Published in final edited form as:

Pediatrics. 2009 September ; 124(3): 895–902. doi:10.1542/peds.2008-2015.

Individual and Social Influences on Progression to Daily Smoking During Adolescence

Min Jung Kim, PhD, Charles B. Fleming, MA, and Richard F. Catalano, PhD

Social Development Research Group, School of Social Work, University of Washington

Abstract

Objectives—To identify individual and social predictors of progression to daily smoking by the end of high school among youth who initiated less than daily smoking by eighth grade.

Methods—The analysis sample of 270 adolescent smokers was taken from the longitudinal community panel of the Raising Healthy Children project. Data used in this study were taken from annual interviews between grades 7 and 12. Daily smoking was defined as having smoked at least one cigarette per day in the past 30 days at the time of each interview. Discrete-time survival analysis was used to assess the overall and unique associations between hazard of progression to daily smoking and time-varying measures of potential 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 onset was smallest in grade 9 (.12) and greatest at grade 12 (.25). Youth depression, prosocial belief, and antisocial behavior had overall associations with risk of smoking escalation. In addition, parental and peer cigarette use, family management, academic achievement, and school commitment had significant univariate associations with smoking progression. After adjusting for gender, low-income status, and other potential predictors, youth antisocial behavior and parental and peer smoking predicted greater likelihood of escalation to daily smoking, while parental use of positive family management predicted lower likelihood of escalation.

Conclusions—This study supports preventing escalation in adolescent smoking through targeting risk factors of parent and peer smoking and involvement in other forms of antisocial behavior and working with parents to improve their use of positive family management practices.

Keywords

progression; daily smoking; smoking prevention; smoking predictors; family management

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 more than 2000 American youth become new daily smokers each day.²

Prior research has identified risk and protective factors for different stages of smoking, including (1) individual influences such as depression,^{3–5} belief or attitudes about smoking,

Correspondence and reprint requests should be addressed to Min Jung Kim, Social Development Research Group, School of Social Work, University of Washington, 9725 3rd Avenue, NE, Suite 401, Seattle WA, 98115; phone (206) 616-9059; fax (206) 543-4507; e-mail minjk@u.washington.edu.

Conflict of Interest Statement: Richard F. Catalano is on the board of the Channing Bete Company, distributor of *Guiding Good Choices*® and *Supporting School Success*®. These programs were tested in the intervention described in this paper.

6–8 and antisocial behavior; 3, 4 (2) family influences such as parent smoking, 8–11 parent-child conflict and bonding, 6, 9 and parental monitoring and family rules; 9 and (3) peer and school influences such as peer 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 parent smoking was not predictive of daily smoking when other psychosocial factors (e.g., delinquency and peer smoking) were controlled, 3, 4 while others showed a unique contribution of parent smoking. 8, 9, 13 The inconsistencies may be due to differing measures of smoking progression, assessment intervals, youth ages studied, or covariates examined. In addition, prior studies on youth smoking escalation have been limited by contrasting daily smokers with all others, including experimental smokers and nonsmokers. 9, 11–13 This may conflate predictors of initiation and escalation.

The present study attempts to add to the literature by (1) focusing on escalation in smoking among early smoking initiators (before grade 8), (2) analyzing annual assessments of smoking from prospective longitudinal data (grades 8 to 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 to 11). Choice of potential predictors of smoking escalation is guided by prior studies on risk and protective factors for adolescent smoking and other substance use. 6, 8, 14 The goals of the present study are 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 Procedure

This study sample consists of 270 participants in the RHC project. In 1993 and 1994, participants were recruited from a pool of 1239 first- and second-grade students in 10 suburban public elementary schools in a Pacific Northwest school district. Parents of 1040 (84%) students 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 with teachers (through eighth grade). Survey completion rates remained over 85% through 12th grade. Procedures were approved by the University of Washington human subjects internal review board. Data reported here are derived from student and parent surveys. Data from the two grade cohorts were organized by grade level, using data from grades 7 through 12 if participants were progressing in school according to schedule. For the older grade cohort, data are from spring 1999 through spring 2004; for the younger grade cohort, data are 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 daily by seventh grade (37 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 seventh-grade survey did not differ on levels of risk and protective factors examined from those interviewed. The final analysis sample consists of 270 participants; 51% ($n = 137$) were male; 85% ($n = 229$) were white; 6% ($n = 15$) were African American, 4% ($n = 12$) were Hispanic American, 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 ($n = 1040$) on measures of gender and low-income status, but differed in regard to ethnic composition: a lower percentage of the analysis sample was Asian American than in the group of participants excluded from the analysis sample (2% vs. 7%; $X^2(4) = 13.51$, $p =$

