The Intergenerational Transmission of Cigarette Smoking: Comparing Non-Hispanic White, Black and Hispanic Youth

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Abstract:

This study examines racial/ethnic differences in maternal smoking as a predictor of children's smoking behavior. Using latent trajectory analysis and a sample of mother-child dyads from the National Longitudinal Survey of Youth, we identified four trajectories of past 30 day smoking among youth ages 14-25. Using multinomial logit models, we identified factors predicting membership in these smoking trajectories and examined racial/ethnic differences in such predictors. Non-Hispanic black youth were at significantly lower risk than non-Hispanic white or Hispanic youth of membership in any of the three smoking trajectories (reference trajectory: "nonsmoker"). We found no racial/ethnic differences in the relationship of maternal smoking variables to membership in the "early start" and "late start" trajectories. However, two categories indicating ongoing maternal post-pregnancy daily smoking, with and without smoking during pregnancy, differed significantly as predictors of membership in the "early experiment" trajectory between non-Hispanic blacks and one or both other racial/ethnic groups.

Keywords:

Adolescent smoking, race/ethnicity, intergenerational transmission

1. Introduction

1.1. Racial and ethnic differences in levels of adolescent and maternal smoking

Nationally representative surveys consistently observe that white adolescents have the highest smoking prevalence, followed by Hispanics and then blacks (Johnston, O'Malley, Bachman, & Schulenberg, 2009; American Legacy Foundation, 2004; Kopstein, 2001). While white and Hispanic adolescents have experienced declines in the prevalence of past 30 day smoking (PTDS) every year since 2000, prevalence has increased for black 12th graders since 2004 (Johnston et al., 2009). Adolescence is an important window for smoking prevention efforts, as most tobacco initiation occurs during this period (Levy, Cummings, & Hyland, 2000; Elders, Perry, Eriksen, & Giovino, 1994). However, our understanding of racial and ethnic differences in the relationships between predictors and the smoking behavior of adolescents remains incomplete (Kandel, Kiros, Schaffran, & Hu, 2004; Avenevoli & Merikangas, 2003; U.S. Department of Health and Human Services, 1998).

One important predictor of youth smoking outcomes is maternal smoking. A number of studies have established that maternal smoking, both during pregnancy and subsequently, increases children's risk of smoking during adolescence (for a review, see Weden & Miles, 2011). However, it is not clear whether the relationship between the smoking behavior of mothers and their offspring varies by race/ethnicity. The relatively high levels of smoking by white adolescents is concordant with the fact that non-Hispanic white mothers are more likely than Hispanic or non-Hispanic black mothers to smoke during pregnancy (Tong, Jones, Dietz, D'Angelo, & Bombard, 2009) or while parenting minor children (Child Trends, 2010). However, this relationship does not hold similarly for differences between Hispanic and non-Hispanic black mothers and their children. Hispanic mothers have lower levels of SDP and in subsequent parenthood than non-Hispanic black mothers (Tong et al., 2009; Child Trends, 2010), but Hispanic adolescents are more likely to smoke than non-Hispanic blacks (Johnston et al., 2009; American Legacy Foundation, 2004; Kopstein, 2001). These findings suggest that the pattern of inter-generational transmission may differ by race and ethnicity.

1.2. Racial and ethnic differences in the relationship between maternal and adolescent smoking

Despite a number of longitudinal studies which have found SDP to be a significant predictor of adolescent smoking (Cornelius et al., 2005; F. V. O'Callaghan et al., 2006; Al Mamun et al., 2006; Roberts et al., 2005; Lawlor et al., 2005; Lieb et al., 2003; Griesler et al., 1998), we have not identified any study which examines racial/ethnic differences in the relationship between SDP and child's smoking behavior.

A number of studies have explored racial/ethnic differences in the role of mother's current or lifetime smoking (or more broadly parental or household smoking) as a predictor for child's smoking behavior. The results of such studies have been mixed. Some find differences in the strength or significance of maternal (or parental/household) smoking by race/ethnicity (Gritz et al., 2003; Griesler & Kandel, 1998; Landrine, Richardson, Klonoff, & Flay, 1994; Sussman, Dent, Flay, Hansen, & Johnson, 1987), while others do not (Robinson et al., 2006; Nichols, Birnbaum, Birnel, & Botvin, 2006; Kandel et al., 2004; C. C. Johnson et al., 2002; Gritz et al., 1998; F. B. Hu, Flay, Hedeker, Siddiqui, & Day, 1995; Flay et al., 1994; Headen, Bauman, Deane, & Koch, 1991). Still others reported ambivalent or mixed findings (Brook, Pahl, & Ning, 2006; Nichols, Graber, Brooks-Gunn, & Botvin, 2004).

