Early-Life Characteristics and Educational Disparities in Smoking

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Abstract

Educational inequalities in adult health outcomes are well-established, but it remains unclear when and how these disparities emerge across the life course. We use the 1970 British Cohort Study (BCS) to examine the links between early life characteristics (cognitive, non-cognitive, psychosocial, socioeconomic, and health-related) and emergent disparities in smoking. We examine whether characteristics from childhood explain differences in never smoking regularly at ages 16 and 26 by the education respondents eventually obtain. Linear probability estimates based on a life course analytic sample (N=1718, using characteristics from ages 0, 5, 10, 16, and 26) reveal that cognitive, socioeconomic, and health-related factors taken together explain little of the education-smoking link. However, characteristics from adolescence such as school attachment and having friends who smoked explain about half (49%) of the education-smoking association at age 16 and explain most of the association (73%) at age 26. A multinomial logistic model reveals the unique as well as joint predictors of educational and smoking outcomes. Further analyses using an extended vector of life course covariates from age 10 uphold our findings, as does inverse probability weighting based on a selection model for our life course analysis.

Keywords: Education, Smoking, Life Course, Health Disparities

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Introduction

The association between education and health in adulthood, including self-rated health, disease burden, and physical limitations, is one of the most robust findings in the population health literature (Cutler and Lleras-Muney 2010; Pampel, Krueger and Denney 2010). Still, it remains unclear when and how educational disparities in health emerge across the life course (Elo 2009; Pampel et al. 2011). While educational differences in health behaviors such as diet, exercise, and smoking contribute substantially to mid- to late-life inequalities in morbidity and mortality (Cutler and Lleras-Muney 2010; Pampel et al. 2010), adult health is also shaped by factors originating in childhood and adolescence (Braveman and Barclay 2009). Indeed, a key component of understanding educational disparities in adult health is explaining the fact that educational inequalities in health behaviors such as smoking, physical activity, and diet are present well before education is actually completed (Maralani 2014). Thus, education and health in adulthood may be correlated because early educational experiences can shape early health behaviors, health-related factors and schooling decisions may be jointly determined, or education and health might have a reciprocal relationship (Conti and Heckman 2010; Maralani 2014; von Hippel and Lynch 2014; Smith 1999).

In developed nations, smoking is the most important behavioral risk factor for mortality, explaining as many as one-fifth of all deaths each year (CDC 2008; Marmot 2006). Smoking accelerates death through acute myocardial infarction (Morton et al. 2014) or debilitating conditions such as cancer, vascular or respiratory disease (Mokdad, Marks, Stroup and Gerberding 2004; Pampel 2005). Gaining a better understanding of the education-smoking link, therefore, is a pivotal step in illuminating educational disparities in overall health and well-being.

In this study, we draw on representative longitudinal data from a UK birth cohort that includes life course histories of smoking into adulthood. While prior work has characterized age-specific educational disparities in health behaviors among adolescents and adults, it has been hampered by a lack of data from the pre-teen years, and it has yet to focus squarely on smoking initiation as an evolving process based on educational and life course factors. Without data linking childhood to adulthood, it has been impossible to study in detail the potential factors that might explain how education and smoking become intertwined across the early life course.

The 1970 British cohort data offer extensive early-life measures of cognitive, non-cognitive, psychosocial, socioeconomic, and health characteristics beginning at birth and continuing through adolescence and adulthood. Using these data, we examine whether disparities in smoking initiation by the education respondents eventually obtain is explained by characteristics present early in the life course. Using this approach, we are better able to pinpoint how and when educational differences in smoking initiation occur, based on characteristics and endowments that are present before and during the process of schooling.

Background

Numerous studies document substantial associations between education and adulthood physical health at the population level (for reviews, see Adler and Stewart 2010; Conti and Heckman 2010; Grossman 2006; Pampel et al. 2010). Researchers now have directed attention to understanding the mechanisms behind these observed associations (e.g., Chandola et al. 2006; Cutler and Lleras-Muney 2010). While identifying the relevant mechanisms may be important for reducing educational disparities in adult health in the population, it is equally important to identify life course factors that jointly determine both education and health. Broadly construed,

these early-life causes may shed light on promising targets for preventative, cost-effective interventions aimed at improving both educational attainment and health outcomes (Campbell et al. 2014). They can also clarify which parts of the education-health relationship are unlikely to be causal.

Educational health disparities in part reflect differences in health behaviors in adulthood by level of schooling, such as differences in diet, physical activity, or smoking (Conti and Heckman 2010; Pampel et al. 2010). For example, adults with more education are more likely to quit smoking (de Walque 2010). Educational gradients in adult smoking, however, are largely explained by never smoking rather than quitting, and smoking typically initiates while schooling is in progress (Maralani 2013; Maralani 2014). These patterns suggest that, in addition to studying these relationships in adulthood, we need to take a life course view of how educational inequalities in health behaviors emerge across childhood and adolescence (Maralani 2014; Schreier and Chen 2013; Widome et al. 2013; Schafer, Wilkinson and Ferraro 2013; Braveman and Barclay 2009).

In this regard, a life course paradigm illuminates health disparities as they emerge. This paradigm defines health as a multifaceted, age-graded process involving the accumulation of health behaviors, outcomes, and risk factors, rather than as an aggregated, distal outcome such as adulthood mortality or comorbidity rate. By focusing on "norms, expectations, and constraints that characterize the age grades" (Crosnoe and Riegle-Crumb 2007:268), a life course approach situates individuals within changing social roles and contexts linked to homes, schools, and neighborhoods. For smoking disparities in particular, the life course paradigm distinguishes any cumulative effects of childhood socioeconomic advantage from transitions into adult roles and achieved SES, while recognizing that such transitions often partly reflect early-life advantages

(Pampel, Mollborn and Lawrence 2014). In short, life course research integrates factors across childhood, adolescence, and adulthood to illuminate the "how" and "when" — the specific mechanisms and patterns of timing — driving the association between education and health outcomes. It also describes the direct effect of childhood health on health in adulthood (Elo 2009).

