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Parental smoking and adolescent smoking initiation: an intergenerational perspective on tobacco control

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Abstract

Objective—Adolescence is an important period of risk for the development of lifelong smoking behaviors. Compelling, although inconsistent, evidence suggests a relation between parental smoking and the risk of smoking initiation during adolescence. This study investigates unresolved issues concerning the strength and nature of the association between parent smoking and offspring smoking initiation.

Methods—We enrolled 564 adolescents aged 12-17, along with one of their parents, into the New England Family Study between 2001-2004. Lifetime smoking histories were obtained from parents and their adolescent offspring. Discrete-time survival analysis was used to investigate the influence of parental smoking histories on the risk of adolescent smoking initiation.

Results—Parental smoking was associated with a significantly higher risk of smoking initiation in adolescent offspring (odds ratio=2.81, 95% CI=1.78, 4.41). In addition, the likelihood of offspring

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smoking initiation increased with the number of smoking parents and the duration of exposure to parental smoking, suggesting a dose-response relation between parental smoking and offspring smoking. Offspring of parents who had quit smoking were no more likely to smoke than offspring of parents who had never smoked. The effects of parental smoking on offspring initiation differed by sex (with a stronger effect of father's smoking on boys than girls), developmental period (with a stronger effect of parental smoking before the adolescent was age 13 than afterwards), and residence of parents (with effects of father's smoking being dependent on living in the same household as the adolescent). Parental smoking was also associated with stronger negative reactions to adolescents' first cigarette, a potential marker of the risk of progression to higher levels of use.

Conclusions—Parental smoking is an important source of vulnerability to smoking initiation among adolescents, and parental smoking cessation might attenuate this vulnerability.

Keywords

Smoking; adolescents; parent-offspring transmission

Most adult smokers began smoking during adolescence;[1-3] preventing adolescent smoking initiation is therefore important for reducing the public health burden of smoking-related illnesses over the life course. There is accumulating evidence that parental smoking increases the risk for adolescent smoking initiation;[4-19] however, unresolved issues persist concerning the strength and nature of the association between parent smoking and initiation of smoking in offspring.[20] For example, while parental smoking and parental nicotine dependence have each been linked with an increased risk of offspring smoking,[21,22] few studies of intergenerational transmission have addressed their comparative effects. Evidence from one such study suggests that the effect of maternal smoking on offspring smoking is largely irrespective of maternal nicotine dependence.[18]

Prior evidence of a dose-response relationship between parental smoking and offspring initiation is also mixed. In some studies, the risk of adolescent smoking increased with the number of smoking parents[23,24] and the number of years exposed to parental smoking.[25] In contrast, there are inconsistent reports showing that either maternal smoking alone is the key determinant of intergenerational transmission,[26] maternal smoking and paternal smoking equally influence offspring smoking,[8,22] and that maternal smoking has a stronger effect on offspring smoking than paternal smoking.[26-28] Finally, there is mixed evidence regarding the stability of parental influences on adolescent smoking behaviors, indicating either that parental influences wane over the course of development as peer influences strengthen[29,30] or that they endure throughout adolescence.[31]

This study investigates the relation between parental smoking and smoking initiation in adolescent offspring in a new generation of participants recruited into the New England Family Study. We address the following questions regarding the intergenerational transmission of smoking: 1) whether parental smoking increases the risk of offspring smoking initiation, and whether this increased risk persists even if parents quit smoking; 2) the effect of parental nicotine dependence on offspring initiation; 3) dose-response relations between parental smoking and offspring initiation; 4) gender-specificity of parental smoking effects on adolescent initiation; and 5) variation in parental smoking effects by age of the adolescent. We also examine subjective reactions to the 1st cigarette among adolescent smokers to determine if there are links with parental smoking. Enhancing our understanding of the intergenerational transmission of smoking will provide further insight into avenues of prevention, particularly with respect to the potential for smoking cessation interventions in adults to reduce smoking in subsequent generations.[14,32-34]

METHODS

Sample ascertainment and interview procedures

The New England Family Study (NEFS) was established to locate and interview the second-generation (G2) offspring of mothers enrolled in the Boston and Providence cohorts of the National Collaborative Perinatal Project[35-39] and their third-generation (G3) adolescent grandchildren. As described previously,[40,41] G2 participants were selected through a multi-stage sampling procedure. We mailed screening questionnaires to 4,579 of the 15,721 National Collaborative Perinatal Project G2 offspring who survived until age 7. Of the 3,121 questionnaires returned (68.2%), we identified 2,271 G2 offspring who were eligible for participation, and enrolled 1,674 (73.7%). Following the G2 interview, we obtained parental consent to invite their age-eligible biological children to participate in the study. Adolescents between ages 12 and 17 who were living within 100 miles of either study site in Providence or Boston were eligible for participation.