There are a number of factors which may contribute to these inconsistent findings. First, we note that all four studies which find racial/ethnic differences in predictors do not report the results of any tests of statistical significance for differences in the magnitude of the effect (Gritz et al., 2003; Griesler & Kandel, 1998; Landrine et al., 1994; Sussman et al., 1987). Rather they report differences across race/ethnic groups in whether the maternal/parental smoking variable was significant, which does not necessarily imply significant differences in the magnitude of the effect (Gelman & Stern, 2006).

Another factor which may help explain the inconsistent findings is differences in sample representativeness. Only three of the existing studies (Kandel et al., 2004; Griesler et al., 2002; Griesler & Kandel, 1998) were based on nationally representative data. Although nationally representative data is important for producing generalizable results, it is not sufficient to clear up the inconsistencies among the

studies reviewed here. Two of these (Griesler & Kandel, 1998; Griesler et al., 2002) used the same national survey but came to differing conclusions regarding race/ethnic differences in maternal smoking as a predictor of adolescent smoking. Similarly, Nichols and co-authors (2004) came to differing conclusions within their study depending on the outcome; they found a significant interaction between perceived maternal smoking and daughters' smoking intentions, but no significant differences regarding daughters' ever smoking. The same study also found that only daughters' perception of maternal smoking, and not actual mother-reported current smoking was a significant predictor of daughters' smoking intentions. This brings us to the final factor which may explain inconsistencies regarding racial/ethnic differences in the relationship of maternal (or parental) smoking to adolescent smoking: differences in maternal and youth smoking measures.

The studies reviewed above use a number of different smoking measures for youth. These include ever (lifetime) smoking (Griesler et al., 1998; Gritz et al., 1998; C. C. Johnson et al., 2002; Nichols et al., 2004), current smoking (Griesler & Kandel, 1998; Gritz et al., 1998; C. C. Johnson et al., 2002), frequency or number of cigarettes (F. B. Hu et al., 1995; Landrine et al., 1994), smoking intentions (Nichols et al., 2004), susceptibility (Gritz et al., 1998, 2003), persistence (Griesler et al., 1998), initiation (Flay et al., 1994; Gritz et al., 2003; Headen et al., 1991; Kandel et al., 2004; Nichols et al., 2006; Sussman et al., 1987), various escalation transitions (Flay et al., 1994; Kandel et al., 2004; Robinson et al., 2006) and smoking trajectories (Brook et al., 2006). Regarding maternal or parental smoking, the majority of studies use youth-reported perceptions of current (Brook et al., 2006; Flay et al., 1994; Gritz et al., 1998, 2003; Headen et al., 1991; F. B. Hu et al., 1995; C. C. Johnson et al., 2002; Landrine et al., 1994; Nichols et al., 2004; Robinson et al., 2006; Sussman et al., 1987) or lifetime (Kandel et al., 2004) parental smoking, while two use mother-reported current and lifetime smoking (Griesler et al., 2002; Griesler & Kandel, 1998), and one study used both child and mother reports of mother's current smoking (Nichols et al., 2004). All of the studies we identified used only measures of maternal (or parental) current and/or lifetime smoking, whether reported by the child or mother. None assesses race/ethnic differences in SDP as a predictor of child smoking.

2. Methods

Our approach to examining racial/ethnic differences in the intergenerational transmission of smoking addresses a number of limitations in the existing literature. As described in more detail in section 2.1, we use a longitudinal, nationally population representative sample of mother-child dyads with multiple, prospective measures of both mother and youth smoking behavior. We use recently developed latent trajectory class methods (Muthén, 2008, 2001) to classify youth into developmental trajectories of smoking, rather than separately modeling various transitions in smoking behavior (White, Nagin, Replogle, & Stouthamer-Loeber, 2004; Mayhew, Flay, & Mott, 2000). We model race/ethnic groups separately and test for statistically significant differences in predictor variables across groups (Gelman & Stern, 2006). We use a detailed set of self-reported maternal smoking variables which include SDP and data on mothers' daily smoking and cessation before and after pregnancy.

2.1 Data

Data come from the Children and Young Adults of the National Longitudinal Survey of Youth 1979 cohort (NLSY79-CYA), a panel survey of all offspring of women in a population-representative cohort (NLSY79) commissioned by the U.S. Bureau of Labor Statistics (Bureau of Labor Statistics, 2005). The NLSY79-CYA employs a biennial, cohort-sequential design in which children born to NLSY79 women have been followed. The NLSY79-CYA thus includes multiple birth cohorts and children-per-mother. The present study utilizes public-use data which does not include individually identifying information. Details of the NLSY procedures for confidentiality and obtaining respondents' informed consent to participate are available in survey documentation (Bureau of Labor Statistics, 2005; Center for Human Resource Research, 2006). We select respondents age 14 to 25 observed at any of the biennial surveys between 1994 and 2006 (i.e. birth cohorts 1970-1992). Children under age 15 were eligible for child interview if their "usual residence" was with the NLSY79 respondent mother. "Young adults" (YA) were eligible for YA interview at ages 15 or greater, regardless of residence at time of YA

interview, if there was at least one child interview record (and thus period of residing with their mother) at ages 0 to 14 (Center for Human Resource Research, 2006). The NLSY79-CYA yearly completion rates range from 83.0% to 88.4% (Center for Human Resource Research, 2006). By the 2006 survey, 6643 youth age 14 and older were eligible for the NLSY79-CYA and had been located for at least one interview between 1994 and 2006. From this sample, 6349 youth responded to questions about cigarette smoking at least once.