In the US, those without a college degree are more than twice as likely to currently smoke and also much less likely to have never smoked as those with at least a Bachelor's degree (Maralani 2013; Pampel et al. 2010). Socioeconomic disparities in smoking and overall rates of smoking in the UK are comparable (Huisman et al. 2005; Marmot 2006). Yet disparities in smoking and other health behaviors by eventual educational attainment, such as degrees eventually completed or standardized achievement tests, are present even by grade school or early adolescence (Maralani 2014; Schreier and Chen 2013; Widome et al. 2013; von Hippel and Lynch 2014), suggesting that educational attainment may proxy for earlier school-related experiences or factors that jointly determine both education and health. It remains unclear, however, when and how educational factors and health behaviors become intertwined.

Several studies of smoking inequalities have found that differences in smoking by eventual educational attainment are present in the teenage years (e.g., Farrell and Fuchs 1982; Maralani 2014; Widome et al. 2013). However, due to data limitations, these studies have not evaluated antecedent characteristics prior to adolescence. While substance use itself is not readily observed prior to early adolescence (e.g., for legal reasons; Chen and Jacobson 2012), antecedents of educational attainment and substance use are likely present beginning early in life (Conti and Heckman 2010).

Our study extends the existing literature by conducting a life course investigation of emergent disparities in smoking using the 1970 British Cohort Study (BCS). Conti and Heckman (2010) utilize BCS data to identify and estimate the contributions of life course factors to educational disparities in smoking and other health behaviors. They focus, however, solely on factors present at age 10, leaving the contributions of early childhood and adolescence unclear. Maralani (2014) connects characteristics from adolescence to adulthood, but lacks data from childhood. As such, neither study is able to provide a comprehensive life course view. Our study bridges these approaches and extends them back to the perinatal period in order to capture health-related factors from infancy and the beginning of enrollment in school to adulthood.

Data and Methods

Our analyses use the 1970 British Cohort Study (N=17198) to estimate the relationship between early life characteristics and endowments to educational disparities in smoking. All members of the birth cohort were born in the UK in a given week in April 1970. These data offer a unique opportunity for understanding the origins of socioeconomic health disparities from childhood to adulthood. There is no comparable longitudinal dataset available for the United States (see Braveman and Barclay 2009).

Dependent Variables: Smoking Status (Never Smoked Regularly) at Age 16 and 26

We use smoking status, measured as whether respondents had ever smoked regularly at ages 16 and 26, as our outcome variables. At age 16, cohort members were asked on a school questionnaire whether they had ever smoked (never smoked a cigarette, used to smoke but

haven't for three or more months, smoke sometimes but less than one cigarette per week, smoke at least one cigarette a week). We define having never smoked regularly at age 16 as either never having smoked a cigarette or smoking less than one cigarette per week. Classifying cohort members who smoke less than one cigarette per week as "never smoked regularly" rests on the assumption these individuals are not in the process of quitting (i.e. used to smoke regularly). In view of age trends of smoking initiation reported in prior work, this is a reasonable assumption. Our key results do not depend on how we classify these individuals. Age 16 smoking measures are well-timed, in that smoking regularly typically begins during adolescence (Maralani 2014; Chen and Kandel 1995).

At age 26, cohort members again report on their smoking status (never smoked, used to smoke, smoke occasionally, smoke every day). We identify those who select the first category as never smokers at age 26. This was followed by a query about the frequency of smoking (number of cigarettes per day; open response). Those who smoked "occasionally" smoked at least one cigarette per day (M=3.99, SD=3.2; Max=20) and those who smoked "every day" smoked about 15 cigarettes per day on average (M=14.96, SD=6.6, Min=1, Max=65). We combine these two categories for an auxiliary multinomial analysis of currently smoking (occasionally or every day) at age 26.

Key Independent Variable: Final Educational Attainment (Age 26)

Because respondents are followed into adulthood, we use the 1996 BCS sweep (age 26) to determine the final educational attainment of cohort members. We dichotomize education as a binary variable coded to one if the respondent has a higher university degree and zero otherwise. Results do not change if measure education at age 30 or use a different educational cutpoint such

as A-level examinations. Our results are also substantively similar if we treat education as an ordinal variable categorizing highest level of qualification at age 26.

Other Independent Variables: Life course Determinants of Education and Smoking

Educational disparities in health are well-theorized, at least with regard to adulthood (Cutler and Lleras-Muney 2010; Link 2008; Grossman 2006; Mirowsky and Ross 2003; Link and Phelan 1995; Ross and Wu 1995). But the evidence also shows that this theoretical perspective is limited with regard to educational disparities in health behaviors because the mechanisms specified are conceptualized as operating in adulthood rather than adolescence (Maralani 2014). In order to understand educational disparities in adult health behaviors such as smoking, which originate much earlier in the life course, our existing theories need to refocus on mechanisms operating in childhood and adolescence. Our study takes this approach by studying a wide range of characteristics, endowments, and experiences in childhood, including cognitive skills, non-cognitive skills, psychosocial characteristics, and socioeconomic and health characteristics.