0.009) because Asian Americans were less likely to initiate smoking in adolescence than 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 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 the intervention reduced levels of risk factors during elementary school and marijuana and alcohol use and risky driving behaviors during high school.^{16–18} However, we found no significant difference by experimental condition in means of the predictors and likelihood of smoking escalation examined in this study. Further, 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 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: “1 = not at all,” “2 = less than one cigarette a day,” “3 = one to five cigarettes a day,” “4 = about half a pack a day,” and “5 = about a pack a day or more.” The first time a participant reported having smoked one cigarette or more per day during the prior 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 by youth self-report items except for parental cigarette use assessed by parent reports. Alpha coefficients for scales at grade 7 are reported below for scales based on 3 or more items. Individual and social factors included in this study have been shown in previous RHC studies to have reliability and validity in examining youth drug use, including smoking.^{18–20} A list of all the items used for scales is available from the first author.

Three characteristics of individuals were included: *youth depressive symptoms* (7 items, $\alpha = .76$, sample question: “Do you feel like crying a lot of the time?”); *antisocial behavior* (7 items, $\alpha = .80$, sample question: “In the past year, how often have you started a fight with someone?”); and *prosocial belief* (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: *parental cigarette use* (parent reports on whether mother or father used cigarettes in prior year); *family conflict* (5 items, $\alpha = .70$, sample question: “Do you and your parent(s) 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?” “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. *Peer cigarette use* was assessed by adolescent perceived peer smoking which has been shown to be more predictive of youth smoking than actual peer cigarette use 21 (1 item, "How many of your 10 closest friends smoke cigarettes?"). School factors were *academic achievement* (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 which might also be associated with predictors described above. *Gender* was coded 1 for males and 0 for females, and *low-income status* was defined by 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 epidemiology and etiology 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 grades 8 to 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 at the subsequent survey (e.g., grade 7 measures were used to predict escalation by grade 8). A complementary log-log model²⁴ was employed:

$$\log [-\log (1 - P_{it})] = \alpha_t + \beta \times X_{it}$$

where P_{it} is a 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 treated as constant over time (i.e., 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 identifies the unique predictors of smoking escalation.

Results

The yearly hazard rates for daily smoking onset and the cumulative rate of onset are shown in Figure 1. A total of 58% ($n = 156$) of the analysis sample made the transition to daily smoking by grade 12. The chances of onset of daily smoking among those who had not yet onset was smallest in grade 9 (.12) and greatest at grade 12 (.25).

Socio-demographic, Individual, and Social Influences

Correlations among predictor variables are represented in Table 1, showing the average of correlations across time points for pairs of variables in which at least one 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 greater than .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 adjusting for other predictors, with boys 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 lower risk of escalation, but these relationships were not statistically significant after adjusting for other predictors in the multivariate model. Antisocial behavior, however, was a significant predictor of higher risk of smoking escalation individually and in the multivariate model.

Of family factors, parental 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 parental smoking, peers' cigarette use predicted a significantly higher risk of progression to daily smoking, with both individual and unique associations. Academic achievement and school commitment were associated with less risk of smoking progression, but were not unique predictors after adjusting for variables in the multivariate model.

As an illustration of the associations between family factors and smoking progression, Figure 2 shows predicted probabilities of smoking progression for youth involved in antisocial behavior and with smoking peers by whether they were exposed to parent smoking and whether they were below or above the 25th percentile in exposure to positive family management. Other influences being the same, by grade 12 the probability of progressing to daily smoking was more than 2 times greater for those exposed to low family management and parental smoking compared to those exposed to high family management and nonsmoking parents (.71 vs. .31).

Discussion

This study examined escalation from experimental or intermittent smoking to daily smoking during adolescence. Among youth who had initiated smoking by eighth grade, 58% made this progression by the time they were in grade 12. Studies of national data have reported that approximately 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 due to the study's longitudinal design that captures transitions in smoking at multiple time points during adolescence. Analysis of national data has more commonly been based on cross-sectional data that captures only those who have progressed to daily smoking and maintained that pattern at one particular time point.²⁵ In addition, our study included youth both in and out of high school (i.e., dropouts), while the majority of national studies interviewed school attenders only.^{25–27}

