How do Mothers, Fathers, and Friends Influence Stages of Adolescent Smoking?

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Abstract

Parent and friend influences may differentially promote or deter adolescent smoking at discrete stages. Drawing from national (Add Health) data, a partial proportional odds ordinal regression model was utilized to examine the multivariate influence of parent and friend variables and their interactions on transitions across smoking stages (Never Smokers, Experimenters, Intermittent, Regular/Established) separately for mother-child pairs (N = 15,983) and father-child pairs (N = 1,142). Friend smoking status was by far the strongest predictor across smoking stages. Gender differences indicated males with one or more daily smoking friends are at higher risk for regular smoking relative to females. Fathers' smoking status had a direct effect on teen smoking across all stages, whereas mothers' smoking was significant in influencing which stage of smoking teens exhibited. Moreover, maternal smoking status had an indirect effect by moderating the association between teen smoking and the closeness of the mother-teen relationship. Mothers who smoke were found to have a stronger impact on the transition to regular smoking compared to mothers who do not smoke regardless of the number of smoking friends the teen reports. Results have implications for stage-matched and family-based prevention and intervention programs.

Keywords

adolescent health; parent-child relationships; social environment; adolescence risk-taking avoidance education

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Tobacco use is the single leading preventable cause of death in the United States, with approximately 80% of tobacco users initiating use before age 18 (McGinnis, JM and Foege, WH, 1993; United States Department of Health and Human Services, 1994). If this trend continues, approximately five million children aged <18 years who are living today will die prematurely as adults because they began to smoke cigarettes during adolescence (Centers for Disease Control, 1997). While various studies have demonstrated that adolescents whose friends and/or parents smoke cigarettes are more likely to smoke cigarettes themselves, it remains unclear how parent and friend factors interact with each other and with demographic factors, such as gender, to predict stages of smoking intensity in youth (Tyas, SL and Pederson, LL, 1998). Interventions aimed at reducing adolescent smoking at early stages of uptake could decrease the number of youth who progress from smoking experimentation to regular smoking, and likely nicotine dependence. For such programs to

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be successful, it is necessary to better understand the role of social influences at different stages of adolescent smoking.

Much of the research on social influences and adolescent smoking has utilized a single measure of smoking onset that perhaps conceals differences between youth who have puffed a cigarette, experimented with cigarettes on occasion, and those who begin to use regularly. More recently, smoking in adolescence has been conceptualized as progressing through a sequence of developmental stages, beginning with the preparation stage (never smoked), and advancing to the initiation stage (trying the first cigarette), the experimentation stage (repeatedly trying cigarettes), the habituation stage (becoming a regular smoker) and the final stage (addictive smoking), (Mayhew, KP, Flay, BR and Mott, JA, 2000). Much of this research has examined predictors of a specific stage, but the few studies that have simultaneously explored effects of covariates across multiple stages of youth smoking have revealed parent and friend factors to differentially affect smoking stages (Flay, BR, Phil, D, Hu, FB and Richardson, J, 1998; Lloyd-Richardson, EE, Papandonatos, G, Kazura, A, Stanton, C and Niaura, R, 2002). For example, Lloyd-Richardson et al. (2002) examined the relative influence of various sociodemographic, psychological, and interpersonal domains on transitions across smoking stages (Never Smokers, Experimenters, Intermittent, Regular/ Established) among adolescents. Results indicated that friends' smoking was particularly influential on differentiating regular smoking from lower levels of smoking. Parental smoking status significantly impacted teen smoking across each smoking stage. However, the model tested failed to examine moderators within the interpersonal domain and did not include measures of parenting practices. The purpose of the current study is to test a focused model of social influences on adolescent smoking stages that examines second- and thirdorder interactions between adolescent gender, friend and parent smoking status, and parenting practices.

Social-cognitive theories contribute to our understanding of why adolescents start smoking and the mechanisms by which parents and friends influence susceptibility for smoking uptake (Chassin, L, Presson, CC and Sherman, SJ, 1995). According to *social learning theory*, behaviors are learned through the observation of others engaged in a behavior and subsequent modeling of this behavior, as well as actual and anticipated consequences (Bandura, A and National Institute of Mental Health, RMD US, 1986). Accordingly, adolescent beliefs regarding the feasibility, acceptability, and consequences of tobacco use may develop primarily through personal experience with tobacco and observations of others, particularly parental role models. Parents that smoke may model smoking behavior, lack credibility as antismoking advocates, be less likely to have smoking-bans in the home, and make cigarettes more readily available in the home (Biglan, A, Duncan, TE, Ary, DV and Smolkowski, K, 1995; Chassin, L, Presson, CC, Todd, M, Rose, JS and Sherman, SJ, 1998; Jackson, C and Henriksen, L, 1997; Proescholdbell, RJ, Chassin, L and MacKinnon, DP. 2000). Moreover, the *social context model* of adolescent cigarette use suggests that parental factors may indirectly impact the likelihood of youth's affiliation with friends that smoke (Biglan, A, Duncan, TE, Ary, DV and Smolkowski, K, 1995). Thereby, youth may be more likely to select friends who smoke or be influenced by friends who smoke if they anticipate positive consequences from their friend group for smoking (e.g., friend acceptance) and do not expect negative consequences from parents (e.g., reinforcement of specific anti-smoking rules in the home). Consistent with Social-Cognitive Theory, this study examines the interaction between parent smoking and friend smoking to test the hypothesis that parental factors indirectly impact the likelihood that youth who affiliate with daily smoking friends will be at higher risk for more regular smoking.

In addition, we examine how parenting practices and socialization may protect youth from smoking after taking into account the parent's smoking status (Chassin, L, Presson, CC,

Todd, M, Rose, JS and Sherman, SJ, 1998; Jackson, C and Henriksen, L, 1997; Henriksen, L and Jackson, C, 1998; Sargent, JD and Dalton, M, 2001). Various measures of parental discipline, involvement, monitoring, and communication have been found to decrease the extent of adolescent tobacco use (Cohen, DA, Richardson, J and LaBree, L, 1994; Distefan, JM, Gilpin, EA, Choi, WS and Pierce, JP, 1998). On the other hand, aspects of parenting style, such as high levels of strictness or control, have been found to increase the likelihood of youth smoking initiation (Chassin, L, Presson, CC, Sherman, SJ, Montello, D and McGrew, J, 1986). We examine which dimensions of parenting, such as parental control, involvement, and communication-based activities (e.g., talking about a problem), are more salient in protecting youth from smoking experimentation and from higher stages of smoking intensity. Moreover, we test the interaction between parental smoking and the parental relationship, reflected by communication-based activities, across youth smoking stages. Based on tenets of social learning theory, we hypothesize that parental modeling and influence will have a stronger impact across teen smoking stages within the context of a closer relationship with the parent. Previous studies have suggested that youth substance use is more highly associated with parental substance use if the teen identifies with or is more strongly attached to the parental figure (Andrews, JA, Hops, H and Duncan, SC, 1997; Brook, JS, Whiteman, M, Gordon, AS and Brook, DW, 1986; Foshee, V and Bauman, KE, 1994).