Cognitive skills are measured by standardized test scores and academic performance across the curriculum. Here we focus on standardized mathematics achievement score at age 10 (Friendly maths score). Also including the four available British Ability Scales (BAS) scores (matrices, word definitions, recall of digits, and word similarities) does not alter our substantive results. Our indicators of *non-cognitive skills* include the Rutter behavioral score at age 5, paying attention at school (rated by teacher at age 10), being in the top quartile of days absent from school (age 10), accepting the school curriculum (rated by teacher at age 10), and child's self-reported locus of control (child's opinion that studying is useless and that grades are luck).

School attachment is assessed again at age 16 by two items concerning whether the respondent does not "like school" or thinks that school is a "waste of time."

Psychosocial characteristics, assessed from birth through age 16, are based on family and peer social environments with respect to smoking. *Familial psychosocial characteristics* include parental smoking during or near pregnancy as well as throughout childhood (ages 5 and 16). Parental smoking carries a strong relationship to children's smoking initiation (Blokland et al. 2004; Gilman et al. 2009), though the relative contributions of maternal and paternal smoking across multiple age points during childhood remain understudied. *Peer psychosocial characteristics* are measured as proportion of friends who smoke at age 16 (none, about a quarter, half, or most friends).

Socioeconomic characteristics are measured as parental social class (occupational grades; unskilled/partly-skilled as reference category), highest education of either parent, and geographic region of residence. We specify parental education as whether at least one parent obtained a university degree. Other specifications do not change our results. Finally, *health characteristics* (birth to age 16) include birth weight, parity, birth complications or congenital abnormalities, and number of antenatal health visits (bottom or top quartile; middle 50% as reference).

Analytic Strategy

We group respondents by final level of educational attainment (university degree versus no degree) and study smoking at age 16 (1986) and age 26 (1996; the next BCS sweep). In a series of linear probability models, we focus on smoking initiation. That is, we model never having smoked regularly at ages 16 and 26. To explain educational smoking disparities, we construct a life course analytic sample from ages 0, 5, 10, 16, and 26 (listwise N=1718). This life

course sample optimizes the use of the available cohort data on life course factors in a way unmatched by previous studies of smoking disparities. In robustness analyses we explore the sensitivity of our results to sample selection.

For each smoking outcome, we estimate six linear probability models. The first model is compositional, including only final educational attainment (age 26), sex, and region of birth. Including race/ethnicity does not change our results, and there are no significant differences in educational gradients in smoking by gender. In Model 2, we add socioeconomic resources at birth and age 5, including mother's and father's work status, social class, and educational levels. Model 3 adds parental health and psychosocial resources from birth through age 16 such as maternal marital status and age at birth, maternal smoking around the time of pregnancy, and maternal and paternal smoking when the respondent was ages 5 and 16. In Model 4, we add health endowments at birth, including birth weight, parity, and congenital conditions or abnormalities. Model 5 adds cognitive and non-cognitive skills and school attachment at ages 5 and 10, and Model 6 includes psychosocial factors such as school attachment and the proportion of one's friends who smoke measured at age 16.

We then consider a model that treats education and smoking in adulthood as bundled statuses, rather than education in adulthood having a causal effect on smoking in adulthood. We group respondents into one of four education-smoking categories at age 26: no university degree and not smoking, no university degree and smoking, university degree and not smoking, and university degree and smoking. Then, using a multinomial logistic model, we show how the life course variables from childhood and adolescence predict the joint distribution of education and smoking in adulthood. The multinomial model allows us to compare across contrasts to identify whether certain variables explain differences in smoking but not completed education or vice

versa. For example, when we consider a contrast between those who have no university degree and do not smoke and those who have a university degree and also do not smoke, we compare groups with the same smoking status but different education statuses. Alternatively, if we compare those with no university degree who do not smoke to those with no university degree who do smoke, we compare groups with the same education status but different smoking statuses.

Results

Cohort Overview

Table 1 shows descriptive statistics for our life course analytic sample. First, at age 16, approximately two-thirds of the BCS cohort had never smoked (65%). By age 26, this proportion was reduced to about half of the cohort (56%), and approximately one-third of the cohort reported smoking currently in that year (29%). By this same age, about one-quarter of BCS cohort members had attained a university degree (28%).Our sample includes a larger share of women than men. Below, we confirm that our results are not sensitive to this unequal selection by gender into the life course analysis. Cohort members in our analysis hailed from many areas of the UK, and spent the first years of their lives in homes with varying socioeconomic resources. Almost all mothers in BCS were married in 1970, with an average age of 26 during April 1970 when the cohort member was born.

In terms of smoking exposure and socialization, more than a third of mothers smoked during pregnancy, and about half of fathers smoked when cohort members were age 5. By age 16, parental smoking was somewhat less common, though still prevalent. Meanwhile, at age 16, almost three-fourths of cohort members reported that some of their friends smoked.

Figure 1 shows differences in smoking at age 16 and 26 by university degree status at age 26. The inequalities shown at age 16 largely reflect the education respondents will go on to complete while by age 26 this education is already completed. Cohort members who go on to obtain a university education are far more likely to be never smokers at age 16 compared to those who complete less education (75% versus 59%). This gap in smoking by education shrinks by age 26 but is still sizable (60% versus 45%).

Linear Probability Estimates: Never Smoked Regularly at Age 16

Next we examine the life course determinants of these educational smoking gaps. Table 2 displays parameter estimates for linear probability models of having never smoked regularly at age 16. Model 1 shows the overall education gap in never smoking, controlling for gender and region of residence. Holding gender and region constant, respondents who go on to complete university have a .18 higher probability of being never smokers compared to those who do not complete a university degree. In Model 2, we control for childhood socioeconomic characteristics. While some coefficients register in the expected direction (i.e. positive), none are significant. This likely reflects selection into the life course analytic sample on the basis of parental SES, which will be addressed in a final robustness check below.