Youth smoking trajectories over age 14-25 were characterized employing latent trajectory analysis (LTA) (Muthén, 2001) and the set of computer assisted personal interviewing (CAPI) reports of smoking during the past 30 days (SPTD), as described in detail elsewhere (Weden & Miles, 2011). Youth were assigned to the trajectory for which their posterior probability of membership was highest in the LTA model (Muthén, 2001). The LTA parameters for the likelihood of SPTD at each age were used to describe and label the four latent smoking trajectory classes as "early start," "early experiment," "late start," and "nonsmoker." Early start (14.6% prevalence) has rates of SPTD that increase rapidly from 30% to 90% between age 14 and 16, and remain high at each subsequent age through young adulthood (87% at age 25). Early experiment smokers (2.6% prevalence) have a similar age-pattern of SPTD between age 14 and 16, but then the rates of SPTD drop back to 30% by age 21 and remain at an average of 35% through age 25. Their age-trajectory suggests early initiation of smoking followed by quitting during the transition to adulthood. Late start smokers (18.7% prevalence) report essentially no SPTD prior to age 16, but then have dramatically increasing rates (climbing from zero to 69% over age 16 to 19), with continued increases to age 25, when 90% report SPTD. Their age-trajectory of SPTD suggests later initiation of smoking than early start or early experiment, followed by continued use. Nonsmokers (64.1% prevalence) report very low to no SPTD at every age. The average rate of SPTD over age 14-25 was 2%.

Mother's smoking history is constructed using mother's responses regarding "daily" smoking in the NLSY79 substance use history supplements taken in 1992, 1994, and 1998 together with reports of any smoking during pregnancy from the NLSY79 birth history taken within one year of the child's birth and an identical retrospective question in the 2004 NLSY79-CYA (Weden & Miles, Forthcoming).

Respondents whose mother never smoked daily but SDP less-than-one pack-per-day (n=32) are excluded from the sample. The six exposure categories are listed in Table 1: never smoked daily or during pregnancy (45.2%); quit daily before birth of child and no SDP (7.4%); no SDP but relapse to daily smoking after birth (10.0%); no SDP, relapse, but then quit daily smoking (6.6%); smoked any cigarettes during pregnancy and smoked daily after birth, but quit (6.7%); and smoked any cigarettes during pregnancy and smoked daily after birth (24.2%).

The measures of race/ethnicity used here are based on self-identification by the adolescents on the NLSY Young Adult (YA) questionnaires for years 1994-2006[1].We coded all respondents into four race/ethnicity categories: Hispanic, non-Hispanic white (hereafter referred to simply as "white"), non-Hispanic black (hereafter "black"), and non-Hispanic other race (hereafter "other race"). We coded as Hispanic all respondents who identified as Hispanic in the 1994 or 1996 race/ethnicity question or the 1998-2006 Hispanic origin question. Additionally, respondents were coded Hispanic if they indicated a Hispanic "origin or descent" on the detailed ethnic origin item[2]. Any respondent who was not coded Hispanic and chose "black" on the race question was coded as black. Any respondent who was not coded Hispanic or black and who chose "white" on the race question, but did not choose any other race in years 2000-2006 was coded white. Remaining respondents with non-missing race information were coded as other race. Other race is excluded from the present analysis due to its small sample size (n=113).

Variables used to control for the youth's sociodemographic background entail the gender of child, the mother's nativity (country of birth), mother's age at the child's birth, mother's educational attainment (when the child was 14) and the mother's marital status (when the child was age 14).

2.2 Participants

Summary statistics, including the proportion with missing data, are reported in Table 1.

[1] These self-reported race/ethnicity items should not be confused with the variables "CRACE" or "YARACE," which are based on interviewer assessments of the *mother's* race in the 1979 screener.
[2] Detailed ethnic origin responses coded "Hispanic" were "Cuban," "Chicano," "Mexican," "Mexican-American," "Puerto Rican," "other Latino", or "other Spanish."

There were notable racial/ethnic differences in youths' sociodemographic background. Hispanic youth were much more likely to have a foreign-born mother (19.5%) than blacks (1.2%) or whites (2.4%). The mothers of white youth were older (mean: 24.3 years) when they gave birth to the child than blacks (22.2 years) or Hispanics (23.3 years). At age 14, white youth had the most educated mothers, followed by blacks and then Hispanics. At this same age, white youths' mothers were also most likely to be married (74.5%) followed by Hispanics (61.8%) and then blacks (32.6%). Mothers of black youth were the most likely to have never married (29.7%) or divorced (37.7%), followed by Hispanics (7.2% and 31.0% respectively) and then whites (1.8% and 23.7% respectively).