We are particularly interested in examining gender differences in the relationships between parent and friend influences on stages of teen smoking. It has been theorized that girls may be more susceptible to social influences than boys, as a result of females' stronger social bonds to parents and school than boys (Flay, BR, Phil, D, Hu, FB and Richardson, J, 1998; Hu, FB, Flak, B R, Hedeker, D, Siddiqui, O and et al., 1995; Swan, AV, Creeser, R and Murray, M, 1990). Whereas some studies have found parental and friend factors to be more influential across smoking stages for girls compared to boys (Flay, BR, Phil, D, Hu, FB and Richardson, J, 1998; Chassin, L, Presson, CC, Sherman, SJ, Montello, D and McGrew, J, 1986; Flay, BR, Hu, FB, Siddiqui, O, Day, LE, Hedeker, D, Petraitis, J, et al., 1994), others have suggested that at certain stages of smoking uptake, boys' smoking may be more related to friend factors than for girls, (Simons-Morton, B, Crump, AD, Haynie, DL, Saylor, KE, Eitel, P and Yu, K, 1999). Studies have used different measures to assess the influence of parents and friends and various definitions of smoking intensity that may contribute to different findings. Differences in social predictors most influential for girls and boys at different stages of smoking are still not understood and these differences have implications for developing programs to reduce adolescent smoking.

The gender of the parent may also affect the transmission of smoking behaviors (Andrews, JA, Hops, H and Duncan, SC, 1997; Griffin, KW, Botvin, GJ, Doyle, MM, Diaz T and Epstein, JA, 1999; Hops, H, Duncan, TE, Duncan, SC and Stoolmiller, M, 1996; Kandel, DB and Wu, P, 1995; Oygard, L, Klepp, KI, Tell, GS and Vellar, OD, 1995; White, HR, Johnson, V and Buyske, S, 2000). Among studies that have examined the differential influence of maternal versus paternal smoking, results have been equivocal (Tyas, SL and Pederson, LL, 1998). One study found no link between paternal and youth smoking, but revealed a dose-response association between maternal smoking and youth's smoking, particularly for daughters (Kandel, DB and Wu, P, 1995). On the other hand, there is evidence that paternal smoking can play an important role in youth smoking and that these effects may be moderated by the youth's age, gender, or other factors (Hops, H, Duncan, TE, Duncan, SC and Stoolmiller, M, 1996). Inconsistent findings to date may be a result of the varying smoking outcomes studied and whether parental smoking status is based on parent self-reports of smoking or youth's perceptions of their parent's smoking status.

Using a large national dataset, this study seeks to further illuminate the differential impact of mothers' versus fathers' smoking status and parenting behaviors on youth smoking and to examine the interactions that may better capture the dynamic interplay of complex social influences on the etiology of adolescent smoking. Through cross-sectional analyses, a partial proportional odds ordinal regression model is utilized to examine whether parent and friend variables have a uniform influence in differentiating between smoking stages, or whether different social predictors exert a stronger or weaker influence at particular stages, as well as by gender. This research further adds to the literature on adolescent smoking by examining models separately for mothers and fathers, inclusive of interactions with child gender.

METHOD

Study Sample and Survey Procedure

The sample was drawn from the first wave of the restricted use National Longitudinal Study of Adolescent Health (Add Health) data set. Permission was granted by the original study Principal Investigators for use of the data and human subjects approval was obtained from the hospital Institutional Review Board. Add Health is a nationally representative study of the health-related behaviors of adolescents that was comprised of multiple methods including in-school, in-home, and parent interviews. Mother-teen dyads (N = 15,983) and father-teen dyads (N = 1,142) used for analyses were drawn from a total of 20,745 adolescents and a resident parent (either a male or female caregiver) who completed in-home interviews administered between April and December of 1995. All adolescent respondents received the same interview, which was one to two hours long depending on the respondent's age and experiences. The majority of interviews were conducted in respondents' homes. To protect confidentiality, no paper questionnaires were used. Instead, all data were recorded on laptop computers. For less sensitive topics, the interviewer read the questions aloud and entered the respondent's answers. For more sensitive topics, the respondent listened through earphones to pre-recorded questions and entered the answers directly. In addition to maintaining data security, this minimized the potential for interviewer or parental influence. Additional details about the survey design may be obtained elsewhere (Berman, PS, Jones, J and Udry, JR, 1997).

Measures

Smoking Stage—Consistent with previous literature (Flay, BR, Phil, D, Hu, FB and Richardson, J, 1998; Lloyd-Richardson, EE, Papandonatos, G, Kazura, A, Stanton, C and Niaura, R, 2002) smoking stage was defined on the basis of smoking frequency and recency. Never Smokers were defined as those adolescents who denied ever trying a puff or two of cigarettes. Experimental Smokers were classified as those who endorsed trying cigarettes, although denied smoking within the past 30 days or ever smoking regularly (i.e., daily smoking). Intermittent Smokers were defined as those who reported smoking between one and 29 out of the past 30 days. Regular/Established Smokers were classified as those who reported smoking on a daily basis within the past 30 days. Ex-Smokers were classified as those who reported quitting smoking, endorsed regular, daily past smoking, and denied smoking within the past 30 days.

Sociodemographic Variables—Variables including gender, ethnicity, poverty, and age were assessed. While the race and ethnicity questions contained within the Add Health study allowed adolescents to choose multiple racial and ethnic backgrounds, a categorical race/ethnicity variable was created using the following logic: A respondent was classified as White, African American, or Asian if he/she marked that category only and did not claim a Hispanic background. A respondent was classified as Hispanic if he/she claimed a Hispanic background, regardless of racial background. A race category of Other was utilized for all

other responses, therefore allowing racial categorizations of: White, African American, Hispanic, Asian, and Other. Poverty level was assessed via parental report of total household income before taxes in 1994. Poverty was then defined as total household income below 1.5 times the US Census Bureau, 1994 poverty thresholds adjusted for household size and number of related children under 18 years of age (Goodman, E, 1999). Poverty level was then categorized in the following way: Below 1.5 times the poverty threshold; 1.5 to less than 2.5 times the poverty threshold; 2.5 to less than 4 times the poverty threshold; 4 times the poverty threshold and higher, according to 1994 census data obtained in figures located at www.census.gov/hhes/poverty/threshld/thresh94.html *(last accessed on February 17, 2002).*

Social Influence Variables—Either a maternal or paternal caregiver responded to the survey. Maternal smoking was coded as positive if the adolescents' biological or resident mother was the participating parent and endorsed current smoking (*Do you smoke? yes/no*). Paternal smoking was coded as positive if the adolescents' biological or resident father was the participating parent and endorsed current smoking (*Do you smoke? yes/no*). No other questions in this existing dataset are available to measure the frequency, intensity, or level of nicotine dependence of the participating parent.