Measures

We obtained detailed information from the G2 parents' regarding their lifetime smoking history, including age at first cigarette, progression to regular smoking (defined as smoking weekly for ≥2 months), quit attempts, and periods of sustained abstinence. Lifetime history and age at onset of nicotine dependence based on Diagnostic and Statistical Manual-IVth Edition criteria[42] were obtained from parents using a modified[43] version of the Composite International Diagnostic Interview.[44,45] We also obtained adolescents' reports of their exposure to maternal and paternal cigarette smoking.[46,47] The intergenerational design allowed for matching the lifetime smoking history of biological parents to the age of offspring to determine the number of years of exposure to parental smoking and parental nicotine dependence.

Adolescent smoking was defined as any lifetime history of cigarette use. Age at smoking initiation was assessed with the question, “How old were you the very first time you ever smoked even a puff of tobacco?” Adolescents who smoked were asked about negative and positive reactions to their first cigarette, which were measured by 4 items assessing negative symptoms (unpleasant sensations, nausea, dizziness, and coughing, α=0.75) and 3 items assessing positive symptoms (pleasant sensations, relaxation, pleasurable rush or buzz, α=0.66). These symptoms were recorded on a 4-point scale ranging from 1=none to 4=intense, which were summed together and then standardized to a mean of 0 and standard deviation of 1.[48,49]

Analysis methods

We used discrete-time survival analysis to investigate the intergenerational transmission of smoking.[50] Regression coefficients from these models, when exponentiated, indicate the factor by which each dimension of parental smoking increases or decreases the odds of adolescent smoking initiation. The dependent variable in these analyses was the adolescents' age at smoking initiation, which for adolescents who had never smoked was censored at their current age. We coded parental smoking as a time-varying covariate, thereby overcoming limitations of prior work in which parental smoking was assumed to be present or absent for the child's entire lifespan. For example, consider a prototypical parent who began smoking when his or her child was age five, met diagnostic criteria for nicotine dependence when the child was age 8, and subsequently quit smoking when the child was age 11. Parental smoking for this individual would be coded as `none' in person-years 1-4, `regular smoker' in person-years 5-7, `nicotine dependent' in person-years 8-10, and `former smoker' thereafter.

Covariates included in all models were indicator variables representing the baseline rate of initiation in each person-year, sex, race/ethnicity, and age at interview. Among adolescents who smoked at least once in their lifetimes, we compared age-adjusted scores on the standardized scales of positive and negative reactions to their first cigarette according to whether or not either parent was smoking in the year they initiated. All variance estimates were adjusted for the presence of multiple siblings per family.[51]

RESULTS

Characteristics of the parent and offspring samples, and comparisons with non-interviewed subjects

We identified 726 adolescent offspring who were eligible for inclusion in NEFS-G3 cohort, and completed in-person interviews of 569 adolescents (78.4%). Five adolescents were excluded from the NEFS-G3 cohort because of problems with interview administration. Due to missing data on either adolescent or parental smoking, an additional five G3 adolescents were excluded from the current analyses, resulting in an analytic sample of 559 adolescents (180 singletons and 176 sibling sets).

The characteristics of the full NEFS-G2 sample (n=1,674), G2 parents with eligible offspring (n=466), and of G2 parents whose offspring were included in the current analysis (n=356) are shown in the first three columns of table 1. G2 parents with enrolled offspring were more likely to be female than the full NEFS sample; the age, race/ethnicity, and education distributions of the G2 parents were comparable across the groups of parents with eligible and enrolled adolescents. The distributions of lifetime regular smoking among parents with eligible and enrolled offspring were similar (64.1% and 62.4%, respectively), as were the distributions of lifetime nicotine dependence (46.1% and 46.0%, respectively). The mean (standard deviation) age of the adolescent sample was 14.0 (1.7) years (range=12-17); the sample was 52.2% female.