In Model 3, we add controls for the family environment, including maternal age, whether the respondent's mother smoked at the time of birth (1970), and parental smoking when the respondent was ages 5 and 16. Of these, only maternal smoking when the respondent is age 16 has a significant association with having never smoked at age 16. The probability of never smoking was about .10 lower for those whose mothers were smoking when the respondent was age 16. Model 4 adds controls for health in infancy, including birth weight, parity, and

congenital conditions or abnormalities. Those who were in the top quartile of antenatal visits—a measure we interpret as reflecting poorer health in infancy—are more likely to have never smoked at age 16 relative to those with fewer doctor visits in infancy (b = 0.063). Model 5 controls for cognitive and non-cognitive factors measured at ages 5 and 10. Among these, only acceptance of the school curriculum, as rated by the teacher on a 47-point scale, is significantly associated with never smoking by age 16 (b = 0.006). Even a modest gain on this scale (e.g., 5 points) translates to a 0.030 increase in the probability of never having smoked.

Across Models 1-5, the education coefficient remains approximately the same magnitude and statistically significant. This suggests that the early childhood measures included in these models explain little of the observed correlation between education and smoking status at age 16. Model 6 adds contemporaneous psychosocial factors from age 16, including school attachment and having friends who smoke. These covariates are significantly negatively associated with having never smoked at age 16. Controlling for these age 16 covariates reduces the education coefficient by nearly half (49%). Respondents who at age 16 reported they did not like school had a .06 lower probability of being a never smoker at age 16. Similarly, having friends who smoked increased the respondent's probability of smoking.

Linear Probability Estimates: Never Smoked Regularly at Age 26

Table 3 shows the results for never having smoked regularly at age 26. These results are largely similar to those for age 16, with the exception that early life course characteristics explain away a larger share of the educational gradient (see Pampel et al. 2014). In the regression predicting never smoking at age 26, some coefficients for parental socioeconomic status at birth are significant and remain at least marginally significant across the first five models: namely, the

coefficients for non-manual or manual parental social class (*b*s > 0.070, *p*s < .10). The parental smoking coefficients are more robust relative to the age 16 models, with maternal smoking mattering to the prediction of never smoking by age 26. To some extent, this may reflect the added number of years for smoking initiation, which serves to make those who never have smoked by their mid-twenties a more select group.

Child's acceptance of the school curriculum at age 10 has strong predictive power for never having smoked ($b = 0.006$, $p < .01$). In Model 6, findings similar to those for age 16 arise, with the child's sense that school is a waste being predictive this time ($b = -0.108$, $p < .01$) more so than not liking school, and having friends who smoke ten years earlier carrying enduring importance for smoking in the mid-twenties (*b*s = -0.13 to -0.44, *p*s < .01). Once we include these covariates in the age 26 model, the education gradient is no longer significant and reduced in magnitude by 73%.

In a seventh model (not shown), we added smoking status at age 16 as a predictor of smoking status at age 26. Including smoking status at age 16 reduces the educational gradient to a trivial size and also to statistical nonsignificance. If never having smoked at age 16 is added to the compositional model (Model 1), the education gradient is reduced to a level similar to that in Model 6. This pattern of results likewise holds for models of currently smoking at age 26 (not shown). We also undertook an auxiliary analysis of currently smoking at age 26, using the same six model specifications in sequence. The LPM estimates for currently smoking at age 26 mirror those for never having smoked (not shown).

Life Course Determination of Smoking and Educational Attainment

Our next set of analyses treat education and smoking status as bundled outcomes in adulthood. That is, rather than conceptualizing the mechanisms as running from education to smoking (both measured in adulthood) we treat education and smoking as jointly determined outcomes predicted by characteristics from earlier in life. Table 4 presents a multinomial logistic model, with non-smoking respondents with less than a university degree by age 26 serving as the reference group. Odds ratios are presented. Comparing contrasts across the same education category but different smoking statuses isolate factors linked to smoking while comparing across the same smoking status but different education groups identify factors linked to education. When the same factor predicts both types of contrasts, this identifies potential shared predictors of both smoking and education in adulthood. This gives us some insight for those factors that may jointly determine both statuses versus only education or smoking across the life course.

The results in the second column describe the contrast between respondents who currently smoke at age 26 and do not have a university degree versus those who do not smoke but who share the same educational status. This compares groups with the same education but different smoking statuses in adulthood. Men show higher odds of belonging in the "no university degree, smoker" group relative to the reference group ("no university degree, not current smoker"), as do those from lower social class backgrounds, respondents whose mothers smoked often in 1975, those who expressed the belief that school is a waste of time, and those respondents with at least a quarter of friends who smoke. Because this contrast focuses specifically on smoking by holding the educational level constant across groups, it suggests that parental and peer smoking along with a lack of adolescent school attachment are important predictors of smoking status in young adulthood.

The results in the third column describe the contrast between nonsmokers with a university degree and nonsmokers without a university degree. This contrast compares groups with the same smoking status but different educational attainment. Here, maternal employment, parental university degree, and having a parent with in a professional or managerial social class emerge as strong positive predictors of university degree attainment, as does pre-teen academic achievement or ability (in mathematics). Meanwhile, peer smoking and lack of adolescent school attachment are all linked to lower relative odds of belonging to the university degree group. Overall, this contrast across groups with the same smoking status but different educational levels shows that some predictors, such as parental socioeconomic status and academic achievement or ability, predict education but not smoking status. Similarly, parental smoking predicted child smoking but not the child's educational attainment.