Parent-adolescent activities reflect the adolescent's self-report of the number of shared parent-child activities within the past 4 weeks. This measure was adapted from an existing parent-adolescent activities scale (Resnick, MD, Bearman, PS, Blum, RW, Bauman, KE, Harris, KM, Jones, J, et al., 1997), which reflected the number of up to ten activities an adolescent reported involvement in with both resident and nonresident biologic parents. The total number of activities shared with either resident or biologic mother was tallied, with the higher of the two counts used as an indicator of activities with mothers. An identical procedure was used to identify an indicator of activities with father. In the final step, counts of activities with mother and father were summed. In the current study, a varimax rotation of the principal factor analysis of the items analyzed for mothers and fathers separately indicated three separate factors in both the mother and father samples. Two factors that appeared to represent "talking about school" and "going out together" (movies, shopping, etc.) had weak internal consistency (alphas range from 0.36 to 0.48) and they were dropped from analyses. The strongest factor for both mother-child activities (aa = 0.64) and father-child activities (aa = 0.68) was comprised of three items that reflect underlying dimensions of parent-child communication (work on a project together, talk about a problem, and talk about a date or party) and consequently was chosen to represent parent-adolescent activities in subsequent analyses.

Parental control was calculated by summing seven items that reflect the adolescents' report of whether the parent allows for independent decision making regarding things the teen does (e.g., how much television to watch, what to wear, what time to be home on weekend nights) and who they "hang around with." Factor analyses of these items indicated one factor with fair internal consistency (aa = 0.64). Parental involvement reflects parent report of how well the parent knows her/his teen's friends based on the sum of four items (e.g., Have you met your teen's best friend in person?). Factor analyses of these items indicated one factor with fair internal consistency (aa = 0.69).

Friends' daily smoking was assessed with the question, "Of your three best friends, how many smoke more than one cigarette per day?"

Statistical Analyses

The proposed study uses advanced statistical methods that permit modeling of the multivariate influence of social variables on various transitions between smoking stages,

without assuming that transition across stages is a linear function of the variables. Although there is certainly precedent for examining predictors of adolescent substance use at different levels of substance use frequency, previous studies have utilized separate binary logistic regressions to model each of three possible dichotomizations of the four-category ordinal outcome (Brook, JS, Cohen, P, Whiteman, M and Gordon, AS, 1992). Such approaches are less efficient statistically than fitting a single ordinal regression model, and do not allow one to test for the presence of theoretically interesting stage-by-covariate interactions. In an earlier analysis of the Add health full sample, a partial proportional odds model was fit to examine the main effects of sociocultural and psychological factors on stages of smoking (Lloyd-Richardson, EE, Papandonatos, G, Kazura, A, Stanton, C and Niaura, R, 2002). As described below, this study differs in that we were primarily interested in higher order covariate-by-covariate interactions with smoking stage in a model stratified by gender of reporting parent. As can be seen from Table 1, 97.5% of the population of interest can be classified into one of four smoking stages (1 = Never Smoker, 2 = Experimental Smoker, 3 = Intermittent Smoker, 4 = Regular/Established Smoker) that are ordered in terms of degree of smoking, and presumed to reflect an underlying dimension of smoking behavior. Given the small sample size (N = 435), and in order to focus on the four-category ordinal outcome alone, we chose to exclude the last smoking category (5 = ExSmoker).

The cumulative odds ordinal regression model is a flexible parametric model for analyzing ordinal outcomes, which assumes that the stages in which we classify the smoking outcome correspond to categories representing an underlying continuous smoking behavior scale (Agresti, A, 1990). Further, when the latent variable is taken to have a logistic distribution in the population of interest and the covariates have uniform impact on all the thresholds of this underlying smoking scale, the model is called a proportional odds model. Generalizations of this model allow a subset of the covariates to have threshold-specific effects, thereby allowing exploration of the salience of different predictors on various stages of smoking (Peterson, B and Harrell, FE, 1990). Improvements in model fit resulting from adoption of a partial proportional odds model can be assessed via likelihood ratio tests.

In coding the data, we chose to standardize all five continuous covariates (age, number of friends who smoke, parental control, parental involvement, number of common parental-adolescent activities) by subtracting off their first quartile and dividing the centered version of the covariates by their interquartile range. In the transformed scale, a single unit increase away from the origin corresponds to a meaningful increase in the value of the original predictor from its first to its third sample quartile. This makes it easier to gauge the practical - as opposed to merely statistical - significance of the associated regression coefficients, since they represent the change in the odds that the response will be in a stage greater than K (K = 1,2,3), rather than a stage no higher than K, when the value of the covariate is varied over its interquartile range. It is particularly important to keep this interpretation in mind for variables such as parental control and parental involvement for which the original scale of measurement is entirely arbitrary and needs to be anchored using location and scale identifiability constraints.

Although initially the same model was fit to two datasets comprised of either maternal respondents and their adolescents or paternal respondents and their adolescents, the decision was made a priori to simplify the models by omitting non-significant interaction terms, but retaining all main effects significant for at least one parental report model. Since multivariate regression coefficients purport to show the impact of each covariate adjusted for all other terms in the model, this modeling strategy aids interpretation without sacrificing the comparability of the regression coefficients across the two models. Because the paternal report data set had less power to detect interactions, due to its smaller size, it was expected that it would have fewer statistically significant terms.

RESULTS

Sample Characteristics

Two data sets were constructed, one composed of maternal respondents and the other composed of paternal respondents, each reporting on their child. Based upon the previously defined smoking stages, Table 1 presents the demographic and key variable characteristics of the entire Add Health sample for which parental reports are available (N_paternal = 1,142; N_maternal = 15,983), as well as the conditional distribution of smoking stage at each level of the predictors. The median age of the participants was 16 years and ranged from 13 to 19 years in both datasets. Although maternal reports were evenly distributed between genders (48.6% male), paternal reports showed a pronounced imbalance in favor of fathers reporting on their male children (70.84% male). Slightly greater than half of each sample was Caucasian, with black adolescents represented more highly in the maternal (22.27%) than the paternal (16.21%) samples. Adolescents with maternal reports were less likely to have a smoking parent responding (48.31%) than those with paternal reports (58.99%). The medians and interquartile ranges were common to the two datasets for both parental control (median = 5, IQR = 4-6) and parental involvement (median = 4, IQR = 3-6).

Since the ordinal regression models assume a continuous latent liability scale, they cannot accommodate responses that are a mixture of ordinal and nominal outcomes. Therefore, we dropped the ex-smokers from the analyses and retained only those subjects whose outcomes could plausibly be assumed to be monotonically increasing in their degree of nicotine dependence (Never Smoker, Experimenter, Intermittent Smoker, Regular/Established Smoker). With only 435 Ex-Smokers among the 16,796 in our sample, their exclusion seemed prima facie unlikely to severely limit the generalizability of our findings. However, we subsequently became concerned that certain racial/ethnic strata of interest might contain ex-smokers in a much larger proportion than the overall sample. The last column of Table 1 shows that there is little deviation from the overall 2.6% ex-smoking rate by racial/ethnic group, other than among African-Americans, for which it is substantially lower at 1.04%. Therefore, our exclusion of the ex-smokers is unlikely to differentially impact the generalizability of our findings by race/ethnicity. Further down column 5 of Table 1, we note that this conclusion remains valid if we stratify our sample by any other covariates of interest.

