A Discrete Time Hazards Model of Smoking Initiation Among West Coast Youth from Age 5 to 23

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Abstract

**Purpose:** Adolescents who initiate smoking at a younger age are at increased risk for tobacco dependence and continued use, tobacco-related health problems, and psychosocial and behavioral difficulties during adolescence and emerging adulthood. Hazards models can identify factors associated with the age of smoking initiation and help distinguish vulnerable periods for initiation according to those factors.

**Methods:** Discrete time hazards analysis was used to model smoking initiation as a function of age (5-23), demographic and familial influence variables (measured at age 13), and their interactions in a cohort of 6,255 youth who completed six assessments over a 10-year period from age 13 to 23 years.

**Results:** Half of the sample had initiated smoking by age 12, and the hazard for initiation was greatest between ages 13 and 14. In addition to differences associated with race/ethnicity, protective factors for age of initiation included high parental education and having an intact family of origin. Having an older sibling, and participant’s exposure to smoking by the adult most important to them were both risk factors, with the latter having a stronger effect for females and African Americans. Although having an intact nuclear family was protective, the existence of a nuclear family was not able to counteract the risk associated with both having an older sibling and being exposed to an important adult smoker, regardless of gender. For all effects, the strength of the association differed across the age range.

**Conclusions:** The impact of demographic and family influence factors on smoking initiation varies over time. However, children are at maximum risk for initiation in their early teen years, and the range of considerable vulnerability is during middle school and high school.

[Key words: smoking initiation, demographics, adolescents and young adults, survival analysis]
A Discrete Time Hazards Model of Smoking Initiation

Among West Coast Youth from Age 5 to 23

Adolescents who initiate smoking at a younger age are at increased risk for tobacco dependence and continued use \(^1\)-\(^3\), as well as tobacco-related health problems \(^4\), \(^5\). Early onset smokers also differ from other adolescents on a broad range of risk and protective factors that may foreshadow future problems \(^6\). Adolescents who are smoking by grade 7, for example, are more likely than their peers to report current academic problems, alcohol and drug use, and delinquent behavior; further, these early smokers show significantly greater rates of such risky behavior five years later, even after adjusting for these initial problems \(^7\). Given the heightened risk associated with early onset, it is important to identify and understand factors associated with the age of smoking initiation and discover potential pathways to delaying initiation.

Demographic characteristics and familial influences are among the most widely studied predictors of adolescent smoking initiation. Much of the research on demographic characteristics has focused on race/ethnicity and gender. The majority of studies on ethnicity and smoking initiation report earlier initiation and higher rates throughout adolescence among White and Hispanic/Latino youth relative to African and Asian Americans \(^3\), \(^8\)-\(^14\). However, one study reported higher initiation rates for Whites than Hispanics \(^15\), and our own study of West Coast youth found that rates of lifetime smoking at age 13 were slightly higher among African Americans compared to Whites \(^16\).

In terms of gender, some results indicate similar initiation rates for boys and girls \(^14\), \(^15\), while others have reported slightly lower rates for girls \(^11\), \(^13\), or gender differences within racial/ethnic subgroups \(^9\). Several studies have found that boys are more likely to initiate early
(i.e., before age 13), but girls’ initiation increases rapidly in the early teen years resulting in equal initiation rates by about age 15. Other demographic risk factors for initiation that have been identified across studies include parental divorce or separation and lower parental education.

Familial influences most relevant to smoking initiation include smoking by parents and older siblings. Both increase the risk of smoking initiation, with several studies suggesting that parental smoking may be particularly influential among Whites and girls. Family smoking appears to be more strongly related to initiation than to the transition to regular smoking, perhaps because it allows for easy access to cigarettes and opportunities for experimentation. At least one study has found that initiation often takes place in the presence of an older sibling.