[Table 1 about here]

2.3 Statistical Procedures

The final analytical sample (n=5406) excluded respondents with missing data on the maternal smoking pattern (n=518) or controls for youth's sociodemographic background (n=260). We first calculated summary statistics on the distribution of youth smoking trajectories, maternal smoking patterns, and the youth's sociodemographic background for the total population and by race/ethnicity (Table 1). Racial/ethnic differences were identified using Pearson chi-squared tests. Then, we used multinomial logit regression models to evaluate whether there were racial and ethnic differences in youth smoking trajectories and their relationship with maternal smoking patterns and sociodemographic characteristics. Racial/ethnic differences in the relationship between the maternal smoking patterns and youth smoking trajectories were considered by first estimating models separately for each racial/ethnic group. The resulting models were combined using Stata's "seemingly unrelated estimation" procedure, which then allowed relatively simple testing for statistically significant differences in the relative risk

ratios[3] (RRR) for each predictor across racial/ethnic groups (StataCorp, 2009; Weesie, 1999; Gelman & Stern, 2006).

All analyses were implemented using StataSE 11 (StataCorp, 2009), with survey weights to adjust for the NLSY79-CYA complex sampling design and differential non-response across waves (Bureau of Labor Statistics, 2005) and corrected standard errors to address clustering by siblings.

3. RESULTS

3.1 Youth Exposure to Maternal Smoking Patterns and Sociodemographic Disadvantage by Race/ethnicity

Table 1 displays the distribution of the maternal smoking patterns and sociodemographic background of the sample by the youth's race/ethnicity. With the exception of gender, the differences in youths' exposure to maternal smoking and their sociodemographic background differed significantly by race/ethnicity. Across all racial/ethnic groups, never smoked daily was the most frequent maternal smoking pattern, but only among the mothers of black (50.3%) and Hispanic (53.2%) youth was it the majority, with the lowest rates among whites (42.8%). Across all racial/ethnic groups, SDP and continuing to smoke was the second most frequent maternal smoking pattern, with the highest frequency among whites (25.0%), then blacks (22.2%), and lastly Hispanics (16.6%). Relapsing to smoking after the child's birth was the third most common pattern, at 9% to 11% irrespective of race/ethnicity. For whites, the prevalence of quit before pregnancy was also about 9%, almost twice the frequency among Hispanics (5.5%) and nearly four-times the frequency among blacks (2.4%).

3.2 Racial/Ethnic Differences in Youth Smoking Trajectories

Table 1 shows that not only are there statistically significant differences in the distribution of youth smoking trajectories by race/ethnicity, but that there are also differences in exposure to maternal

[3] Relative risk ratios are exponentiated multinomial logit coefficients, similar to odds ratios in (binomial) logistic regression models, except that they represent a ratio of probabilities, rather than odds.

smoking and sociodemographic background by race/ethnicity. In Table 2, we evaluate whether there are persisting racial/ethnic differences in youth smoking trajectories, adjusting for maternal smoking patterns and sociodemographic background.

[Table 2 about here]

Model 1 shows that white and Hispanic youth were more likely than black youth to have smoking histories from age 14 to 25 that resulted in their assignment to the early start, early experiment, or late start trajectories relative to the nonsmoker trajectory. They were 3 to 3.5 times more likely to be early start versus nonsmokers, nearly 4 to 5 more likely to be early experiment versus nonsmokers, and about 60% more likely to be late start versus nonsmokers. Relative to the late start trajectory (results not reported in Table 2), whites and Hispanics were also significantly more likely to be assigned to the early start trajectory (2.3 and 1.9 times more likely) or to the early experiment trajectory (3.1 and 2.4 times more likely, respectively). There were no significant white/Hispanic differences in assignment to any of the smoking trajectories relative to nonsmokers, nor were there any race/ethnic differences regarding assignment to the early start trajectory relative to the early experiment trajectory.

In Model 1, we also found that several of the sociodemographic control factors which were distributed differentially by race/ethnicity, were statistically significant predictors of the youth's smoking trajectory. Mother's age at birth was modeled as a quadratic, with risk of membership in all 3 smoking trajectories (relative to nonsmoker) decreasing as maternal age increases beyond 20 years. Relative to children of married mothers, never married mothers were at 1.35 times greater risk of assignment to the late start trajectory and 1.82 times greater risk of assignment to the early start trajectory (versus nonsmoker). Similarly, divorced mothers were at 1.44 times greater risk of assignment to the early start trajectory.

3.3 Racial/ethnic differences in sociodemographic factors as predictors of youth smoking

In Models 2-4, we stratify the analyses by race/ethnicity, allowing us to examine racial/ethnic differences in the relationships of predictors to membership in the 4 trajectories. Note that there are empty cells (zero observations) for the combinations of the early experiment trajectory and the "quit before pregnancy" variable for blacks and Hispanics and for the mother foreign-born variable for blacks. We do not report RRRs for these combinations of predictors and outcomes because of uncertainty as to their correct values, nonetheless the overall model fit should be unaffected and the model acceptable for understanding the overall relationship of all predictors (with non-zero cells) to the youth smoking trajectories (Menard, 2002).