Odds Ratios

The crude odds ratios are useful in examining bivariate relationships between the outcome and each candidate predictor and in screening covariates for failure of the proportional odds assumption. In Table 2, we present crude odds ratios for each of three contrasts: (A) Experimental, Intermittent, and Regular/Established versus Never Smokers; (B) Intermittent and Regular/Established versus Never and Experimental Smokers; and (C) Regular/ Established versus Never, Experimental, and Intermittent Smokers. Since odds ratios for the baseline categories are all one by definition, the first row for each variable contains baseline odds (represented by stars), rather than odds ratios. For example, Table 2 shows that adolescents with maternal reports whose age was below the median (16 years) were 0.96 times as likely to be experimental, intermittent or regular/established smokers than never smokers; 0.27 times as likely to be intermittent or regular/established smokers than never or experimental smokers; and 0.06 times as likely to be regular/established smokers than never, experimental or intermittent smokers. Re-expressing these results in the probability scale using the relationship P = Odds / (1 + Odds), we find that the corresponding probabilities are 0.49 for being an experimental, intermittent or regular/established smoker, 0.21 for being an intermittent or regular/established smoker and 0.06 for being a regular/established smoker. Taking differences, we find that of these adolescents, 51% were never smokers, 28%

experimental, 15% intermittent, and 6% regular/established smokers. Up to rounding error, these proportions are exactly equal to those reported in the corresponding row of Table 1, after adjusting for the exclusion of the never smokers.

For those older than 16 years of age, we find that the odds of being experimental, intermittent or regular/established smokers rather than never smokers were 1.54, i.e. 60% higher than younger participants. Similarly, their odds of being intermittent or regular/established smokers rather than never or experimental smokers were 0.45, i.e. 68% higher than for early adolescents. As for their odds of being regular/established smokers rather than never, experimental or intermittent smokers, at 0.144 they were 2.40 times as large than participants below 16 years of age. Converting these odds to the probability scale as described above, we find that they agree with the entries of Table 1 after adjusting for the exclusion of the never smokers, i.e 39% of these students were never smokers, 29% experimental, 19% intermittent and 13% regular/established smokers, indicating that older age is positively associated with increases in smoking behavior, especially in terms of crossing the threshold into regular/established smoking.

Regression Analyses

As shown in Table 3, using the intercept row as a common baseline for all variables, five predictors in the maternal report dataset (race, age, gender, parental and friend smoking) and three predictors in the paternal report dataset (race, age and friend smoking) were found to violate the proportional odds assumption ($p < 0.05$) and remained in the final model coded as nominal predictors using first-to-zero contrasts. For ethnicity, the proportional odds assumption could be rejected for Blacks irrespective of the gender of the reporting parent, but for Hispanics it could only be rejected among adolescents with maternal reports; this could possibly be due to reduced power to detect departures from proportionality among the much smaller paternal report dataset. Number of common activities with a reporting parent was not significant in the paternal report model, but was deemed significant in the maternal report model.

Therefore, all exponentiated regression coefficients presented in Table 3 can be interpreted as odds ratios relative to a baseline group of white 16-year-old adolescents who had no reporting parents or friends who smoke, had low parental control and no common activities with their reporting parents. The standard logistic density assumed for the underlying continuous smoking scale had cut-points distinguishing the four stages of smoking progression that were estimated among subjects with maternal reports at 0.58 (95% CI = 0.48 to 0.69) for never smokers in our baseline group, 2.30 (95% CI = 2.12 to 2.41) for experimental smokers, and 4.71 (95% CI = 4.51 to 4.96) for intermittent smokers. Exponentiating the cutpoints and inverting the result gives the odds of being in a smoking stage higher than the cutpoints, which are reported in the intercept row of Table 2. These can then be used to obtain point estimates and 95% confidence intervals for the probabilities of being in each stage of smoking progression: 64.2% for never smokers (95% CI = 61.6% to 66.8%), 26.7% for experimental smokers (95% CI = 23.8% to 29.6%), 8.2% for intermittent smokers (95% CI = 7.4% to 9.1%) and just 0.9% for regular/established smokers (95% CI = 0.6% to 1%). Almost two thirds of this low-risk group appear to be never smokers, with experimental smokers predominating among the remaining third. Adolescents in the baseline group for whom paternal reports were available appear to have a slightly larger prevalence of never smokers; however, the associated confidence intervals were significantly wider due to the smaller sample size of this dataset (Never Smoking: 66.1%, 95% CI = 58.4% to 73.7%; Experimental Smoking: 27.0%, 95% CI = 18.7% to 35.2%, Intermittent Smoking: 5.9%, 95% CI = 3.8% to 7.9%, Regular/Established Smoking: 0.9%, 95% CI = 0.5% to 2%). Profiles of participants showing higher degrees of cigarette use can be guessed at by examining each of the significant covariates in turn while keeping in mind that odds ratios

less than one are protective, because they make higher levels of use less likely. Specific results for the main effects of all significant variables not involved in interactions with other variables are given below. Parental and friend smoking, adolescent's gender and parental-adolescent activities are all involved in two- or three-way interactions and need to be analyzed jointly, since their main effects depend on our choice of baseline group.

(a) Race/Ethnicity—Blacks, Hispanics and Asians had odds ratios significantly different from those of Whites. As seen in the entries of Table 3, being Black was far more protective in lowering the odds of a transition to regular/established smoking (82% decrease) than to either experimentation (63% decrease) or smoking initiation (35% decrease) in the maternal report group and was even more protective for adolescents with paternal reports, the corresponding reductions being of the order of 91%, 37% and 32%. Similarly, being Hispanic conferred only mild protection against smoking initiation (11% decrease), but stronger protection against experimentation (35% decrease) and transition to regular/established smoking (54% decrease), the latter phenomenon being limited to subjects in the maternal report dataset. Being Asian lowered the odds of higher stage transitions by three tenths across the board. The crude odds ratios of Table 2 suggest that non-proportional odds may well hold for all three minority groups irrespective of gender of the reporting parent, but that there may be simply too few Asian and Hispanic subjects to allow the interaction between race and the smoking thresholds to be tested with sufficient power across all racial/ethnic groups. The group designated as Other is mostly comprised of Native Americans and was not significantly different from the baseline Caucasian group.

(b) Age—Older adolescents were more likely to find themselves in higher smoking stages. Specifically, adolescents older than 16 years were 25% more likely to have initiated smoking or to have moved into experimentation than their younger classmates, an effect that was not found to be statistically significant in the paternal report dataset. However, their odds of reporting regular/established smoking were considerably higher in both the maternal (OR = 1.60) and the paternal (OR = 2.26) reports, increases that were statistically significant at the 5% level.

(c) Parental Control—A high degree of parental control was a risk factor for smoking among adolescents, increasing the odds of being in a higher rather than a lower smoking stage by about a fifth in the maternal report dataset and a quarter in the paternal report dataset, as it was varied over its interquartile range.

(d) Friend Smoking by Adolescent's Gender—By far the strongest predictor of smoking progression is Friend Smoking, which should not be interpreted on its own, since it is involved in two-way interactions with Gender in both datasets and with Parental Smoking in the maternal report dataset alone. Still, the univariate odds ratios reported in Table 2 show that for the 12% of our total sample with at least three friends who smoke, the odds of experimentation were at least 25 times higher than for the 55% of adolescents with no friends who smoke; even stronger odds ratios are reported for the prevalence of regular/established smoking.