Despite the considerable empirical attention that has been devoted to adolescent smoking initiation and its correlates, relatively few studies have used hazard or survival modeling to focus specifically on issues related to the timing of initiation such as when initiation is most likely to occur, what risk factors are associated with early initiation, and how the impact of these risk factors may change during the course of adolescence. Studies of this type that do exist have limitations including using retrospective cross-sectional data, estimating the conditional hazard of initiation (i.e., at wave 2 for non-smokers at wave 1), or using a restricted age range (i.e., 9-14). One study, based on a sample from the UK, used incidence data from ages 12-22, but the primary focus was on regular smoking and the authors did not examine whether the impact of predictors on initiation varied over time.

The present study used a discrete time hazard model approach to examine smoking initiation from childhood to young adulthood as a function of age, demographic and familial
influence variables, and their interactions, in a cohort of 6,255 youth who completed multiple assessments over a 10-year period from age 13 to 23 years. Retrospective age at initiation was used for initiation prior to the first wave of data collection and incidence data was used for initiation during the study period, providing a broad age range (from 5-23) that largely covers the timing of initiation. Six demographic and familial influence variables, assessed at age 13, were selected for inclusion in this study based on prior research indicating their relevance to adolescent smoking initiation, as well as their stability (or relative stability) over time: gender, race/ethnicity, parental education, having an intact nuclear family, presence of an older sibling, and having an important adult who smoked. We expected that each of these variables would predict smoking initiation, but were particularly interested in examining whether and how the impact of these variables on initiation varied as a function of time. Based on previous literature, we were also interested in testing the interaction between gender and ethnicity, and the interaction of both of these factors with the important adult smoking variable. A final interest was to examine the combined effect of different family characteristics on age of initiation to determine whether certain protective factors are strong enough to counteract the influence of risk factors.

Methods

Participants

Subjects included in this study were participants in the RAND Adolescent/Young Adult Panel Study, a multi-year panel study originally conducted to evaluate Project ALERT, a drug prevention program for middle school children (see Ellickson & Bell, 1990). The study sample included students originally drawn from 30 California and Oregon middle or junior high schools.
The schools were chosen to reflect a wide range of school and community environments, and encompassed urban, suburban, and rural school districts. Nine schools had a minority population of 50% or more, and 18 schools drew students from neighborhoods with household incomes below their state median.

The baseline sample in 1985 consisted of 6,527 seventh-graders whose parents had given implied consent for their participation and who, themselves, gave active consent. This group represented nearly the entire cohort (85%) of the 30 original schools; analyses of the eligible subjects not surveyed at baseline showed that the sample was unbiased with respect to age, gender, ethnicity, and grades \(^{28}\).

Participants with missing information about their age of smoking initiation (N=263) or ethnic background (N=9) were excluded from this study. Approximately half (49%) of the sample of 6,255 participants in this study were female, and the majority were Caucasian (68%), with 10% African American, 8% Asian, 10% Hispanic, and 4% of other ethnicity. Less than half (44%) of participants reported that one or both of their parents had attended some college, over half of the participants came from intact nuclear families (59%), many participants had at least one older sibling (71%), and approximately half the sample (49%) had an important adult smoker in their lives. Over half (56%) of the sample had smoked at least once prior to the baseline survey.

**Missing Data**

The percentage of missing values for the variables used in this study was low (range <1% to 5%), but listwise deletion of cases with any missing values would have resulted in a loss of 19% of the sample. To avoid this loss, we imputed the missing values for each predictor variable
based on regression from all the other variables using an imputation procedure provided by Stata software 29.

Measures

**Age of smoking initiation.** For the 56% of participants who had initiated before Grade 7 (baseline assessment), age at initiation was based on participants’ self-reported age of first trying a cigarette. However, 263 of these respondents were excluded from analyses because their reported initiation age was missing or was less than 5 years old. For the remaining 44% who had not initiated prior to the baseline survey, age at initiation was assigned as their approximate age at the midpoint of the interval between the first wave at which the respondents said they had ever smoked (even just a puff) and the previous wave (in which they said they had never smoked).

**Predictor variables.** Because many of the 6,255 participants had already initiated at the time of the baseline survey, predictors in the model were limited to those that could be assumed relatively constant prior to the baseline survey. These predictors included indicators for female gender, ethnicity (African American, Hispanic, Asian, Other), existence of an intact nuclear family (i.e., living with both biological parents), one or both parents having some college education, having an older sibling, and whether the adult who was most important to the respondent smoked cigarettes.