Prevalence of smoking initiation in adolescent offspring

The prevalence of lifetime cigarette use was 27.8% (n=157), ranging from 7.2% among adolescents interviewed at age 12 to 61.3% among adolescents interviewed at age 17. The mean (SD) age of first smoking was 12.4 (2.4). The prevalence of lifetime cigarette use was 30.7% (n=83) among males, and 25.2% (n=74) among females.

Survival analysis of smoking initiation in adolescent offspring

Incidence rates of adolescent smoking initiation were calculated: 1) during person-years prior to the onset of regular parental smoking; 2) during person-years of exposure to active parental regular smoking; and 3) during person-years following parental smoking cessation. These rates were 1.35, 2.84, and 2.23 (per 100 person-years), respectively, indicating a higher likelihood of initiation in the context of exposure to active parental smoking. A similar pattern emerged in the survival analysis of smoking initiation. Exposure to active parental smoking was strongly related to offspring initiation (adjusted odds ratio=2.81; CI=1.78, 4.41), in contrast to former parental smoking, which was not related to offspring initiation (OR=1.03; CI=0.61, 1.74).

Active parental smoking—either with or without exposure to parental nicotine dependence—was associated with an elevated risk of offspring initiation. Table 2 presents the distribution of adolescent smoking initiation according to the G2 parent's smoking status, with a separate category for exposure to parental nicotine dependence. There was no difference in the likelihood of initiation between adolescents whose G2 parent was a nicotine dependent smoker and adolescents whose G2 parent was a regular smoker without symptoms of nicotine dependence. Therefore, the remaining analyses focus on active parental smoking alone, and

do not distinguish between former versus never parental smoking, nor between parental smoking and nicotine dependence.

Using the life-chart method,[52] adolescents were asked to indicate the years of their life in which their mother and father smoked; this information enabled us to determine the duration of exposure to both biological parents' smoking. Adolescents' reports were highly correlated with their G2 parents' own reports: the correlation between the number of years of mothers' self-reported smoking and adolescent reports of maternal smoking was 0.89; the correlation between fathers' self-reported smoking and adolescent reports of paternal smoking was 0.88.

We tested for a dose-response relation between parent smoking and offspring smoking by comparing the risk of initiation according to the number of smoking parents and according to the duration of exposure to parental smoking. Exposure to one parent's smoking was associated with a 1.45 times higher odds of initiation (CI=0.82, 2.59), and exposure to both parents' smoking raised the odds of offspring initiation almost threefold (OR=2.75; CI=1.48, 5.08). In addition, a prolonged duration of exposure to parental smoking was associated with a higher risk of offspring initiation; we observed a threshold effect of duration, in that adolescents exposed to 4 (OR=3.29; CI=1.28, 8.46) or ≥5 (OR=1.82; CI=0.95, 3.51) years of parental smoking, compared to 0 years, exhibited elevated risks of initiation.

In gender-specific analyses, mother's (OR=2.34; CI=1.57, 3.51) and father's (OR=1.67; CI=1.12, 2.48) smoking independently raised the risk of offspring smoking initiation, and overall, the effects of mother's smoking and father's smoking were not significantly different from one another (χ^2=1.1, df=1, p=0.307). However, there was evidence of a differential effect of father's smoking according to offspring sex (χ^2 for the interaction between father's smoking and offspring sex=4.5, df=1, p=0.034), indicating a stronger effect of father's smoking on boys than girls. We also observed a stronger effect of parental smoking prior to the teen years than at age 13 or after (χ^2 for the interaction between parental smoking and adolescent age=4.2, df=1, p=0.042). Finally, incorporating information from adolescents' reports of which years of their lives they were living with each biological parent into the analysis, we observed a differential effect of paternal smoking depending on the presence of the father in the household (χ^2 for the interaction between paternal smoking and father's presence in the household=5.0, df=1, p=0.026). Adolescents living with smoking fathers were more than three times as likely to initiate smoking; in contrast, non-resident father's smoking had no effect on the risk of their offspring's initiation. Odds ratios for the differential effects of parental smoking according to offspring sex, offspring age, and the presence of the father in the household, are presented in table 3.

Parental smoking status and adolescents' first smoking experiences

First smoking reactions are a potential marker of the risk of progression, and therefore we compared adolescents' reactions to their first cigarette according to parental smoking status in the year of initiation. Offspring of current smokers reported significantly stronger negative reactions (unpleasant sensations, coughing, and overall negative reactions) to their first cigarette than offspring of non-smoking parents (Figure 1). There were no differences in the level of adolescents' positive reactions to their first cigarette across categories of parental smoking status.