We first note that the pattern of gender differences in youth smoking trajectories varies by race/ethnicity. Males were significantly more likely than females to be assigned to early start or late start trajectories versus the nonsmoker trajectory across all racial/ethnic groups. However, this gender difference was nearly 2 times larger among Hispanics (RRR=2.114 for early start, RRR=2.247 for late start) than whites (RRR=1.127 for early start, RRR=1.287 for late start)[4]. Furthermore, although white and Hispanic males were less likely than females to be assigned to the early experiment than the nonsmoker trajectory, the reverse was observed for blacks. Black males were over 3.6 times more likely to be assigned to the early experiment trajectory than white males (P = 0.003) or Hispanic males (P = 0.045).

With regards to mother's sociodemographic characteristics, we identified a small number of racial/ethnic differences. Most pronounced was mother's marital status. The risk of membership in the early start trajectory was 3.25 time higher for whites than Hispanics with never married mothers (P = 0.025) and 2.15 times higher for whites than Hispanics with divorced mothers (P = 0.016). Regarding mother's educational attainment, the only significant racial/ethnic difference was that among youth with mothers with less than a high school education, whites were nearly twice as likely as blacks to be

[4] The *p* value for the gender Hispanic/white difference was 0.020 for both the early start and late start trajectories (versus nonsmoker).

assigned to the early experiment trajectory (P = 0.042). Although point estimates for the relationship of foreign-born mothers to youth smoking trajectories varied considerably across racial/ethnic groups, in no case did such differences reach statistical significance at the P < 0.05 level[5]. There were also no significant racial/ethnic differences in the risks associated with mother's age at birth.

3.4 Racial/ethnic differences in maternal smoking as a predictor of youth smoking trajectories

In Table 2 we present findings for the relationship between mothers smoking pattern and youth smoking trajectories for the total sample (Model 1), and in models by race/ethnicity for whites (Model 2), blacks (Model 3), and Hispanics (Model 4). There were few statistically significant differences by race/ethnicity in the RRRs for mother's smoking history variables. The risk of membership in the early experiment trajectory was significantly lower for black youth whose mothers' relapsed (without quitting) post-pregnancy compared to Hispanic (P = 0.018) or white (P = 0.020) children of mothers with the same smoking history. Similarly, blacks with mothers who SDP (without quitting) were significantly less likely to be assigned to the early experiment trajectory than whites with the same maternal smoking history (P = 0.039). There were no significant differences in the relationship of mother's smoking history to youth smoking trajectories between whites and Hispanics. Nor were there any statistically significant differences between any racial/ethnic groups in the relationship between the mother's smoking history variables and the youths' relative risk of membership in either the early start or late start trajectories. While there are racial/ethnic differences in the relationship between two specific categories of mother's smoking history and the risk of membership early experiment trajectory, the joint significance of racial/ethnic difference of all four of the mothers' smoking history categories without empty cells (i.e., not including the "quit before pregnancy" category) for membership in this trajectory do not reach the P < 0.05 level for any comparison of groups (black vs. white, black vs. Hispanic or white vs. Hispanic). Also, in analysis (results not reported here) which combined the mother "quit before pregnancy" category with

[5] Due to the uncertain estimate due to zero observations of black youth with foreign-born mothers, we are not including this estimate in our racial/ethnic comparisons.

the mother "never daily smoker" (reference) category, joint tests of the significance of racial/ethnic differences in the relationship between all four mother smoking history variables also did not reach significance at the $P < 0.05$ in any case.

All statistically significant racial/ethnic differences in maternal smoking predictors relate to the early experiment trajectory. While mothers' SDP or post-pregnancy smoking without quitting did not increase black youths' risk of such experimentation as it did for whites (SDP without quitting) or whites *and* Hispanics (relapse without quitting), such protective effects with regard to experimentation were not coupled with any significantly reduced risk of membership in the two heavier smoking trajectories, early start and late start. To the contrary, although the differences are not statistically significant, the point estimates suggest that black children with mothers in these two categories of smoking history were at higher risk than whites of membership in both the early start and late start trajectories, and at higher risk than Hispanics for membership in the early start trajectory relative to the nonsmoker trajectory.