Table 4a shows that smoking rates of adolescents with maternal reports display a qualitative interaction pattern: females with no friends who smoke not only seem to be protected against smoking relative to males, but the degree of protection their gender confers seems to increase with the smoking threshold, whereas for females with at least one friend who smokes the additional risk conferred by their environment increases with each threshold, although it remains at a generally lower level than that of comparable male adolescents. The paternal dataset is not directly comparable to the maternal dataset due to smaller sample

size. In the paternal dataset (Table 4b), gender appears protective only among females with no friends who smoke and becomes a significant risk factor among females with smoking friends, increasingly so at the higher smoking thresholds. Females with one or more smoking friends were at higher risk across smoking stage contrasts than male teens with one or more daily-smoking friends.

(e) Friend Smoking by Maternal Smoking—An examination of Table 5 shows that maternal smoking is a risk factor for both male and female adolescents with one or two friends who smoke. Relative to mothers who do not smoke, maternal smoking is actually protective for youth in earlier stages of initiation and experimentation among adolescents with three daily smoking friends. Youth who do not have friends who smoke but have a mother who smokes are at increased risk for smoking across stages.

(f) Maternal Smoking by Maternal-Adolescent Activities by Adolescent's Gender—Examining Table 6 we notice that in this 3-way interaction, maternal smoking and common maternal-adolescent activities act synergistically as risk factors for smoking, in that their joint impact is larger than that for either factor alone. However, the synergistic effect is stronger for males than for females, whose smoking rates are mostly driven by maternal smoking status, rather than number of common activities. These Tables also indicate that the odds ratios among adolescents whose mothers do not smoke seem to be stable for males and declining with threshold for females, whereas they show a quadratic pattern for adolescents whose mothers are reported to smoke, indicating that maternal smoking may affect smoking initiation and uptake of regular smoking more than experimentation with cigarettes.

DISCUSSION

Our understanding of the dynamic relationships between social influence variables and their association with specific stages of adolescent smoking can direct the development of more effective smoking prevention interventions. Using advanced statistical methods allowing for analysis of two- and three-way interactions, specific parent and friend influences varied at particular smoking stages within the separate maternal and paternal models of smoking. Consistent with previous literature, demographic variables such as race and age appear to strongly differentiate later smoking stages, or the regular/established smokers from never, experimental and intermittent smokers. Friends' daily smoking, paternal smoking status, and parental control were found to be risk factors across all of the smoking contrasts. On the other hand, maternal smoking had a stronger impact on the contrast between regular smoking and earlier smoking stages. Underscoring the dynamic relationships between social predictors, main effects of predictors such as maternal smoking were further understood beyond what has been explained in previous studies based on complex interactions with adolescent gender, friend smoking, and parenting variables (e.g., number of communication based parent-child activities).

The Relationship between Friends' Daily Smoking and Adolescent Smoking Stages

Friends' daily smoking was the strongest predictor of teen smoking across stages. Our results indicate that friends' daily smoking was a particularly strong predictor of regular/established smoking. Previous research has found that among the most predictive factors of transition from nonsmoking to experimental or regular smoking status is the number of best friends who smoked (Wang, MQ, 2001). The assessment of friend smoking in our study, however, is based on how many friends smoke cigarettes *daily*, reflecting the high-end of the spectrum of friend influence and lending itself to underestimation of how experimental use of cigarettes may influence susceptibility to smoking in youth. Further research may

indicate that having friends in earlier, more experimental smoking stages, may be more influential at early stages of smoking, as has been previously reported (Flay, BR, Phil, D, Hu, FB and Richardson, J, 1998). Moreover, measurement of friend influence is limited by the adolescent's self-report of their friend's behavior. Adolescent smokers, in particular experimental and regular smokers, tend to overestimate the prevalence of smoking among friends and erroneously inflate the correlation between self and friend's behavior (Urberg, KA, Shyu, SJ and Liang, J, 1990).

The relationship with friends' smoking can further be explored through interactions with gender, such that, in the maternal database, female teens with no friends who smoke are protected against higher smoking stages relative to males. It has been hypothesized that females may display a greater social sensitivity to the smoking environment than males, which may account for the increased protection indicated for girls with no smoking friends (Flay, BR, Phil, D, Hu, FB and Richardson, J, 1998; Chassin, L, Presson, CC, Sherman, SJ, Montello, D and McGrew, J, 1986; Hu, FB, Flak, BR, Hedeker, D, Siddiqui, O and et al., 1995; Swan, AV, Creeser, R and Murray, M, 1990; Flay, BR, Hu, FB, Siddiqui, O, Day, LE, Hedeker, D, Petraitis, J, et al., 1994). On the other hand, we found that males with one or more friends who smoke daily are at higher risk for regular smoking relative to females. Others have found that social influence variables, such as friends' problem behavior and direct peer pressure, were associated with smoking among boys only (Simons-Morton, B, Crump, AD, Haynie, DL, Saylor, KE, Eitel, P and Yu, K, 1999). Examination of smoking-stage specific factors may assist with explanation of these previously contradictory results. Non-smoking female teens with non-smoking friends may have limited exposure to cigarettes and incur increased protection from smoking experimentation, whereas male teens who are already smoking daily may have friendships with other regular smokers that contribute to the increased availability and accessibility of smoking in their everyday life and make smoking reduction attempts less likely. There is some debate over whether these relationships can be explained through peer influence theories, in which friends model smoking behaviors and may provide direct or indirect "peer pressure" to smoke, or whether there is a "social selection" process whereby adolescent smokers seek out friends who are smokers while ceasing friendships with nonsmoking friends (Ennett, ST and Bauman, KE, 1994; Wang, MQ, Eddy, JM and Fitzhugh, EC, 2000). Longitudinal examinations are needed to tease apart influence and selection processes that may differ for males and females at different stages of smoking initiation and progression.

Relationships between Maternal Smoking and Friend Smoking on Adolescent Smoking Stages

The evidence is firm that affiliation with friends who smoke is an important contributor to adolescent smoking across all stages. Previous research regarding parental contributions, particularly differences in influences of mothers and fathers, to adolescent smoking has been less clear. Our results indicate that maternal smoking as a risk factor across all of the smoking stages has a stronger impact on the contrast between regular/established smoking and earlier smoking stages. The stronger influence of maternal smoking on the regular smoking stage is consistent with a 10-year follow-up report of youth smoking in Norway that found mother's smoking status in early adolescence was the most important long-term predictor in multivariate analyses of later daily smoking in young adults (Oygard, L, Klepp, KI, Tell, GS and Vellar, OD, 1995).

An interesting relationship between mothers' smoking status and friends' smoking status revealed that maternal smoking is a risk factor for both male and female adolescents with less than three friends who smoke, but acts protectively in terms of both initiation and experimentation among adolescents with three smoking friends. One possible explanation for this paradoxical result is that having a mother that smokes already provides the teen with

easy access to cigarettes even when he/she has friends who smoke, whereas for teens whose mothers do not smoke having friends who smoke is much more indicative of an environment likely to lead to tobacco use. Interestingly, mothers who smoke have a stronger impact on the transition to regular/established smoking compared to mother's who do not smoke, regardless of the number of smoking friends the teen reports.