DISCUSSION

We investigated the intergenerational transmission of smoking in the adolescent cohort of the New England Family Study. The dimensions of parents' smoking that were most strongly predictive of smoking initiation were active regular smoking, as opposed to prior smoking or nicotine dependence, and the number of smoking parents. We also observed differential effects

according to sex (with a stronger effect of father's smoking on boys), developmental period (with a stronger effect of parental smoking before age 13 than afterwards), and residence of parents (with resident fathers' smoking predictive of offspring initiation, but not non-resident fathers' smoking).

Distinguishing the effects of current and former parental smoking has direct implications for prevention insofar as parental cessation may reduce the risk of adolescent smoking initiation.[17,33] Our results demonstrated that only active parental smoking was associated with an increased risk of smoking initiation in offspring, and that children whose parents had quit smoking were no more likely to begin smoking than children whose parents had never smoked. These findings are consistent with a social learning model of smoking initiation, which posits that attitudes, beliefs, and behaviors toward cigarette use are learned through modeling.[17,33,53,54] Adolescents may therefore observe smoking, imitate smoking, and absorb favorable outcome expectations over time with repeated exposure. The findings for resident fathers' smoking are also consistent with a social learning model, in that a custodial father who smokes has a greater influence on smoking initiation than a non-custodial father who smokes, by virtue of his greater contact with the adolescent. The absence of an elevated risk of initiation associated with former parental smoking implies that not only do adolescents imitate their parents' smoking behaviors, but potentially their parents' cessation behaviors as well; however, we did not directly analyze adolescents' cessation behaviors in this study.

Nicotine dependence may represent more intense and persistent parental smoking,[55-57] and may also be indicative of a broader constellation of parental psychopathology,[58] both of which would be expected to increase the risk of offspring initiation. However, we observed no difference in the risk of smoking initiation between person-years of exposure to active parental smoking (without nicotine dependence) and person-years of exposure to parental nicotine dependence. Although our study might have lacked the temporal precision needed to distinguish between parental smoking and parental nicotine dependence, our results are consistent with prior evidence that parental nicotine dependence does not increase the risk of adolescent smoking beyond the risk conferred by parental smoking.[18]

We found that each additional smoking parent was associated with an increased risk of adolescent initiation, as was exposure to ≥4 years of exposure to parental smoking. In addition, maternal and paternal smoking were both related to the risk of offspring smoking initiation. While maternal smoking predicted smoking initiation among sons and daughters, paternal smoking was predictive only among sons. Considering the strong effect of custodial parent's smoking that we observed, it is conceivable that these gender differences in the effects of parental smoking reflect the gender of the custodial parent rather than inherent differences in the effects of mothers' versus fathers' smoking. We also observed that parental smoking was more strongly predictive of offspring smoking initiation prior to age 13 than at age 13 and beyond.

Finally, we observed stronger negative reactions to smoking among adolescents whose parents were currently smoking at the time of their first cigarette. Prior evidence relates both positive and negative initial smoking experiences to the development of regular smoking and nicotine dependence.[48,49,59-62] The counterintuitive finding of aversive reactions to initial smoking predicting escalating levels of use has been hypothesized to reflect a heightened sensitivity to nicotine, and consequently a heightened vulnerability to the reinforcing effects of nicotine.[62] If this is the case, then our findings suggest a correlation between parental smoking and offspring sensitivity to nicotine. We could not, however, differentiate adolescents' reactions to nicotine from their reactions to other constituents in cigarette smoke.

Limitations of this study include the use of parents' retrospective reports of lifetime smoking to establish patterns of cigarette smoking, symptoms of nicotine dependence, and ages at smoking onset and offset. Adolescents' ages at smoking initiation were also reported retrospectively. Inaccuracies in these reports may have weakened our ability to distinguish between various aspects of intergenerational transmission. In addition, information on parental smoking was obtained partly by self-report and partly by adolescent report, giving rise to the possibility of overestimating the intergenerational transmission if there were systematic reporting biases. We found a high degree of correspondence between parent-reported and child-reported parental smoking, and no systematic difference in concordance for mother versus father smoking.[63] Consistent with this, the intergenerational transmission models that relied exclusively on parents' self-reported smoking were similar to those that included parental smoking information obtained from parents and adolescents. Finally, we emphasize that our current findings are specific to smoking initiation defined as first puff of a cigarette. However, prior research has shown that smoking just once is associated with a higher risk of subsequent regular smoking.[64]