4. DISCUSSION

This study makes several contributions to the literature on racial and ethnic differences in youth smoking and on the intergenerational transmission of smoking. First, we contribute to the growing literature that has employed latent trajectory models to differentiate longitudinal patterns of entry and exit and/or progression of youth cigarette smoking (Abroms, Simons-Morton, Haynie, & Chen, 2005; Audrain-McGovern et al., 2004; Bernat, Erickson, Widorne, Perry, & Forster, 2008; Chassin, Presson, Pitts, & Sherman, 2000; Colder et al., 2001; Karp, O'Loughlin, Paradis, Hanley, & Difranza, 2005; Lessov-Schlaggar et al., 2008; Orlando, Tucker, Ellickson, & Klein, 2004; Pollard, Tucker, Green, Kennedy, & Go, 2010; Riggs, Chou, Li, & Pentz, 2007; Soldz & Cui, 2002; Weden & Miles, 2011). Only three of these have employed a U.S. representative sample of youth (Costello, Dierker, Jones, & Rose, 2008; Pollard et al., 2010; Weden & Miles, 2011). The trajectories which we observe are consistent with the characteristics and prevalence of youth smoking groups identified previously (Abroms et al., 2005; Audrain-McGovern et al., 2004; Bernat et al., 2008; Chassin et al., 2000; Colder et al., 2001; Costello et

al., 2008; Karp et al., 2005; Lessov-Schlaggar et al., 2008; Orlando et al., 2004; Pollard et al., 2010; Riggs et al., 2007; Soldz & Cui, 2002; Weden & Miles, 2011).

Second, the present study is the first which uses nationally representative data to examine differences in youth smoking trajectories by youth's self-reported racial/ethnic identity. We find that blacks have a significantly lower risk than either whites or Hispanics of being members of any of the three smoking trajectories versus the nonsmoker trajectory, while there are no significant differences between whites and Hispanics net of the control variables in the models.

Our third contribution is to explore racial/ethnic differences in a detailed set of maternal smoking variables, including measures of both SDP and cessation, as predictors of youth smoking trajectories. We are not aware of any study which examines racial/ethnic differences in such a detailed set of maternal smoking variables as predictors of any youth smoking outcome. Our approach involves separate multinomial logit models for each racial/ethnic group, which produce a set of relative risk ratios (RRRs) for the relationship between mother's smoking history indicator variables and youth smoking trajectories. We then combine these models using Stata's "seemingly unrelated estimation" (suest) procedure, and test for statistically significant differences in the RRRs which would indicate significant differences in maternal smoking as a predictor of youth smoking across racial/ethnic groups. We find no racial/ethnic differences in any of the maternal smoking indicator variables as predictors of youth membership in either of the two heaviest smoking trajectories, early start or "late start." While we did find significant racial/ethnic differences in the strength of two of the maternal smoking indicator variables as predictors of membership in the early experiment trajectory, we did not find joint significance for racial/ethnic differences in mother smoking variables (excluding the "quit before pregnancy" indicator due to the zero cells for blacks and Hispanics and uncertainty as to the correct values of these RRRs[6]).

[6] As noted above, in analysis not reported here, we combined the small "mother quit before pregnancy" category with the reference "never daily smoker" category and found no jointly significant racial/ethnic differences (at the $P < 0.05$ level) in the full set of remaining mother smoking indicator variables relative to the combined reference category.

As such we conclude that the evidence does not indicate significant differences in the *overall* relationship between maternal smoking patterns and youth smoking trajectory. We note that the consistency in this relationship across race/ethnic groups suggests that our estimates of intergenerational transmission, controlling for a limited set of control variables, are largely capturing a physiological or genetic effect which does not differ with social or cultural factors. However, additional research across diverse populations would be needed to establish conclusively that patterns of intergenerational transmission of smoking, as we have modeled them here, are invariant across social and cultural groups.

We also note a number of limitations of the present study. First, the sample employed for this study was large, but the low prevalence of the early experiment trajectory (n=134) has limited statistical power in analyses including this group. Combined with the relatively low prevalence of the maternal smoking "quit before pregnancy" group (n=334), zero cells for black and Hispanic youth result in uncertain estimates of the relative risks for these combinations. It is possible that an analysis of a larger sample would indicate overall significant racial/ethnic differences in the relationship of the full set of mother's smoking history variables to membership in the early experiment trajectory. Similarly, small sample sizes of respondents in other race/ethnic groups prevented comparisons of these groups with the three largest groups represented in the present study. Second, all smoking measures employ self-reported data. Despite this limitation, self-report has been shown to provide a reasonable estimate of actual smoking (Chan, 2008; Dolcini, Adler, Lee, & Bauman, 2003), and the NLSY79-CYA employs CAPI to reduce reporting bias. Furthermore, because the data on youth smoking is reported biennially, our trajectories cannot capture short-term fluctuations in cigarette behavior but rather describe overarching patterns of youth smoking across adolescence and young adulthood. However, regarding maternal smoking, the primary source of SDP data comes from reports within one year of the child's birth, addressing a limitation of long recall times discussed elsewhere (Kandel & Udry, 1999; F. V. O'Callaghan et al., 2006). Due to the cohort structure of the NLSY79-CYA sample, the richest portion of data covers the period age 14 to 16, and thus may be less representative of smoking patterns in early adulthood than have been described in previous population representative studies (Costello et al., 2008;

Pollard et al., 2010). Also, no data on nicotine dependence is available for either mothers or children in the NLSY-CYA data. Finally, we were unable to assess the role of father's smoking and exposure to second-hand smoke in the household, which may exacerbate the genetic, physiological, and social mechanisms for intergenerational transmission. That said, previous studies have found maternal effects are stronger than paternal (Distefan, Gilpin, Choi, & Pierce, 1998; Griffin, Botvin, Doyle, Diaz, & Epstein, 1999; Kandel, Wu, & Davies, 1994).