The Influence of Parenting Practices on Adolescent Smoking Stages

There is a growing literature on the complex relationships between parent smoking status versus parenting practices, and how these relationships influence youth smoking. Parental control over adolescents has been associated with adolescent smoking and with other problem behaviors (Chassin, L, Presson, CC, Sherman, SJ, Montello, D and McGrew, J, 1986; Gray, MR and Steinberg, L, 1999). Our results indicate that a high degree of parental control is a risk factor for smoking among adolescents across all smoking contrast points. Findings are consistent with the conceptualization of authoritative parenting practices, which holds that adolescents respond best to parenting practices that are both demanding and responsive, but not overly controlling or strict (Jackson, C, Bee-Gates, DJ and Henriksen, L, 1994; Simons-Morton, B, Haynie, DL, Crump, A D, Eitel, SP and Saylor, KE, 2001). The number of communication-based activities a parent engaged in with their teen was found to be a significant predictor of smoking experimentation and more advanced stages of smoking. Examination of the main effect of this variable contradicted previous literature and it superficially appeared as if spending time talking with a parent was actually a risk factor for smoking. However, examination of this variable within the context of a thirdorder interaction with gender and maternal smoking status clarified that spending time with a parent that does *not smoke* is protective, whereas time spent with a parent who currently smokes cigarettes increased the likelihood that both males and females would be at a higher smoking stage. Results are consistent with our hypothesis that maternal smoking status has a stronger impact across teen smoking stages within the context of a closer mother-teen relationship (Andrews, JA, Hops, H and Duncan, SC, 1997; Brook, JS, Whiteman, M, Gordon, AS. and Brook, DW, 1986; Foshee, V and Bauman, KE, 1994). The measure of parent-adolescent activities utilized in this study focused on the extent to which a parent talked to their teen or helped with a project and reflects underlying dimensions of parent-child communication. Communication between teens and their parents about problems has been found to be protective against progression from experimentation to established smoking and is an important area to target in smoking prevention and cessation interventions (Distefan, JM, Gilpin, EA, Choi, WS and Pierce, JP, 1998). Within these programs, our results highlight the need to assist parents who currently smoke or have a history of smoking with strategies that will enable them to effectively communicate the risks of cigarette smoking to their teens.

The lack of standard measures for parenting practices makes it difficult to compare findings across studies or to make firm conclusions about which dimensions of parenting may be most critical to adolescent smoking behavior. Results of this study indicate that the nature of the relationship between parenting practices and teen smoking is moderated by teen gender and the smoking status of the parent. Thus, if a teen has a close relationship with and spends time with a parent that smokes he/she may be more likely to have access to cigarettes, be exposed to second-hand smoke, and have more favorable attitudes and beliefs regarding cigarette smoking. Thereby, these youth may be more vulnerable to smoking experimentation with friends or to maintaining a regular pattern of smoking. Moreover, intervention efforts may need to differentially target parents and teens according to smoking status and address cessation issues specific to those pairs that both smoke (e.g., encourage parent and teen to quit together). Parent report of involvement with their teen's friends (parental involvement) was dropped from the multivariate model due to non-significance.

Although previous studies have reported that parental monitoring of teen behavior can be protective against smoking initiation and progression (Cohen, DA, Richardson, J and LaBree, L, 1994; Distefan, JM, Gilpin, EA, Choi, WS and Pierce, JP, 1998), the questions utilized in this study focused on one parent's knowledge of the teen's best friend, communication with the parents of their teen's friends, and meetings with the parent of the teen's best friend. The number and the quality of teens' friendships at the time of the assessment may have confounded this measure, and these additional variables were not available in this study. Given the importance of friends to adolescent smoking and previous findings that various measures of parental monitoring may impact teens' choice of friends, future measurement work to better define this level of parental involvement in teens' social relationships is warranted (Biglan, A, Duncan, TE, Ary, DV and Smolkowski, K, 1995; Steinberg, L, Fletcher, A and Darling, N, 1994).

Paternal Influences Across Adolescent Smoking Stages

The smaller sample size of the paternal dataset relative to the maternal database and sample bias indicated by the imbalance of fathers reporting on their male children prohibited direct comparison between the maternal and paternal models and limited interpretation of fathers' influences on youth smoking. However, we report our findings specific to fathers' influences on differentiating adolescent smoking stages because of the paucity of work in this area. Results among studies that have examined the differences in influence of maternal versus paternal smoking have been equivocal, with some studies concluding that there is no link between paternal smoking status and youth smoking (Tyas, SL and Pederson, LL, 1998; Kandel, DB and Wu, P, 1995). Our results indicated that paternal smoking does increase the risk of youth smoking, particularly in the early smoking stage contrast from never smoking to smoking experimentation and advanced stages of smoking intensity. Although the interaction term between teen gender and paternal smoking was not statistically significant, there was a trend for paternal smoking to increase the odds of male teens' transitioning to higher smoking stage compared to female teens. Others have also found paternal smoking to play an important role in youth smoking and suggested that these effects may be moderated by the youth's age, gender, or other factors (Hops, H, Duncan, TE, Duncan, SC and Stoolmiller, M, 1996). The importance of further understanding the different roles of male and female caregivers, siblings, and extended family within the context of the larger social and cultural environment of youth is paramount to a comprehensive understanding of adolescent smoking.

Limitations and Future Directions

The relationships explored in this study are complex and reflect the dynamic, developmental nature of youth smoking. Statistical procedures that incorporate stage-variant and stage-invariant predictors of transitions are vital (Mayhew, KP, Flay, BR and Mott, JA, 2000). Limitations of this paper include the fact that analyses were cross-sectional, and therefore prevent us from determining causality. Future research should incorporate longitudinal investigations that allow for causal discussion of variables influencing smoking stages over time, as well as investigation of various trajectories of smoking uptake and nicotine dependence.

The Add Health survey did not allow for indepth assessment of constructs. The measurement of friend smoking failed to assess this predictor at different levels of influence (e.g. friends that have tried smoking or who are intermittent smokers). While poverty level, mother/father smoking status, and parental involvement were based on parental report, all other variables were based on adolescent self-report. Thus, only teens' perceptions of parenting behaviors (parental control and number of parent-teen activities) were measured. We did not distinguish biological versus resident status of mothers and fathers, thereby

examination of biological versus environmental contributions to adolescent smoking were not possible in this study. We did not have information pertaining to the level or history of parent tobacco use nor did we have available reports from more than one participating parent to determine differences in parental influence according to the number of caregivers who smoke in the teen's environment. It has been previously reported that parental influence in two-parent homes may be a function of the parent with the highest use (Hops, H, Duncan, TE, Duncan, SC and Stoolmiller, M, 1996). Additionally, adolescent smoking stages reflected self-report quantity-frequency data, prohibiting evaluation of tolerance and withdrawal symptoms to classify nicotine dependence, and without biochemical assessment to verify self-report data (Colby, SM, Tiffany, ST, Shiffman, S and Niaura, RS, 2000).

Our theoretical model was restricted to the outcome of cigarette smoking and predictor variables. These focused on social influences in order to maximize power and allow for further examination of interactions between variables that have been neglected in previous studies. Results revealed valuable relationships warranting further investigation. We plan to expand these models to incorporate adolescent intrapersonal characteristics (e.g., depression, coping styles, temperament), as well as explore the role of other highly related risk behaviors, such as drug and alcohol use, and the impact of school and neighborhood contextual variables.