Analytic Approach

The age of smoking initiation was estimated with a discrete-time hazards model 27, 30. This approach accounts for the right-censored data using logistic regression with a person-period dataset and was implemented with SAS PROC LOGISTIC 31.

As a first step in fitting the model, different representations of time were tested (e.g., age in years modeled as a series of indicator variables, or modeled as a polynomial function). These
representations were evaluated based on \( \chi^2 \) nested model comparison tests. To get a representation of the overall trend of initiation, a simple model was fitted that modeled initiation solely as a function of age and age-squared. Next, a more complex model was fitted that incorporated the predictor variables. For this model, first the main effects were added, then the planned interactions among factors were tested (between gender and ethnicity, and between these two factors and important adult smoker), as were interactions between the predictor variables and the age function. These interaction terms were evaluated based on the significance of the beta coefficients. Finally, plots of the hazard and survival functions were constructed based on the final model to represent the effects of several predictor variables.

Results

Of the 6,255 respondents included in this study, 1,175 (19%) left the study while still at risk for smoking initiation and were treated as right-censored observations in all analyses. A quadratic polynomial function (age and age-squared) provided an accurate and parsimonious representation of the passage of time. Results from the simple discrete-time hazards model that included this polynomial function as a predictor of initiation showed that the probability of initiation increased over time (age: OR=1.26, \( p<.01 \)), but decelerated during the later years (age-squared: OR=0.96, \( p<.01 \)). Table 1 displays the hazard and survival rates over time for this basic model and gives a general picture of smoking initiation across the age span. Examination of the hazard rates show that the risk for initiation was greatest between ages 10 and 17. The survival rates indicate that nearly 25% of the sample had initiated by age 9, over 50% by age 12, and more than 75% had initiated by age 16. Overall, an estimated 16% of the sample did not smoke a cigarette at some point before or during the study period. Additionally, most initiation in this sample occurred before age 20. The hazard rates for age 20 and above were very low, and
survival rates also indicate a leveling off after age 19.

Odds ratios and confidence intervals from the full model that included the demographic and family influence variables, as well as interactions are shown in Table 2. All of the predictor variables had a significant impact on initiation either as main effects or in interaction terms. Initial testing of the gender by ethnicity interactions revealed a significant gender by Asian effect. However, when the model had been fully developed (i.e., when significant interactions among predictors and the age function were added) these effects became non-significant, so all gender by ethnicity effects were excluded from the final model. The interaction between gender and important adult smoker was significant. There was also a significant interaction between African American ethnicity and important adult smoker. Finally, there were several significant interactions between the predictor variables and the polynomial age variables (age and age-squared). As a general rule, only significant interactions were included in the final model. However, there were some instances where a variable had a significant interaction with age-squared, but the interaction with age and/or the main effect were not significant. In these cases, all terms were included in the final model.

The presence of multiple significant interaction terms makes interpretation of the final model results difficult. To aid in interpretation, plots of the hazard and survival functions were generated (Figures 1 – 5) to illustrate the effects of most interest. Figure 1 contains the hazard and survival functions for Whites, Hispanics, Asian Americans, and those of “other” ethnicity (African Americans are excluded from this figure because of their interaction with adult smoker). For these four ethnic groups, the risk of initiation peaked at age 13-14. In addition, consistent with other findings, Asian Americans were at a lower risk of initiation across the age span and had a higher survival rate than those in the other three ethnic groups. In contrast, Hispanics and
those in the “other” ethnicity group tended to have higher hazard rates. The absence of interactions with age for Asian Americans and the “other” ethnic group indicates that their effects were stable over time. For Hispanics, the hazard of initiation was initially lower, but increased more rapidly and decreased more sharply than that for Whites, so at its’ peak the hazard function was higher than that for Whites, but the range of relatively high risk was slightly narrower.