Finally, the fourth column reports the relative odds for being in the "has university degree, smoker" group versus the reference group (nonsmoker without a university degree), which compares groups that differ in both educational and smoking status. Parental professional or managerial social class, parental university degree, and pre-teen academic ability again emerge as strong positive predictors of this contrast. Also, belonging to a peer group in which most of one's friends smoke is a positive predictor of membership in this smoking group versus the reference group, which is non-smoking.

Taken together, these results show that parental SES and childhood academic ability matter specifically for predicting cohort members' educational outcomes, irrespective of smoking status. Thus, these factors are best viewed as predictors of education rather than as predictors of smoking or as joint factors determining the education-smoking link. This is consistent with the linear probability results presented earlier, in which these variables did not

noticeably explain the educational smoking gradient at either age 16 or 26. In contrast, school attachment and peer smoking (at age 16) predict smoking as well as schooling, suggesting that these life course factors may be common determinants of both education and smoking. In line with this interpretation, the linear probability models showed large gradient reductions for attachment and peer smoking.

Robustness Checks

In additional analyses, we examined whether our conclusions changed if we included a more detailed set of covariates from age 10. In particular, we added child perseverance (non-cognitive), family intactness (non-biological parents or absent parents), number of children in household, family income, child head circumference, child height, father and mother height, and child standardized reading score. Including this detailed set of covariates does not change our substantive results regarding educational smoking gradients.

Our life course analytic sample retains only 10% of the original BCS. It is therefore important to examine whether our results concerning educational smoking gradients hold once they are adjusted for selection into the analysis. We estimated a logistic model of being included in the life course analysis conditional only on key age 0 covariates (N=15,371). Because parental education is not queried at age 0, we used ages of maternal and paternal education completion as proxies for attainment, specified in single year categories (age 15, 16, 17, 18 or later). We show the results for this model in the appendix. Using this model, we calculate the probability of selection into our analytic sample and re-estimated all age 16 and age 26 models using inverse probability weighting. Our substantive conclusions regarding smoking gradients did not change.

Discussion and Conclusion

Although the links between education and smoking are well-documented, studies rarely venture beyond cross-sectional designs focused on adulthood, which limits our understanding of how educational gradients in smoking come to exist. In this study, we broke new ground in understanding the educational smoking gradient by implementing a life course analysis focused on smoking status at ages 16 and 26. We used characteristics from birth through age 26 to account for a variety of important factors in childhood and adolescence, at both the individual and family level, to explain educational gradients in smoking as they emerge in adolescence and young adulthood.

Our results show several important conclusions. We find that educational smoking gradients in adulthood cannot be traced to characteristics from very early in life. In particular, cognitive, socioeconomic, and health-related factors from early childhood only minimally explain the education-smoking link at age 16 or 26. To our knowledge, this is the first convincing demonstration that educational smoking disparities in adulthood are not anchored to factors from childhood. Instead, we find that non-cognitive and psychosocial factors from age 16, in particular school attachment and having friends who smoked, explained about half of the education-smoking association at age 16. Similarly, these same factors explained almost three-fourths of the education-smoking association at age 26 and render the association no longer statistically significant. In further analyses, we considered experimentation with smoking by age 10, and the proportion of the cohort member's friends who had tried smoking by age 10. However, including these variables did not change our findings regarding educational smoking gradients, reinforcing our core conclusion that these gradients are best viewed as taking shape in adolescence, rather than in childhood.

Our multinomial results show that adolescent school attachment and peer smoking predict schooling as well as smoking differences, reinforcing the insight that these factors may contribute to the observed association between smoking and education in adulthood. The bundling of these two statuses suggests that our understanding of the mechanisms relating "education" and health should be disaggregated into the component parts of school experiences, treating schooling as a *process* that unfolds across adolescence rather than using years of schooling as a status in adulthood. The potential mechanisms underlying the education-smoking link operate in adolescence rather than adulthood.

Our study contributes to a growing body of research that takes a life course approach to understanding educational inequalities in health in order to develop clearer insights into the mechanisms that link these statuses. In contrast to a long line of work that that seeks to explain adulthood educational health disparities in terms of covariates that for the most part are observed contemporaneously, our study analyzes how education and health become bundled across the life course. The joint determination of education and smoking trajectories across adolescence involves several mechanisms (Maralani 2014). For instance, it is possible that prior common factors such as future expectations or time preferences, which we have not measured directly in this study, inform both schooling and smoking decisions. Another possibility is a bidirectional pathway, whereby early schooling performance or attachment induces differences in smoking initiation that in turn reinforce or build varying preferences for higher education.

While our study offers important insights for understanding the links between education and smoking, it also has some limitations. The BCS offers the unique opportunity to link childhood characteristics to adult outcomes but lacks data on key teenage years (between age 10 and 16) that might be central for understanding the decision to start smoking regularly. This

design makes it impossible to study closely the transition to smoking initiation at ages 13, 14, and 15, or to take a sample of nonsmokers at age 10 and watch smoking initiation evolve from age 10 to 16. Our study also leaves several important questions unanswered. Friend smoking status is by far the most potent predictor of own smoking in our models. Whether recruitment of friends who smoke mostly precedes or reflects the cohort member's own smoking initiation is an important question that deserves closer attention with more suitable data on the structure of peer smoking networks. We have also not studied how much individuals smoke, although this is associated with education as well. This distinction merits additional research using a life course approach.