Healthy People 2020 identifies the reduction of cigarette smoking among adolescents, young adults and pregnant women as important public health objectives (U.S. Department of Health and Human Services, 2010). In 1998, the Surgeon General called for research on racial and ethnic differences in predictors of smoking and the extent to which culturally specific interventions are needed to reduce tobacco use (U.S. Department of Health and Human Services, 1998). Our findings strengthen the evidence that the relationship between maternal smoking and youth smoking does not vary by race/ethnicity (Flay, Hu, et al., 1994; Griesler et al., 2002; Gritz et al., 1998; Headen et al., 1991; F. B. Hu et al., 1995; Kandel et al., 2004; Nichols et al., 2006; Robinson et al., 2006; but see Brook et al., 2006; Griesler & Kandel, 1998; Gritz et al., 2003; Landrine, Richardson, et al., 1994; Nichols et al., 2004; Sussman et al., 1987), and thus that universal interventions to reduce maternal smoking are likely to reduce adolescent smoking across all three racial/ethnic groups studied. However, our findings that postnatal maternal daily smoking and any level of SDP are both strong predictors of youth smoking suggest that prevention and cessation efforts should be aimed at women before they become pregnant, that is, at women of childbearing age. As such, efforts to reduce smoking among adolescent and young adult females may pay a double dividend: effective interventions will reduce smoking among today's young women, as well as reducing the risk that their children will smoke when they reach adolescence.

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Table 1: Summary Statistics (Weighted)

	All	NH White	NH Black	Hispanics	Difference	Item
	%/mean (SD)	%/mean (SD)	%/mean (SD)	%/Mean (SD)	Chi² P($\chi^2 \geq X^2$)	non-response
Race/ethnicity						0.06%
Non-Hispanic White	70.3%	100.0%	0.0%	0.0%		
Non-Hispanic Black	17.4%	0.0%	100.0%	0.0%		
Hispanic	12.4%	0.0%	0.0%	100.0%		
Male	51.1%	51.0%	49.9%	53.5%	0.322	0.00%
Youth Smoking Trajectory					0.000	0.00%
Early Start	14.6%	16.1%	8.1%	15.0%		
Early Experiment	2.6%	2.9%	1.0%	2.6%		
Late Start	18.7%	17.9%	20.3%	21.1%		
Non-Smoker	64.1%	63.0%	70.6%	61.4%		
Maternal Smoking History					0.000	8.38%
Never Daily	45.4%	42.8%	50.3%	53.2%		
Quit Before Pregnancy	7.6%	9.3%	2.4%	5.5%		
Relapse	9.9%	9.4%	11.8%	10.3%		
Relapse then Quit	6.8%	6.2%	7.4%	9.9%		
SDP then Quit	6.7%	7.3%	5.9%	4.5%		
SDP	23.5%	25.0%	22.2%	16.6%		
Mother Foreign-Born	4.3%	2.4%	1.2%	19.5%	0.000	0.00%
Mother's Age at Birth	23.77	24.25	22.20	23.25	0.000	0.00%
	(4.31)	(3.24)	(6.04)	(5.92)		
Mother's Education†					0.000	3.44%
Less than HS	12.8%	9.4%	19.3%	22.6%		
High School	47.2%	48.7%	44.6%	42.7%		
More than HS	40.0%	41.9%	36.1%	34.8%		
Mother's Marital Status†					0.000	5.03%
Never Married	7.3%	1.8%	29.7%	7.2%		
Married	65.6%	74.5%	32.6%	61.8%		
Divorced	27.1%	23.7%	37.7%	31.0%		
N (unweighted)	5406	2267	1815	1324		6184

Notes:
Weighted and corrected for clustering on mothers.
Testing of differences across race/ethnicity based on Pearson's chi-squared statistics.
Item non-response expressed as a percentage of all cases with youth smoking data, excluding other race.
"Non-Response" for maternal smoking history includes 32 excluded cases of mothers who smoked less than 1 pack/day during pregnancy (SDP) but never reported daily smoking.
† Measured at child's age 14.