The interaction between African American ethnicity and important adult smoker is displayed in Figure 2. On average, the survival rates for African Americans were slightly lower relative to Whites in the early years, but higher by the end of the study period indicating that African Americans were at higher risk early on relative to Whites, but their risk diminished over time. For Whites, the presence of an important adult smoker was a risk factor across the age span. Although its’ influence waned in later years, White youth with an important adult smoker had higher hazard rates up to age 17, and lower survival rates across the age span relative to their counterparts without an important adult smoker. In contrast, for African Americans the presence of an important adult smoker was actually a protective factor in the pre-teen years; the hazard for initiation among African American youth without an important adult smoker was higher up to age 11 and peaked at age 12, whereas the hazard for those with an adult smoker was higher after age 11 and peaked at age 13. By age 15, the survival rates of African Americans without an adult smoker caught up and exceeded rates of those with an adult smoker indicating that the early protective effect of having an adult smoker had eroded.

The effects of gender and its’ interaction with important adult smoker are displayed in Figure 3. Consistent with other studies, results show that boys tended to have higher hazard rates in the early years, but that girls were at higher risk during mid- to late-adolescence. Also as has
been reported previously, the presence of an important adult smoker had a much stronger impact for girls than for boys. The hazard function for girls with an important adult smoker spiked sharply after age 10 and continued to be higher than the hazard for boys with an important adult smoker throughout the teen years. In contrast, for those without an adult smoker, although the hazard for girls exceeded that of boys in the early teen years, this occurred later, lasted less time, and was not as dramatic. From age 15 on, the survival rates for girls without an adult smoker were highest, while girls with an adult smoker had the lowest survival rates, averaging out to a nearly equal survival rate between young men and women by age 24.

The effect of nuclear family was very striking (see Figure 3), indicating a strong protective factor across the age span until about age 19, beyond which the hazard for initiation was low regardless of nuclear family. Those with intact nuclear families at age 13 had a higher survival rate across the age span relative to those without an intact family. The impact of high parental education was inconsistent, showing a small protective factor in the early years, but actually reversing at later ages; those whose parents had high levels of education had higher hazard rates between ages 17 and 24 than those whose parents had lower levels of education, and the overall survival rate at age 24 was very similar for the two groups, indicating that parental education may delay initiation, but does not have a lasting protective effect. Throughout childhood and the teen years, the presence of an older sibling was a risk factor for initiation. Although the impact of the older sibling waned in the later years, it had a lasting effect on survival rates.

A final set of plots, generated separately for boys and girls, illustrates the combined effect of the different family characteristics (Figure 5). In these plots, the overall protective effect of having an intact nuclear family (dotted line vs. solid line) is combined with risk factors (adult
smoker and older sibling). For both genders, the nuclear family remains somewhat protective when there is an older sibling, and for boys the nuclear family’s protective effect also remains to some degree in the presence of an important adult smoker. However, for girls, the protective effect of the nuclear family is counteracted by the presence of an important adult smoker. Finally, for both genders, the nuclear family’s protective effect erodes in the presence of both an older sibling and an adult smoker, and this erosion is much stronger for girls.

Discussion

This study used a discrete time hazards analysis to model smoking initiation among a large cohort of West Coast youth. As in other studies of smoking initiation, the greatest risk for initiation occurred during the pre-teen and teen years, peaking at about age 13-14 and then declining. The effects of demographic and familial influence variables on smoking initiation in this study were also largely consistent with previous research (e.g., ). However, the rich longitudinal data set and inclusion of interactions between predictive factors and age in the model produced findings that significantly extend previous research by elucidating the distinct periods during early adolescence during which identifiable subgroups are most vulnerable to initiation. Furthermore, the ability to examine survival rates as well as hazard functions allowed us to determine which demographic and familial influence variables had a lasting impact on initiation, and which did not.

Results of this study further delineate the age of risk for smoking initiation. It is striking that nearly 25% of the sample had initiated before age 10. This result emphasizes the need for early prevention efforts before children reach middle school. Additionally, it appears that children are at greatest risk for initiation in their early teen years. Although initiation rates continue to increase throughout the teen years, there is a substantial deceleration in initiation
rates that nearly levels off after age 19, implying that the range of greatest vulnerability is during middle school and high school.