Smoking not only is a leading cause of death but it also is a root determinant of major chronic disease. Understanding its life course origins should pay considerable dividends for public health and health policy. In this study we have focused on personal education, one of the most robust predictors of differences in smoking across the life course. By placing a specific emphasis on how educational smoking disparities originate in the first place, these results offer firmer and clearer insights into how educational smoking disparities are positioned in the life course. Our results clearly demonstrate that early-life factors hold very limited efficacy in propelling smoking differences, and they instead recommend the view that adolescent psychosocial factors in particular are of vital consequence and deserve further attention in subsequent research.

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Table 1. Descriptive Statistics, 1970 British Cohort Study, N=1718

Variable	Mean	95% CI	
1986: Never Smoked Regularly	0.65	0.63	0.67
1986: Ever Smoked Regularly	0.35	0.33	0.37
1996: Quit/Former Smoker	0.15	0.13	0.17
1996: Never Smoked Regularly	0.56	0.54	0.59
1996: Currently Smokes	0.29	0.26	0.31
Educ (1996): University Degree=1	0.28	0.26	0.30
Male	0.37	0.34	0.39
1970: Father Employed	0.94	0.93	0.95
Mother Employed	0.04	0.03	0.05
Social Class			
Professional	0.07	0.05	0.08
Managerial/Technical	0.18	0.16	0.20
Nonmanual	0.17	0.15	0.18
Manual	0.43	0.40	0.45
1975: Parent Has Univ. Degree	0.22	0.20	0.24
1970: Mother Is Married	0.98	0.97	0.99
Mom: Age at Baby's Birth	26.23	25.98	26.47
Mom Stop Smoking Before Preg.	0.13	0.11	0.14
Mom Stop Smoking During Preg.	0.04	0.03	0.05
Mom Smoked During Pregnancy	0.35	0.32	0.37
1975: Mom Smokes Often	0.35	0.33	0.37
1975: Dad Smokes Often	0.48	0.46	0.50
1986: Mom Smokes	0.32	0.30	0.35
1986: Dad Smokes	0.42	0.40	0.44
Birth Weight (kg)	3.33	3.31	3.36
Twin or Triplet	0.02	0.01	0.02
Baby: Any Breathing Problems	0.02	0.02	0.03
Baby: Any Cerebral Signs	0.01	0.01	0.02
Def./Susp. Congen. Abnormality	0.04	0.03	0.05
Baby: Any Other Conditions	0.04	0.03	0.05
Antenatal Visits (Bottom Quartile)	0.14	0.13	0.16
Antenatal Visits (Top Quartile)	0.36	0.34	0.39
1975: Child's Rutter Scale	8.72	8.49	8.95
1980: Child Pays Attention	73.51	72.24	74.78
1980: Child Friendly Maths Score	67.68	66.96	68.39

1980: Child Missed School	0.23	0.21	0.25
1980: Child Accepts Curriculum	40.10	39.78	40.43
1980: Child: Studying is Useless	0.13	0.11	0.14
1980: Child: Grades are Luck	0.38	0.36	0.40
1986: Child: School Waste of Time	0.28	0.26	0.30
1986: Child Doesn't Like School	0.56	0.54	0.58
1986: Quarter of Friends Smoke	0.42	0.40	0.44
1986: Half of Friends Smoke	0.14	0.12	0.16
1986: Most of Friends Smoke	0.17	0.15	0.19

Table 2. Linear Probability Estimates for Never Smoked Regularly in 1986 (Age 16; N=1718)

	1	2	3	4	5	6
Educ (1996): Obtained Univ Degree	0.180**	0.187**	0.173**	0.173**	0.170**	0.092**
Male	0.051*	0.052*	0.047*	0.048*	0.073**	0.047*
1970: Father Employed (Stated)		-0.011	-0.032	-0.034	-0.039	-0.038
Mother Employed (Stated)		0.072	0.071	0.077	0.078	0.090+
Social Class: Professional		-0.044	-0.041	-0.035	-0.032	-0.018
Social Class: Managerial/Technical		0.027	0.020	0.022	0.017	-0.018
Social Class: Nonmanual		-0.003	-0.013	-0.013	-0.016	-0.032
Social Class: Manual		0.025	0.026	0.029	0.028	0.001
1975: Parent Has Univ. Degree		-0.010	-0.019	-0.024	-0.020	-0.024
1970: Mother Is Married			0.046	0.038	0.035	-0.057
Mom: Age at Baby's Birth			-0.001	-0.001	-0.001	-0.002
Mom Stopped Smoking Before Preg.			-0.062+	-0.062+	-0.059	-0.030
Mom Stopped Smoking During Preg.			-0.084	-0.093	-0.094	-0.092+
Mom Smoked During Pregnancy			-0.037	-0.041	-0.035	-0.038
1975: Mom Smokes Often			0.058	0.064	0.060	0.041
1975: Dad Smokes Often			0.003	0.005	0.008	0.006
1986: Mom Smokes			-0.102**	-0.107**	-0.100**	-0.054
1986: Dad Smokes			-0.043	-0.041	-0.043	-0.013
Birth Weight (g)				0.000	0.000	0.000
Twin or Triplet				-0.112	-0.112	-0.081
Baby: Any Breathing Problems				0.076	0.069	0.025
Baby: Any Cerebral Signs				-0.023	-0.011	0.064
Def. or Suspect Congen. Abnormality				-0.022	-0.028	-0.035
Baby: Any Other Conditions				-0.011	-0.015	-0.016
Antenatal Visits (Bottom Quartile)				0.014	0.017	0.008
Antenatal Visits (Top Quartile)				0.063*	0.067**	0.060**
1975: Child's Rutter Behavioral Scale					-0.002	-0.001
1980: Child Pays Attention at School					0.001	0.000
1980: Child Friendly Maths Score					-0.001	-0.001+
1980: Child Missed School					0.037	0.034
1980: Child Accepts Curriculum					0.006**	0.004*
1980: Child: Studying is Useless					0.008	0.006
1980: Child Thinks Grades are Luck					0.020	0.015
1986: Child: School Waste of Time						-0.061*
1986: Child Doesn't Like School						-0.062**
1986: Quarter of Friends Smoke						-0.163**
1986: Half of Friends Smoke						-0.270**
1986: Most of Friends Smoke						-0.520**
Constant	0.647**	0.640**	0.719**	0.753**	0.568**	0.978**
Adjusted R^2	0.033	0.032	0.041	0.041	0.048	0.186