CONCLUSIONS

The results of this study expand our understanding of the intergenerational transmission of smoking. With respect to smoking initiation during adolescence, the aspects of parental smoking that emerged as most important were active parental smoking, number of smoking parents, maternal smoking (and for boys, paternal smoking), and exposure to parental smoking prior to adolescence. There was no elevated risk of smoking initiation among adolescents whose parents were former smokers. Future work with the NEFS-G3 sample includes examining hypothesized mechanisms of intergenerational transmission such as parental socioeconomic status and parental psychopathology;[29,65,66] how peer and sibling smoking interact with parental smoking;[16] effects of non-biological parents on offspring smoking;[6] and the ways in which parental smoking impacts their offspring's progression to regular smoking, nicotine dependence, and likelihood of smoking cessation in adulthood.[9,67] A deeper understanding of the intergenerational transmission of cigarette smoking will provide further insight into avenues of prevention, in particular family-based interventions and those that emphasize assisting parents in cessation efforts that will not only reduce the parent's smoking but likely reduce smoking uptake in subsequent generations.

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Abbreviations

(NEFS), New England Family Study; (G2), second-generation; (G3), third-generation.

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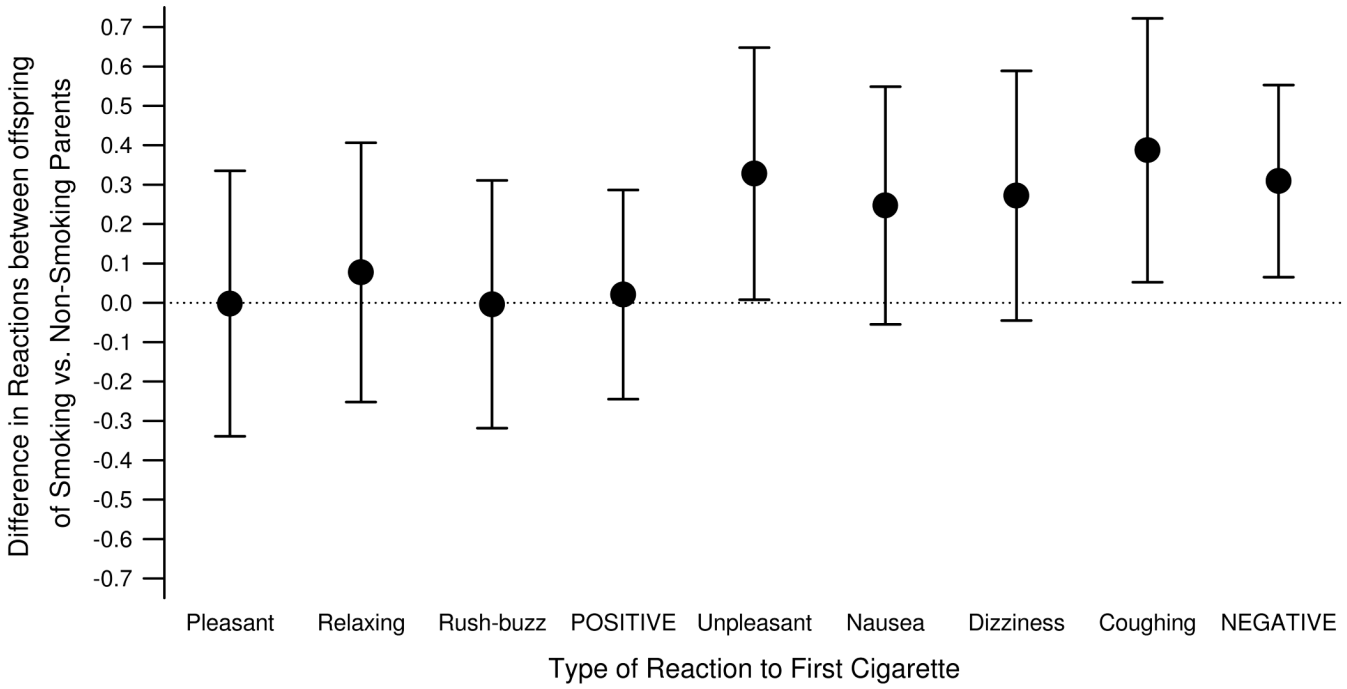

Figure 1. Reactions to first smoking experience associated with parental smoking in the year of adolescent smoking initiation (n=157)

Differences (and 95% confidence intervals) in age-adjusted standardized scores of negative and positive reactions to adolescents' first cigarette between offspring of smoking versus non-smoking parents.[48,49] Means are shown for the individual items and also the summary scores of POSITIVE and NEGATIVE reactions.