Studies generally find that Asians initiate smoking at lower rates than Whites and this was also true in our study. What other studies have not found is that the hazard of initiation for Hispanics relative to Whites appears to vary over time. Although Hispanics had a lower hazard of initiation during childhood compared to Whites, their hazard increased more rapidly during early adolescence and decreased more sharply during late adolescence relative to Whites indicating a narrower time frame for high vulnerability. In general, African Americans in this sample tended to be at greater risk relative to Whites in their pre-teen years, but at lower risk thereafter. By age 24, African Americans tended to have lower initiation rates than all other ethnic groups with the exception of Asian Americans. However, as discussed below, differences between African American and other youth in the hazard of initiation depended on the presence of an important adult smoker.

In terms of family influences, having an older sibling was a risk factor for initiation, although its impact waned in later years. Because variable selection was limited to those considered as relatively stable prior to the baseline survey, the presence of an older sibling smoker was not used as a predictor in this model. However, based on reported findings in the literature on this topic as well as supplementary analyses, it is likely that the significance of the older sibling variable is a marker for the influence of smoking by an older sibling, rather than indicative of risk due to the presence of an older sibling per se. A substantial percentage (37%) of respondents with older siblings reported that those older siblings were smokers. In addition, as a sensitivity analysis, we estimated a model that had both older sibling non-smoker and older
sibling smoker as predictors. In this model, only older sibling smoker had a significant effect on initiation.

More complex is the impact of smoking by an important adult on initiation, which differs as a function of the youth’s race/ethnicity and gender. Among non-African American youth, the presence of an important adult smoker was a risk factor for initiation from childhood through emerging adulthood. However, the presence of an important adult smoker was actually protective for black youth during the pre-teen years. Although unexpected, previous studies have found that African Americans are more deterred by parental disapproval of smoking. Perhaps those who disapprove most effectively are those who are smoking themselves. Incidentally, a relatively large percentage of African American respondents in this sample reported that the adult most important to them smoked (58% as compared to 48% for non-African Americans).

In the case of gender, the overall trend for girls and boys in this study was consistent with other findings and suggested that on average boys were at greater risk than girls of initiating smoking during childhood (until about 10) but that girls’ risk increased to exceed that of boys after age 11 or so. It has been documented that girls are more likely to initiate smoking if they are concerned with dieting. It is possible that girls’ increased hazard relative to boys at age 11 is associated with their growing awareness of body image and weight. In addition, the presence of an important adult smoker was a much stronger risk factor for girls than boys. Although other studies have also reported this result, it is not clear why girls are more strongly influenced. Future research is necessary to understand the mechanism behind this effect, but in the meantime, the strong impact of the important adult smoker in this and other studies
suggests a need for prevention programs to explicitly counteract this influence, especially among girls.

The importance of social influences is demonstrated in our findings regarding nuclear family. Although having an intact nuclear family was protective until age 19, its protective effect eroded in the presence of an important adult smoker among girls, and the presence of both an important adult smoker and an older sibling among boys. Finally, we found that higher parental education had a small protective effect on initiation until about age 15, but reversed directions and was a risk factor for initiation between ages 17 and 24. The overall survival rate at age 24 is very similar regardless of parental education indicating that this factor may delay initiation, but does not have a lasting protective effect. Perhaps the later initiation among those whose parents had high levels of education is associated with going away to college and heightened experimentation with substance use that often occurs during this period 35.

Strengths of this study include use of a large sample and a rich longitudinal data set that allowed for the modeling of smoking initiation across the entire age range for which this event is likely to occur. The study also benefited from the modeling of interactions that highlighted the ways in which influential factors may change over time and according to demographic characteristics. Limitations of this study include the fact that our findings are based on a single sample of West Coast youth, which might restrict the generalizability of our results. However, the schools from which participants were recruited were chosen for their diversity and the sample includes high school dropouts. Second, attrition occurred over the 10-year follow-up period, necessitating the use of sample weights to account for most of the bias due to source. A third limitation is the reliance on self-report measures. Reports of current smoking at grades 7 and 8 were found to be highly accurate when externally validated and subjected to internal consistency
checks\textsuperscript{36} and there is no reason to suspect that these self-reports became less accurate over time. Nonetheless, it was not feasible to obtain external validation of smoking reports at subsequent waves of data collection.