Note. Fixed effects for UK region included (not shown). + $p < .10$, + $p < .05$, * $p < .01$ (two-tailed)

Table 3. Linear Probability Estimates for Never Smoked Regularly in 1996 (Age 26; N=1718)

	1	2	3	4	5	6
Educ (1996): Obtained Univ Degree	0.139**	0.144**	0.126**	0.126**	0.116**	0.037
Male	0.003	0.002	-0.005	-0.002	0.026	0.003
1970: Father Employed (Stated)		0.045	0.017	0.019	0.018	0.020
Mother Employed (Stated)		0.086	0.083	0.079	0.081	0.091+
Social Class: Professional		-0.001	0.000	-0.001	-0.002	0.005
Social Class: Managerial/Technical		0.024	0.016	0.013	0.008	-0.032
Social Class: Nonmanual		0.084*	0.074+	0.074+	0.064	0.044
Social Class: Manual		0.074*	0.076*	0.073*	0.071*	0.042
1975: Either Parent Has Univ. Degree		-0.007	-0.018	-0.014	-0.011	-0.015
1970: Mother Is Married			0.069	0.072	0.070	-0.021
Mom: Age at Baby's Birth			-0.002	-0.001	-0.002	-0.002
Mom Stopped Smoking Before Preg.			-0.058	-0.058	-0.055	-0.029
Mom Stopped Smoking During Preg.			-0.068	-0.064	-0.066	-0.062
Mom Smoked During Pregnancy			-0.004	-0.005	-0.001	-0.006
1975: Mom Smokes Often			0.091*	0.089*	0.087*	0.071+
1975: Dad Smokes Often			-0.056+	-0.057+	-0.053+	-0.054+
1986: Mom Smokes			-0.127**	-0.127**	-0.119**	-0.080*
1986: Dad Smokes			-0.048	-0.049	-0.048	-0.018
Birth Weight (g)				0.000	0.000	0.000
Twin or Triplet				0.046	0.042	0.064
Baby: Any Breathing Problems				-0.055	-0.061	-0.095
Baby: Any Cerebral Signs				-0.034	-0.013	0.043
Def. or Suspect Congen. Abnormality				-0.072	-0.081	-0.079
Baby: Any Other Conditions				-0.026	-0.031	-0.031
Antenatal Visits (Bottom Quartile)				-0.006	-0.003	-0.011
Antenatal Visits (Top Quartile)				-0.031	-0.027	-0.034
1975: Child's Rutter Behavioral Scale					-0.002	-0.001
1980: Child Pays Attention at School					0.001+	0.001
1980: Child Friendly Maths Score					-0.002*	-0.002*
1980: Child Missed School					0.011	0.009
1980: Child Accepts Curriculum					0.006**	0.004*
1980: Child: Studying is Useless					-0.036	-0.042
1980: Child Thinks Grades are Luck					-0.032	-0.036
1986: Child: School Is a Waste of Time						-0.108**
1986: Child Doesn't Like School						-0.050*
1986: Quarter of Friends Smoke						-0.128**
1986: Half of Friends Smoke						-0.320**
1986: Most of Friends Smoke						-0.443**
Constant	0.517**	0.426**	0.512**	0.594**	0.463**	0.856**
Adjusted R^2	0.014	0.016	0.032	0.03	0.039	0.156

Note. Fixed effects for UK region included (not shown). + $p < .10$, + $p < .05$, * $p < .01$ (two-tailed)

