those exposed to low family management and smoking parents (probability: 0.71), compared with those exposed to high family management and nonsmoking parents (probability: 0.31).

DISCUSSION

This study examined escalation from experimental or intermittent smoking to daily smoking during adolescence. Among youths who had initiated smoking by eighth grade, 58% made this progression by the time they were in grade 12. Studies of national data reported that ~30% to ~50% of experimental smokers progressed to being daily smokers.^{25,26} The higher rate of smoking escalation reported in the present study may be attributable to the study's longitudinal design, which captures transitions in smoking at multiple time points during adolescence. Analyses of national data have been based more commonly on cross-sectional data, which capture only subjects who have progressed to daily smoking and maintained that pattern at 1 particular time point.²⁵ In addition,

**FIGURE 2**

Predicted probability of smoking progression according to family management and parents' smoking status for youths who had smoking peers and were in the highest 25% of the antisocial behavior distribution.

our study included both youths in high school and youths not in high school (ie, dropouts), whereas the majority of national studies interviewed school attenders only.^{25–27}

The present study found unique contributions of youths' antisocial behavior and peers' and parents' smoking to increased risk of smoking escalation among smoking initiators, whereas positive family management was associated with lower risk of escalation, controlling for other predictors. Although researchers have agreed that peers' smoking is the best predictor of youths' regular use of cigarettes, as well as onset,^{28–30} findings with respect to parents' smoking have been mixed. Some argue that family influences decrease in adolescence and the association between parents' and youths' smoking is small.^{12,31,32} However, our study of experimental intermittent smokers corroborates findings from other researchers, who demonstrated a significant influence of parents' smoking on children's daily smoking,^{8–11} and further suggests a critical role of the family in reducing the risk of smoking escalation among initiators. This study indicated that family management, including effective monitoring and parental use of appropriate positive and negative consequences, continued to affect whether initiators became regular smokers even after accounting for parents' smoking, peers' smoking, and individual predictors of smoking escalation.

This study was based on a primarily white sample from a suburban school district in the Pacific Northwest, and the findings may not be generalizable

to populations in urban or rural areas. Rates of progression to daily smoking were relatively high, however, and the sample was heterogeneous with respect to gender and family income. In addition, peers' smoking was assessed with 1 item on how many close friends smoked cigarettes. This narrow range of peer influences cannot capture the smoking atmosphere of a broader peer group (eg, what proportion of youths at an individual's school smoked). Another limitation of the study is that it focused on the unique contributions of individual and social influences in predicting the risk of smoking progression among experimental intermittent smokers. The possible indirect effects of some predictors on more-proximal risk and protective factors (eg, the possible effects of antisocial behavior on parenting) remain to be investigated. Finally, we examined 1 dimension of smoking transition, namely, the transition from uptake to daily smoking. Other transitions (eg, initiation, dependence, and quitting) were not modeled. Certain factors may be more or less salient with respect to these other types of transitions in smoking behavior.

Findings from this study have a number of implications for interventions designed to prevent the onset of regular smoking. First, this study points to the importance of targeting adolescents who have engaged in experimental intermittent smoking, to prevent nicotine dependence, because the cumulative rate of escalation to daily smoking was high. Second, our study found multiple risk and protective factors that were related to the process of escalation among smoking

initiators. These factors were consistent with predictors that were found to be related to initiation and levels of smoking, as well as to other types of substance use.^{3,4,8,9,14} The universal intervention during elementary and middle school that was part of the RHC study attempted to address some of those factors, including youth antisocial behavior, positive family management, and peer influences. There was no evidence, however, that the intervention reduced progression to higher levels of smoking among experimental smokers. This suggests that it may be necessary to integrate universal and targeted interventions (eg, tobacco-specific, with more-intensive content) to produce a measurable effect among smoking initiators. Third, we found that exposure to parents' smoking was a unique predictor of smoking escalation. Many intervention programs, including the RHC intervention, do not address parents' own smoking directly.³³ This study indicates that child health care providers should consider working with parents to emphasize the importance of parents' smoking as a risk factor for youths' regular smoking. Finally, our findings indicate that youths with antisocial behavior are at increased risk of becoming regular smokers, which suggests that programs targeting either smoking escalation or antisocial behavior need to account for the comorbidity of these phenomena.

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