The results from this study comprise a rich picture of smoking initiation, the factors that influence it, and how the strength of those influences change as youth approach young adulthood. One of the more practical implications of these findings can be gleaned from the significance of the family variables, especially the impact of the important adult smoker. Recently, researchers have advocated that primary care physicians identify the smoking status of parents of their adolescent patients\textsuperscript{37}. Results from this study indicate that this knowledge may be useful in the prevention or delay of smoking initiation, especially among adolescent girls.
References


Table 1. Fitted hazard and survival probabilities from a basic model predicting initiation as a function of age and age-squared.

<table>
<thead>
<tr>
<th>Age</th>
<th>Fitted Hazard Probability</th>
<th>Fitted Survival Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.016</td>
<td>0.984</td>
</tr>
<tr>
<td>6</td>
<td>0.028</td>
<td>0.956</td>
</tr>
<tr>
<td>7</td>
<td>0.047</td>
<td>0.911</td>
</tr>
<tr>
<td>8</td>
<td>0.070</td>
<td>0.847</td>
</tr>
<tr>
<td>9</td>
<td>0.098</td>
<td>0.764</td>
</tr>
<tr>
<td>10</td>
<td>0.126</td>
<td>0.668</td>
</tr>
<tr>
<td>11</td>
<td>0.151</td>
<td>0.567</td>
</tr>
<tr>
<td>12</td>
<td>0.169</td>
<td>0.471</td>
</tr>
<tr>
<td>13</td>
<td>0.178</td>
<td>0.387</td>
</tr>
<tr>
<td>14</td>
<td>0.175</td>
<td>0.319</td>
</tr>
<tr>
<td>15</td>
<td>0.162</td>
<td>0.268</td>
</tr>
<tr>
<td>16</td>
<td>0.140</td>
<td>0.230</td>
</tr>
<tr>
<td>17</td>
<td>0.113</td>
<td>0.204</td>
</tr>
<tr>
<td>18</td>
<td>0.085</td>
<td>0.187</td>
</tr>
<tr>
<td>19</td>
<td>0.059</td>
<td>0.176</td>
</tr>
<tr>
<td>20</td>
<td>0.037</td>
<td>0.169</td>
</tr>
<tr>
<td>21</td>
<td>0.022</td>
<td>0.165</td>
</tr>
<tr>
<td>22</td>
<td>0.012</td>
<td>0.163</td>
</tr>
<tr>
<td>23</td>
<td>0.006</td>
<td>0.162</td>
</tr>
<tr>
<td>24</td>
<td>0.003</td>
<td>0.162</td>
</tr>
</tbody>
</table>

Note: Shaded hazard probabilities indicate age range of highest risk, bolded survival rates indicate approximate quartiles of the survival distribution.
Table 2. Hazards ratios and 95% confidence intervals for discrete-time hazard model predicting smoking initiation as a function of age, demographics, and family influence variables.