A limitation of the current analysis is that the sampling design utilized to collect the Add Health data has not been incorporated in the analysis, since sample survey procedures for binary logistic regression have not been as yet extended to ordinal logistic regression with partial proportional odds. In an earlier publication using the AddHealth dataset (Lloyd-Richardson, EE, Papandonatos, G, Kazura, A, Stanton, C and Niaura, R, 2002), we compared the results of an ordinal logistic regression with no adjustment for survey weights to those of separate binary logistic regressions with the same set of contrasts and full weight adjustment and found that adjustment did not materially affect the inferences of the model, possibly because key demographic predictors used in the stratum definitions were also entered as covariates in the regression model.

Stage conceptualizations of smoking have tremendous implications for prevention efforts, both in allowing for identification of which teens may progress to higher stages of use, and likely dependence, as well as for developing interventions tailored to an adolescent's previous experiences with smoking(Lloyd-Richardson, EE, Papandonatos, G, Kazura, A, Stanton, C and Niaura, R, 2002),. Our findings demonstrate that the nature of the relationship between parenting practices and transitions across adolescent smoking stages is a complicated one, and appears to be moderated by teen gender and the smoking status of the mother. The more time a teenager spends with a maternal role model that smokes, the more likely a transition to a higher smoking stage. Moreover, teenagers with a parent who smokes and at least three friends who smoke are highly likely to be at an advanced stage of regular smoking. These results suggest that there is a need to develop early and effective prevention/intervention programs that reach and educate parents *before* children transition to adolescence and a greater likelihood of smoking uptake. It is important for parents to learn that their own behaviors (both their own specific smoking behaviors and more general parenting practices) make a difference in the development of their child's beliefs and behaviors regarding smoking. Prevention programs that focus on both the modeling of healthy parental behaviors, as well as enhancing parenting skills, may be influential in decreasing the uptake of smoking among youth.

Acknowledgments

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TABLE 1

Demographic and Key Variable Characteristics of Adolescents by Smoking Stage

Variable	Total Sample (N = 16,796)		1:Never Smoked (N = 7,392)	2:Experimenter (N = 4,624)	3:Intermittent (N = 2,830)	4:Reg/estab (N = 1,515)	5:Ex-Smoker (N = 435)
	N	%	%	%	%	%	%
Race							
White	8963	53.36	38.63	25.39	19.75	13.03	3.20
Black	3658	21.78	55.69	30.70	10.88	1.69	1.04
Hispanic	2739	16.31	45.38	30.38	16.28	5.55	2.41
Asian	927	5.52	51.24	27.62	12.94	5.72	2.48
Other	500	2.98	33.80	27.20	19.00	16.00	4.00
Age							
<= 16 years old	8159	48.58	50.04	26.88	15.61	5.42	2.05
> 16 years old	8632	51.39	38.28	28.16	18.03	12.43	3.10
Gender							
Male	8316	49.51	43.88	26.94	17.27	9.46	2.45
Female	8480	50.49	44.14	28.11	16.44	8.58	2.72
Peer Smoking							
No peers who smoke	9242	55.03	58.34	30.83	7.83	1.10	1.89
1 peer who smokes	3423	20.38	35.47	30.41	24.63	6.02	3.48
2 peers who smoke	1949	11.60	20.99	22.63	31.97	20.06	4.36
3 peers who smoke	2005	11.94	13.72	11.72	31.47	40.40	2.69
Maternal Smoking							
No	8540	50.85	51.07	26.74	14.33	5.40	2.46
Yes	7978	47.50	36.71	28.39	19.44	12.74	2.72
Paternal Smoking							
No	5978	35.59	51.32	26.16	14.45	5.64	2.43
Yes	9193	54.73	39.91	28.00	18.54	10.70	2.85
Parental Control							
<= 4	4913	29.25	52.03	26.36	14.49	5.17	1.95

Variable	Total Sample (N = 16,796)		1:Never Smoked (N = 7,392)	2:Experimenter (N = 4,624)	3:Intermittent (N = 2,830)	4:Reg/estab (N = 1,515)	5:Ex-Smoker (N = 435)
	N	%	%	%	%	%	%
= 5	3448	20.53	45.71	28.07	17.02	6.93	2.26
>= 6	8174	48.67	38.65	28.11	18.24	11.95	3.05
Parental Involvement							
<= 3	4777	28.64	44.71	27.97	15.60	9.13	2.60
4 - 5	5818	34.64	43.12	27.21	17.31	9.68	2.68
>= 6	5112	30.44	46.19	27.66	17.45	6.49	2.21
Maternal-Adolescent Activities							
0	5723	34.07	49.33	27.29	14.99	6.10	2.29
>= 1	10889	64.83	41.22	27.73	17.84	10.50	2.71
Paternal-Adolescent Activities							
0	8048	47.92	46.24	27.31	16.33	7.77	2.36
>= 1	6849	41.05	41.53	27.55	17.97	10.05	2.90

Note: Percentages may not add up to 100% due to missing data as well as rounding errors. Quartiles of quasicontinuous variables may not contain exactly 25% of the sample because of 'clumping'.

TABLE 2

Cumulative Odds Ratios: Fixed Effects Univariate Regression Models

	Maternal Report				Paternal Report			
	2,3,4 vs 1 OR	3,4 vs 1,2 OR	4 vs 1,2,3 OR	2,3,4 vs 1 OR	3,4 vs 1,2 OR	4 vs 1,2,3 OR
Race						
White *	1.51	0.51	0.15	1.50	0.57	0.19
Black	0.51	0.28	0.12	0.53	0.30	0.06
Hispanic	0.76	0.55	0.38	0.78	0.66	0.55
Asian	0.59	0.46	0.42	0.68	0.42	0.30
Other	1.25	1.11	1.34	0.96	1.10	1.00
Age						
<= 16 years old	0.96	0.27	0.06	1.00	0.33	0.07
> 16 years old	1.60	1.68	2.40	1.52	1.58	2.66
Gender						
Male *	1.22	0.38	0.11	1.23	0.39	0.10
Female	0.98	0.89	0.84	1.06	1.39	1.99
Friend Smoking						
No friends *	0.68	0.10	0.01	0.71	0.11	0.02
1 friend	2.55	4.65	6.50	2.13	4.14	4.11
2 friends	5.24	11.58	26.30	4.99	16.56	14.79
3 friends	9.11	28.31	71.23	7.34	24.96	24.75
Parental Smoking						
No *	0.91	0.25	0.06	0.83	0.27	0.07
Yes	1.83	1.97	2.49	1.93	2.04	2.52
Parental Control						
<= 4	0.88	0.25	0.05	1.04	0.33	0.07
+ 5	1.30	1.29	1.51	1.07	1.08	1.26
>= 6	1.72	1.79	2.76	1.36	1.54	2.52

	Maternal Report			**Paternal Report**		
	2,3,4 vs 1 OR	**3,4 vs 1,2 OR**	**4 vs 1,2,3 OR**	**2,3,4 vs 1 OR**	**3,4 vs 1,2 OR**	**4 vs 1,2,3 OR**
Parental-Adolescent Activities						
0	0.97	0.27	0.07	1.12	0.30	0.08
>= 1	1.40	1.50	1.70	1.20	1.72	1.93

Note: 1 = Never Smokers; 2 = Experimental Smokers; 3 = Intermittent Smokers; 4 = Regular/Established Smokers.