The present study found unique contributions of youth antisocial behavior and peer and parent smoking to a heightened risk of smoking escalation among smoking initiators, while positive family management was associated with lower risk of escalation, controlling for other predictors. Although researchers have agreed that peer smoking is the best predictor of youth regular use of cigarettes, as well as onset,^{28–30} findings with respect to parent smoking have been mixed. Some argue that family influences decrease in adolescence and the association between parental and youth smoking are small.^{12, 31, 32} However, our study of experimental intermittent smokers corroborates findings from other researchers who demonstrated a significant influence of parental smoking on children's daily smoking.^{8–11}

and further suggests a critical role of 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 impact whether initiators become regular smokers, even after accounting for parent smoking, peer 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 generalize to populations in urban or rural areas. Yet, rates of progression to daily smoking were relatively high and the sample was heterogeneous with respect to gender and family income. In addition, peer smoking was assessed by 1 item regarding how many close friends smoked cigarettes. This narrow range of peer influences cannot capture the smoking atmosphere of a broader peer group (e.g., what proportion of the youth at an individual's school smoke). A further limitation of the study is that it focused on the unique contribution 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 (e.g., the possible effects of antisocial behavior on parenting) remain to be investigated. Finally, we examined one dimension of smoking transition, the transition from uptake to daily smoking. Other transitions (e.g., initiation, dependence, 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 is high. Second, our study found multiple risk and protective factors that are related to the process of escalation among smoking initiators. These factors are consistent with predictors that have been 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 these factors, including youth antisocial behavior, positive family management, and peer influences, on substance use. 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 (e.g., tobacco-specific and including more intensive content) to produce a measurable effect among smoking initiators. Third, we found that exposure to parental smoking was a unique predictor of smoking escalation. Many intervention programs, including the RHC intervention, do not directly address parents' own smoking.³³ This study underscores that child healthcare providers should consider working with parents to emphasize the importance of parental smoking as a risk factor for youth regular smoking. Finally, our findings indicate that youth with antisocial behavior are at heightened risk of becoming regular smokers, suggesting that programs targeting either smoking escalation or antisocial behavior need to account for the comorbidity of these phenomena.

Acknowledgments

This research was supported by grant #DA08093-15 from the National Institute on Drug Abuse. Points of view are those of the authors and not the official positions of the funding agencies.

Abbreviations

RHC Raising Healthy Children

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Figure 1.
Hazard and cumulative rates of progression to daily smoking

Figure 2.
Predicted probability of smoking progression by family management and parent smoking status for youth having smoking peers and involved in the highest 25% of the antisocial behavior distribution

Table 1

Average Correlations Among Independent Variables in Grades 7 to 11

	Males	Low income	Depress	Prosocial belief	Anti behavior	Parent smoke	Bond	Conflict	Management	Peer smoke	Grades
	1	2	3	4	5	6	7	8	9	10	11
2. Low income	.12										
3. Youth depressive symptoms	-.22	-.04									
4. Prosocial belief	-.11	.05	-.23								
5. Antisocial behavior	.12	.01	.24	-.41							
6. Parental cigarette use	.08	.10	.04	.02	.05						
7. Family bonding	.12	.02	-.27	.39	-.24	-.06					
8. Family conflict	-.09	-.03	.39	-.28	.27	-.06	-.34				
9. Positive family management	-.04	.06	-.23	.54	-.39	.01	.57	-.29			
10. Peer smoking	-.09	.01	.18	-.19	.33	.08	-.16	.15	-.22		
11. Academic grades	-.13	-.10	-.21	.19	-.25	-.07	.12	-.23	.15	-.20	
12. School commitment	-.10	.06	-.20	.37	-.27	-.01	.20	-.23	.29	-.20	.34

Note. 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

Socio-demographic, Individual, and Social Influences on Progression to Daily Smoking in Grades 8 through 12: Complementary Log-Log Models

Domains/Time-Varying Predictors (Grades 7 to 11)	Single-predictor models		Multivariate model	
	B	(SE)	B	(SE)
<i>Control variables (at grade 7)</i>				
Gender (girls = 0 boys = 1)	−0.23	(.16)	−0.40*	(.19)
Low income	−0.13	(.19)	−0.10	(.20)
<i>Individual domain</i>				
Youth depressive symptoms	0.45*	(.15)	0.29	(.18)
Antisocial behavior	0.73*	(.15)	0.45*	(.21)
Prosocial belief	−0.43*	(.17)	0.14	(.24)
<i>Family domain</i>				
Parental cigarette use	0.50*	(.17)	0.54*	(.19)
Family conflict	0.12	(.14)	−0.19	(.16)
Family bonding	−0.19	(.15)	0.41	(.22)
Positive family management	−0.73*	(.18)	−0.66*	(.29)
<i>Peer and school domain</i>				
Peer cigarette use	0.34*	(.07)	0.21*	(.08)
Academic achievement	−0.19*	(.08)	−0.09	(.09)
School commitment	−0.48*	(.15)	−0.19	(.19)

Note. Control variables were measured at Grade 7, while time-varying individual and social influence predictors were measured in Grades 7 through 11.

* $p < .05$ or better