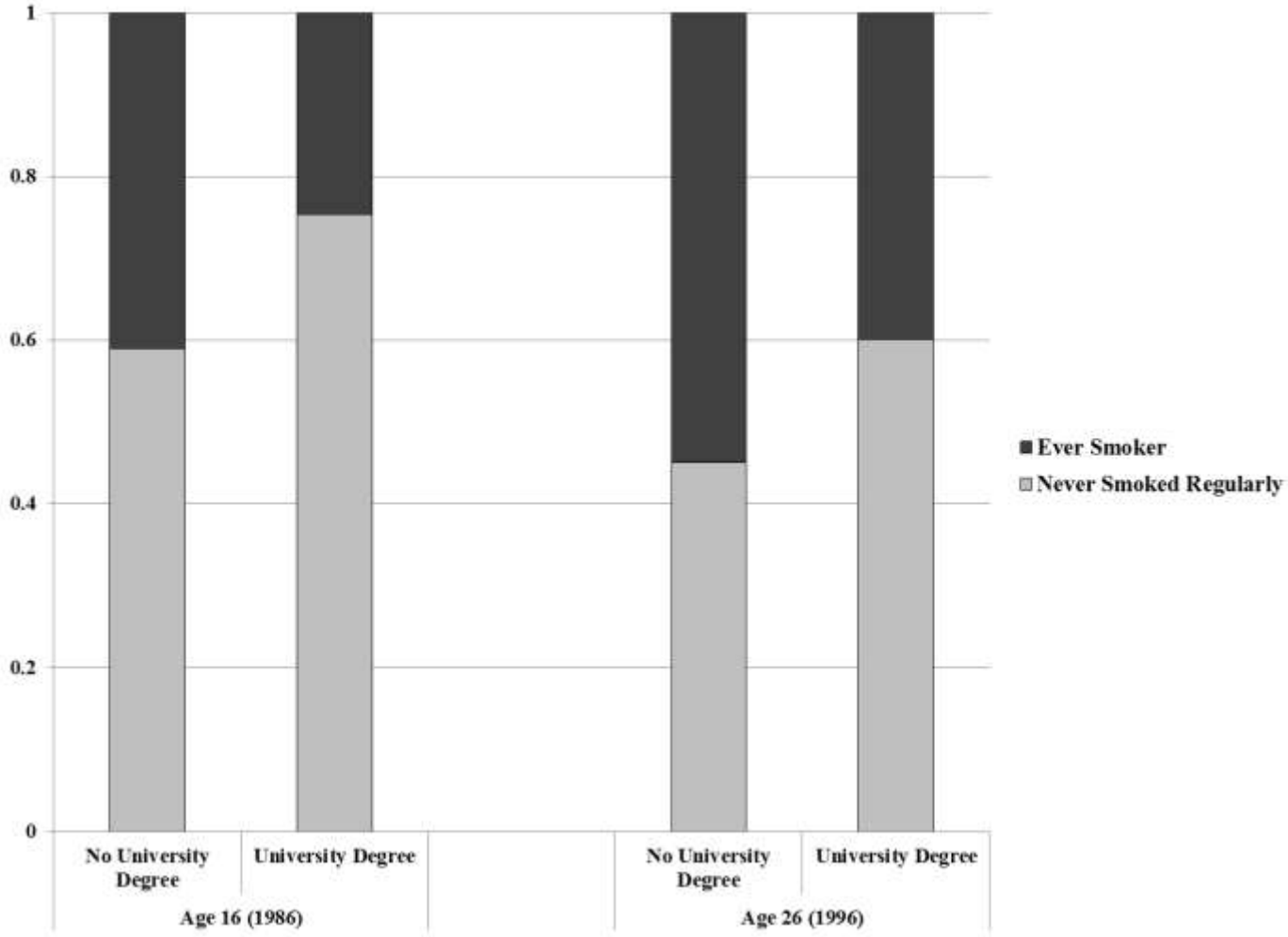
Table 4. Multinomial Model of Education and Smoking at Age 26 (Odds Ratios Shown; N=1718)

Reference: <Degree, Not Current Smoker	<Degree, Smoker	Degree, Not Smoker	Degree, Smoker
Male	1.202	1.256	0.798
1970: Father Employed (Stated)	1.143	1.059	0.646
Mother Employed (Stated)	0.958	2.770**	0.697
Social Class: Professional	0.365*	3.341**	2.737
Social Class: Managerial/Technical	0.682	1.828*	2.809*
Social Class: Nonmanual	0.608*	1.699+	1.068
Social Class: Manual	0.698*	1.212	1.094
1975: Either Parent Has Univ. Degree	1.061	2.403**	3.930**
1975: Mom Smokes Often	0.829	0.714	0.508
1975: Dad Smokes Often	1.155	0.777	0.886
1986: Mom Smokes	1.808**	1.073	1.049
1986: Dad Smokes	1.085	0.835	1.134
1980: Child Friendly Maths Score (0 to 1)	1.010*	1.050**	1.072**
1986: Child: School Is a Waste of Time (0/1)	1.555**	0.621*	0.880
1986: Child Doesn't Like School (0/1)	1.061	0.365**	0.778
1986: Quarter of Friends Smoke	2.222**	0.787	1.683
1986: Half of Friends Smoke	4.495**	0.702	2.047+
1986: Most of Friends Smoke	7.335**	0.462*	3.596**
Constant	0.121*	0.003**	0.000**

Note. N=839 in reference category (<Degree, Not Current Smoker); N=401 in <Degree, Smoker; N=389 in Degree, Not Smoker; N=89 in Degree, Smoker. Fixed effects for UK region included as well as other life course covariates (not shown).

+ $p < .10$, * $p < .05$, ** $p < .01$ (two-tailed)

Figure 1. Smoking Status by Completed Education at Ages 16 and 26 (1970 British Cohort Study)



Appendix. Logistic Model of Selection into Life course Analytic Sample Conditional on 1970 (Age 0) BCS Covariates

Dependent Variable = 1 if Included in Our Life Course Sample (N=1718)	
Male	0.493**
Father Employed (Stated)	1.457**
Mother Employed (Stated)	0.972
Social Class: Professional	1.328*
Social Class: Managerial/Technical	1.465**
Social Class: Nonmanual	1.486**
Social Class: Manual	1.206*
Mother Educ Complete at Age 15[1]	1.136
Age 16	1.498**
Age 17	1.423*
Age 18 or Later	1.590**
Father Educ Complete at Age 15[1]	1.410*
Age 16	1.706**
Age 17	1.778**
Age 18 or Later	1.633**
Mother Is Married	2.408**
Mom: Age at Baby's Birth	1.010+
Mom Stopped Smoking Before Preg.	0.865+
Mom Stopped Smoking During Preg.	0.813
Mom Smoked During Pregnancy	0.787**
Constant	0.023**
N	15371
Pseudo R2	0.041
Log Likelihood	-5.10E+03

Note. Odds ratios are shown. Fixed effects for UK region included (not shown).
[1] Reference = Education Complete Before Age 15
+ $p < .10$, * $p < .05$, ** $p < .01$ (two-tailed significance tests)