*
Baseline Cumulative Odds, OR, Odds Ratio.

TABLE 3

Multivariate Cumulative Odds Ratios: Mixed Effects Regression Model

Covariate	Maternal Model Contrast				Paternal Model Contrast			
	2,3,4 vs 1 OR (95% CI)	3,4 vs 1,2 OR (95% CI)	4 vs 1,2,3 OR (95% CI)		2,3,4 vs 1 OR (95% CI)	3,4 vs 1,2 OR (95% CI)	4 vs 1,2,3 OR (95% CI)
Intercept *	0.56 (0.50 -0.62)	0.10 (0.09 -0.12)	0.0009 (0.007 -0.011)		0.51 (0.36 -0.72)	0.07 (0.05 -0.12)	1.00 (0.01 -0.70)
Race							
White	1.00	1.00	1.00		1.00	1.00	1.00
Black	0.65 (0.59 -0.71)	0.37 (0.32 -0.42)	0.18 (0.13 -0.23)		0.68 (0.45 -1.00)	0.63 (0.36 -1.10)	0.09 (0.01 -0.70)
Hispanic	0.89 (0.81 -0.99)	0.65 (0.57 -0.74)	0.46 (0.37 -0.56)		0.87 (0.59 -1.28)		
Asian	0.69 (0.59 -0.80)				0.58 (0.38 -0.88)		
Other	1.11 (0.92 -1.35)				0.85 (0.45 -1.54)		
Age							
< 16 years old	1.00	1.00	1.00		1.00	1.00	1.00
> 16 years old	1.31 (1.00 -1.41)	1.24 (1.13 -1.36)	1.60 (1.30 -1.98)		1.21 (0.91 -1.61)	1.18 (0.83 -1.68)	2.23 (1.35 -3.68)
Gender							
Male	1.00	1.00	1.00		1.00	1.00	1.00
Female	0.78 (0.68 -0.91)	0.69 (0.58 -0.81)	0.59 (0.48 -0.73)		0.69 (0.45 -1.07)		
Friend Smoking							
No friends	1.00	1.00	1.00		1.00	1.00	1.00
1 friend	2.26 (1.96 -2.61)	4.18 (3.56 -4.94)	4.80 (3.61 -6.37)		1.71 (1.15 -2.53)	3.39 (2.11 -5.44)	3.06 (1.38 -6.75)
2 friends	4.52 (3.72 -5.50)	10.16 (8.24 -12.36)	18.19 (13.70 -24.15)		3.16 (1.89 -5.28)	12.03 (7.01 -20.65)	8.43 (3.65 -19.45)
3 or more friends	8.18 (6.53 -10.24)	25.83 (20.75 -32.15)	52.00 (39.11 -69.15)		4.97 (2.80 -8.83)	16.95 (9.85 -26.16)	18.92 (8.75 -40.90)
Parental smoking							

	Maternal Model Contrast			Paternal Model Contrast
No	1 ..	1.00	1.00	1.00
Yes	1.19 (1.02 -1.37)	1.17 (0 .99 -1.38)	1.60 (1 .30 -1.98)	1.63 (1 .26 -2.11)
Parental-Adolescent Activities	1.04 (0.96 -1.12)			1.08 (0.93 -1.25)
ParentalControl	1.19 (1.13 -1.24)			2.43 (1.16 -5.06)
Friend smoking * Gender				
1 friend	1.17 (1.00 -1.38)			2.43 (1.16 -5.06)
2 friends	1.01 (0 .83 -1.24)			2.95 (1.23 -7.06)
3 friends	1.33 (1.07 -1.66)			2.66 (1.25 -5369)
Friend * Parental Smoking				
1 friend	0.89 (0.76 -1.05)			
2 friends	0.94 (0.76 -1.15)			
3 friends	0.69 (0 .55 -0.86)			
ParentalSm oking * Gender	1.66 (1.36 -2.02)			
Activities * Gender	1.06 (0.95 -1.17)			
Activities *Parental Smoking	1.15 (1 .03 - * 1.28)			
Activities * Smoking * Gender	0.84 (0.73 -0.97)			

Note:1 = Never Smokers; 2 = Experimental Smokers; 3 = Intermittent Smokers; 4 = Regular/Established Smokers

* Baseline Cumulative Odds,OR = Odds Ration, CI= Confidence Interval

Table 4a

Friend Smokin by Adolescent's Gender (Maternal Model)

		Gender					
		Female			Male		
	2,3,4,vs 1	3,4 vs 1,2	4 vs 1,2,3	2,3,4 vs 1	3,4 vs 1,2	4 vs 1,2,3
Friend-smoking							
None	0.78	0.69	0.59	1.00	1.00	1.00
1 Friend	2.09	3.37	3.35	2.26	4.18	4.80
2 Friends	3.59	7.06	10.94	4.52	10.16	18.19
3 Friends	8.53	23.59	41.06	8.18	25.83	52.00

Table 4b

Friend Smoking by Adolescent's Gender (Paternal Model)

			Gender				
		Female			Male		
	2,3,4,vs 1	3,4 vs 1,2	4 vs 1,2,3	2,3,4 vs 1	3,4 vs 1,2	4 vs 1,2,3	
Friend-smoking							
None	0.69	0.69	0.69	1.00	1.00	1.00	
1 Friend	2.87	5.70	5.14	1.71	3.39	3.06	
2 Friends	6.49	24.68	17.29	3.16	12.03	8.43	
3 Friends	9.49	31.34	34.97	4.97	16.95	18.92	

Table 5

Friend Smoking by Maternal Model

			Maternal Smoking					
			Yes			No		
	2,3,4,vs 1	3,4 vs 1,2	4 vs 1,2,3	2,3,4 vs 1	3,4 vs 1,2	4 vs 1,2,3
Friend-smoking						
None	1.19	1.17	1.60	1.00	1.00	1.00
1 Friend	2.40	4.35	6.85	2.26	4.18	4.80
2 Friends	5.02	11.09	27.26	4.52	10.16	18.19
3 Friends	6.65	20.67	57.11	8.18	25.83	52.00

TABLE 6

Maternal-Adolescent Activities by Maternal Smoking by Adolescent Gender

		Number of Maternal-Adolescent Activities (Male adolescent gender)					
		2,3,4 vs 1	3,4 vs 1,2	4 vs 1,2,3	2,3,4 vs 1	3,4 vs 1,2	4 vs 1,2, 3
Maternal Smoking							
	Yes	1.41	1.38	1.90	1.19	1.17	1.60
	No	1.04	1.04	1.04	1.00	1.00	1.00
		Number of Maternal-Adolescent Activities (Female adolescent gender)					
Maternal Smoking							
	Yes	1.63	1.40	1.66	1.55	1.33	1.58
	No	0.86	0.75	0.65	0.78	0.69	0.59