Table 2: Adjusted Relative Risk Ratios of Smoking Trajectory Membership

	Early Start				Early Experiment				Late Start			
	Model 1 All	Model 2 Whites	Model 3 Blacks	Model 4 Hispanics	Model 1 All	Model 2 Whites	Model 3 Blacks	Model 4 Hispanics	Model 1 All	Model 2 Whites	Model 3 Blacks	Model 4 Hispanics
Non-Hispanic White	3.503				4.871				1.557			
	(< .001)				(< .001)				(< .001)			
Hispanic	3.089				3.959				1.666			
	(< .001)				(< .001)				(< .001)			
Male	1.250	**1.127¤**	1.527	**2.114¤**	0.642	**0.523••**	**2.556••+**	**0.691+**	1.460	**1.287¤**	1.824	**2.247¤**
	(.032)	(.351)	(.054)	(.002)	(.038)	(.014)	(.041)	(.433)	(< .001)	(.040)	(< .001)	(< .001)
Mother Smoking History (Ref= Never daily & No SDP)												
Quit before Pregnancy	1.936	2.137	0.663	1.132	2.770	3.622	#	#	1.213	1.095	1.458	2.081
	(.005)	(.005)	(.590)	(.834)	(.035)	(.014)	#	#	(.403)	(.747)	(.490)	(.102)
Relapse	2.441	2.409	2.987	2.370	2.542	**3.029•**	**0.191•+**	**3.334+**	1.811	1.717	1.802	2.413
	(< .001)	(< .001)	(.006)	(.021)	(.007)	(.010)	(.136)	(.012)	(< .001)	(.010)	(.004)	(.006)
Relapse then Quit	1.764	2.048	1.099	1.169	1.268	1.254	1.165	1.877	1.645	1.639	1.828	1.490
	(.014)	(.016)	(.837)	(.735)	(.608)	(.736)	(.850)	(.299)	(.005)	(.056)	(.031)	(.231)
SDP then Quit	2.159	2.520	1.477	1.063	2.255	2.556	0.707	3.927	1.890	2.200	1.254	0.957
	(.001)	(< .001)	(.373)	(.921)	(.098)	(.125)	(.740)	(.117)	(.001)	(.001)	(.490)	(.935)
SDP	3.008	2.955	3.102	2.858	2.001	**2.264•**	**0.508•**	1.880	1.596	1.397	1.955	2.462
	(< .001)	(< .001)	(< .001)	(.005)	(.021)	(.031)	(.274)	(.258)	(< .001)	(.053)	(< .001)	(.009)
<u>Mother's Characteristics</u>												
Mother Foreign Born	0.795	0.797	2.190	0.701	0.730	0.395	#	1.283	0.632	0.458	0.292	0.826
	(.404)	(.613)	(.280)	(.309)	(.471)	(.369)	#	(.554)	(.017)	(.056)	(.142)	(.428)
Mother's Age at Birth	2.270	2.214	1.972	2.936	3.250	3.665	1.720	4.737	1.830	1.795	2.003	1.930
	(< .001)	(< .001)	(.027)	(.002)	(.004)	(.011)	(.510)	(.046)	(< .001)	(.001)	(< .001)	(.022)
Mother's Age at Birth Squared	0.980	0.980	0.984	0.974	0.968	0.966	0.982	0.960	0.983	0.984	0.981	0.982
	(< .001)	(< .001)	(.024)	(< .001)	(< .001)	(.003)	(.348)	(.024)	(< .001)	(< .001)	(< .001)	(.004)
Mother's Education Level†												
Less than High School	1.296	1.230	1.848	1.240	1.068	**1.308•**	**0.149•**	0.660	1.030	0.934	1.347	1.048
	(.108)	(.355)	(.023)	(.492)	(.842)	(.515)	(.053)	(.344)	(.833)	(.766)	(.112)	(.863)
Greater than High School	0.872	0.826	0.701	1.413	0.872	0.893	0.594	0.866	0.808	0.759	0.893	0.966
	(.289)	(.227)	(.232)	(.242)	(.625)	(.735)	(.301)	(.799)	(.050)	(.054)	(.485)	(.888)
Mother's Marital Status†												
Never Married	1.823	**2.553¤**	1.256	**0.785¤**	1.059	0.781	3.822	0.593	1.349	1.461	1.246	0.839
	(.002)	(.003)	(.457)	(.575)	(.892)	(.807)	(.044)	(.500)	(.045)	(.379)	(.219)	(.543)
Divorced	1.440	**1.673¤**	0.903	**0.775¤**	1.071	1.057	2.959	0.788	1.183	1.343	1.033	0.820
	(.004)	(< .001)	(.749)	(.369)	(.785)	(.861)	(.128)	(.613)	(.133)	(.049)	(.848)	(.399)
N	5406	2267	1815	1324	5406	2267	1815	1324	5406	2267	1815	1324

Relative Risk Ratios (RRRs); *p* values in parentheses refer to significance *within* model relative to reference category

Racial/ethnic differences (*across* models) significant at $p < .05$ in **bold** and indicated as follows:

• white/black difference $p < .05$; •• white/black difference $p < .01$; ¤ white/Hispanic difference $p < .05$; **+** black/Hispanic difference $p < .05$

No white/black differences significant at $p < .001$; No white/Hispanic or black/Hispanic differences significant at $p < .01$

† Measured at child's age 14, # uncertain value due to empty cell (zero observations).