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Hazard Ratio</th>
<th>95% Wald Confidence Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.254</td>
<td>(1.212 – 1.297)**</td>
</tr>
<tr>
<td>Age-squared</td>
<td>0.965</td>
<td>(0.959 - 0.970)**</td>
</tr>
<tr>
<td>Female</td>
<td>0.373</td>
<td>(0.285 – 0.488)**</td>
</tr>
<tr>
<td>Female*Age</td>
<td>1.089</td>
<td>(1.063 – 1.116)**</td>
</tr>
<tr>
<td>Female*Age-squared</td>
<td>0.990</td>
<td>(0.986 – 0.994)**</td>
</tr>
<tr>
<td>African American</td>
<td>2.503</td>
<td>(1.361 – 4.602)**</td>
</tr>
<tr>
<td>African American*Age</td>
<td>0.938</td>
<td>(0.886 – 0.992)*</td>
</tr>
<tr>
<td>African American*Age-squared</td>
<td>0.989</td>
<td>(0.981 – 0.998)*</td>
</tr>
<tr>
<td>Asian</td>
<td>0.714</td>
<td>(0.636 – 0.802)**</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.491</td>
<td>(0.316 – 0.762)**</td>
</tr>
<tr>
<td>Hispanic*Age</td>
<td>1.096</td>
<td>(1.051 – 1.144)**</td>
</tr>
<tr>
<td>Hispanic*Age-squared</td>
<td>0.988</td>
<td>(0.979 – 0.996)**</td>
</tr>
<tr>
<td>Other ethnicity</td>
<td>1.221</td>
<td>(1.049 – 1.420)**</td>
</tr>
<tr>
<td>Nuclear family</td>
<td>0.684</td>
<td>(0.531 – 0.881)**</td>
</tr>
<tr>
<td>Nuclear family*Age</td>
<td>0.995</td>
<td>(0.972 – 1.020)</td>
</tr>
<tr>
<td>Nuclear family*Age-squared</td>
<td>1.005</td>
<td>(1.001 – 1.010)*</td>
</tr>
<tr>
<td>Parents education</td>
<td>0.918</td>
<td>(0.711 – 1.185)</td>
</tr>
<tr>
<td>Parents education*Age</td>
<td>0.989</td>
<td>(0.965 – 1.014)</td>
</tr>
<tr>
<td>Parents education*Age-squared</td>
<td>1.007</td>
<td>(1.002 – 1.011)**</td>
</tr>
<tr>
<td>Adult smokes</td>
<td>2.519</td>
<td>(1.973 – 3.215)**</td>
</tr>
<tr>
<td>Adult smokes*Age</td>
<td>0.945</td>
<td>(0.926 – 0.965)**</td>
</tr>
<tr>
<td>Has older sibling</td>
<td>1.078</td>
<td>(0.816 – 1.423)</td>
</tr>
<tr>
<td>Has older sibling*Age</td>
<td>1.020</td>
<td>(0.993 – 1.047)</td>
</tr>
<tr>
<td>Has older sibling*Age-squared</td>
<td>0.995</td>
<td>(0.990 – 0.999)*</td>
</tr>
<tr>
<td>Female *Adult smokes</td>
<td>1.232</td>
<td>(1.091 – 1.391)**</td>
</tr>
<tr>
<td>African American*Adult smokes</td>
<td>0.154</td>
<td>(0.070 – 0.338)**</td>
</tr>
<tr>
<td>African American*Adult smokes *Age</td>
<td>1.157</td>
<td>(1.078 – 1.241)**</td>
</tr>
</tbody>
</table>

Note: * indicates p<.05; ** indicates p<.01
Figure Captions

Figure 1. Hazard and Survival Functions for Four Ethnic Groups

Figure 2. Hazard and Survival Functions for White and Black Ethnicity by Adult Smoker

Figure 3. Hazard and Survival Functions for Gender by Adult Smoker

Figure 4. Hazard and Survival Functions for Nuclear Family, High Parental Education, and Older Sibling. Note: Comparison represents respondents with non-nuclear families, parents of high school education or less, and no older siblings.

Figure 5. Hazard and Survival Functions for Combinations of Family Factors by Gender. Note: Comparison represents respondents with non-nuclear families, no older siblings, and no important adult smoker.
Hazard and Survival Functions for Four Ethnic Groups

Hazard and Survival Functions for White and Black Ethnicity by Adult Smoker

--- White, No Adult Smoker  --- Black, No Adult Smoker  ▲ White, Adult Smoker  ○ Black, Adult Smoker
Hazard and Survival Functions for Gender by Adult Smoker

Hazard and Survival Functions for Nuclear Family, High Parental Education, and Older Sibling
Hazard and Survival Functions for Combinations of Family Factors by Gender

**Girls**

![Graph showing fitted hazard and survival probabilities for girls by age of first cigarette, comparing different family factors and combinations.](image)

**Boys**

![Graph showing fitted hazard and survival probabilities for boys by age of first cigarette, comparing different family factors and combinations.](image)

- **Comparison**
- **Nuclear Family**
- **Nuclear Family and Older Sibling**
- **Nuclear Family and Adult Smoker**
- **Nuclear Family and Older Sibling and Adult Smoker**