Table 1

Characteristics of parents and adolescent offspring selected and enrolled into the NEFS-G3 cohort

	Parental Characteristics			Adolescent Characteristics	
	All NEFS G2's (n=1674)	**G2's with eligible G3 offspring[a] (n=466)**	**G2's whose offspring were included in the analysis sample (n=356)**	**Eligible G3's (n=726)**	**Final analysis sample of G3 adolescents (n=559)**
Mean Age (SD)	39.2 (1.9)	40.0 (1.85)	39.6 (1.9)	14.0 (1.9)	14.0 (1.7)
Percent female (n)	59.2% (991)	71.5% (333)	77.8% (277)	52.5% (379)	52.2% (292)
G2 Race/ethnicity					
Percent white (n)	83.5% (1354)	81.8% (372)	85.0% (301)		
Percent non-white (n)	16.5% (268)	18.2% (83)	15.7% (56)		
G2 Education					
Percent college or more (n)	57.7% (937)	45.5% (208)	49.0% (173)		
Percent high school (n)	36.4% (591)	47.9% (219)	46.4% (165)		
Percent less than high school (n)	6.0% (97)	6.6% (30)	5.1% (18)		
G2 Smoking characteristics					
Percent lifetime regular smokers (n)	58.5% (949)	64.1% (293)	62.4% (222)		
Percent lifetime nicotine dependence (n)	39.0% (625)	46.1% (207)	46.0% (161)		

[a]Not included in this column are an additional 101 G2's whose adolescent children were ineligible for participation in the study based on living >100 miles from one of the study sites or not being a biological child. The prevalence of regular smoking among G2 parents whose children were ineligible for participation (66.7%) was similar to that among G2 parents with eligible children (64.1%).

Table 2

Parental smoking status in each person-year and the risk of smoking initiation among their adolescent offspring

	Person-years	Number of adolescents initiating	Rate of smoking initiation per 100 person-years	Odds ratio[a]	95% CI
Parental smoking status					
Active smoking with nicotine dependence	1,502	51	3.40	3.06	1.90,4.91
Active smoking without nicotine dependence	924	20	2.16	2.30	1.21,4.39
Quit smoking, former nicotine dependence	972	22	2.26	1.13	0.65, 1.98
Quit smoking, never dependent	540	6	1.11	0.77	0.30, 1.96
Never a weekly smoker	2,960	40	1.35	1	referent

[a]Odds ratios estimated from a discrete-time survival analysis of the age at smoking initiation also adjusting for the G2 parent's sex, adolescent sex, age at interview, and the baseline hazard of initiation in each year of life.

Table 3

Differential effects of parental smoking according to offspring sex, age, and the presence of the father in the household

	Odds Ratio	95% CI	Odds Ratio	95% CI
	Differential effects according to offspring sex			
	Girls[a]		Boys[a]	
Mother's Smoking	2.73	1.50,4.98	2.29	1.39,3.77
Father's Smoking	1.06	0.59, 1.89	2.39	1.45,3.92
	Differential effects according to offspring age			
	≤Age 12[b]		≥Age 13[b]	
Mother's or Father's Smoking	3.63	2.07, 6.36	1.71	1.06,2.76
	Differential effects according to father's presence in the household			
	Father at home[c]		Father not at home[c]	
Father's Smoking	3.18	1.93,5.23	1.13	0.59,2.17

[a]Results of two discrete-time survival models of the age at smoking initiation, one estimated for girls and one for boys. Models also adjusted for age at interview and the baseline hazard of initiation in each year of life.

[b]Results of two discrete-time survival models of the age at smoking initiation, one estimate for person-years through age 12, and one for person-years 13 and above. Models also adjusted for adolescent sex, age at interview, and the baseline hazard of initiation in each year of life.

[c]Results of two discrete-time survival models of the age at smoking initiation, one estimate for person-years in which the father was living at home, and one for person-years when father was not living at home. Models also adjusted for adolescent sex, age at interview, and the baseline hazard of initiation in each year of life.