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A Life Course Perspective on Child Health, Academic Experiences and Occupational Skill Qualifications in Adulthood: Evidence from a British Cohort*

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Abstract

Existing research rarely examines the social consequences of poor childhood health from a longitudinal perspective. Using data from the British National Child Development Study, I follow a cohort from before birth through middle age to examine whether children's health limitations before and during the educational process predict occupational skill qualifications in mid-adulthood, and whether any negative consequences are strongest for children in persistently poor health. I also examine whether differences in achievement explain the observed associations, and at what point during the schooling process performance begins to play a large explanatory role. Poor health is strongly negatively related to qualifications in adulthood, particularly for children in persistently poor health. These associations are largely explained by differences in performance early in children's academic careers, before the first important transition point. The relationship between prenatal maternal smoking and mid-adulthood qualifications is more persistent. This paper demonstrates that a static conceptualization of childhood health is inadequate to fully understand the dynamic process through which social status and health over the course of childhood have long-run consequences for the adult life course.

There is a strong link between children's environments and their socioeconomic success as adolescents and adults (Heckman 2006; Shonkoff and Phillips 2000). Long-lasting consequences are associated with the quality of children's socioeconomic environments (Hayward and Gorman 2004;Hobcraft 2004), family settings (McLanahan and Sandefur 1994), and local contexts, especially neighborhoods and schools (Cunha et al. 2006; Sampson et al. 2008). Attention to the short and long-term consequences of children's socioeconomic and family circumstances remains essential, given their role as the primary units in children's lives. Recent evidence, however, points to the far-reaching consequences of another circumstance: children's health. Whether measured physically or psychologically, early-life health is an important contributor to mortality (Bengtsson and Lindstrom 2003), educational achievement and attainment (Conley and Bennett 2000; Jackson 2009), earnings and labor force participation (Currie and Madrian 1999; Currie and Stabile 2006). The converse of this relationship is also well established: disparities in physical and mental health, behaviors and health care are structured in part by social background (Kitigawa and Hauser 1973). The resurgence of attention to the reciprocal connections between health and social status has led researchers to question the role that health may play in generating and maintaining levels of social mobility and reproduction across generations (e.g., Palloni 2006).

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Despite recognition of childhood health as a strong correlate of social background and socioeconomic attainment, as well as the reality that children's experiences vary and exert their influence cumulatively over time, childhood is often represented as a static period. Researchers studying the consequences of early-life health often empirically define “childhood” during infancy (e.g., Conley and Bennett 2000) or at one point in adolescence (Jackson 2009; Smith forthcoming). These characterizations establish useful relationships and are sometimes the only possibility afforded by available data. By aggregating many developmentally important years, however, we miss the opportunity to fully understand when, how and for whom early-life health matters. I use rich longitudinal data spanning early through midlife to examine relationships among children's health, educational experiences and adulthood occupational skill qualifications. With an intra-generational perspective, I study health limitations before and during the educational process as predictors of mid-adulthood qualifications; whether those consequences are strongest for children experiencing persistently poor health or socioeconomic hardships; and whether differences in cognitive achievement during the schooling process explain the associations.

BACKGROUND

A Life Course Perspective

Inherent in the life course approach is the idea that children participate in social institutions as they age. Kerckhoff (1993) shows that children's socioeconomic backgrounds are strong determinants of their placement into educational curricula in the U.K.; moreover, the experiences that children have within the educational system act as “deflecting” points that reinforce or reduce existing socioeconomic disparities (Kerckhoff, Haney and Glennie 2001). Students in rigorous academic tracks can experience an upward deflection higher than would be expected from their social background, while students in basic curricula are more likely to be deflected downward. I extend Kerckhoff's general life course approach to consider childhood health problems, which may lower eventual attainment by influencing education position and progression, independent of socioeconomic circumstances.

Disparities in cognitive and non-cognitive skill development have received substantial attention as the primary channel through which negative environments adversely impact success in adulthood (Farkas 2003). Children living in disadvantaged environments are less likely to enter school adequately prepared (Carneiro and Heckman 2003); these students then remain less likely to demonstrate strong performance throughout their schooling or attain key educational credentials (Heckman 2008; McLanahan and Sandefur 1994). Whether children's cognitive skill development appears sensitive to the timing of negative environments and health disadvantages may depend in part on whether cognition is defined by ability or achievement. There is evidence that cognitive ability is a more stable trait and is especially influenced by both genetic and early-life environments, whereas achievement is more variable during childhood and adolescence (Guo 1998). In reality, many cognitive assessments measure both ability and achievement, and there is evidence that children's performance on these assessments is strongly predicted by education and environmental factors (Shonkoff and Phillips 2000; Winship and Korenman 1997). In order to understand how differences in cognitive achievement may play a role in linking children's health and eventual professional qualifications, health should be considered at multiple points in childhood: that is, the timing and duration of poor health should be considered. In this vein it is instructive to separate early-life health into two rough periods: *before entrance* into the educational system and during *school ages*.

Before Educational Entrance—Mothers' behaviors while pregnant and during the child's infancy may be related to adulthood occupational skill qualifications. There is evidence that impaired motor and reactive skills are related to infants’ health and prenatal

environments (Ruff et al. 1984; Scott et al. 1989) and that smoking during pregnancy may reduce blood and oxygen flow to the placenta, exposing fetuses to nicotine (Slotkin 1998; Wakschlag et al. 2002). If these exposures are related to academic performance (e.g, Almond , Edlund and Palme, forthcoming), the observed influence of prenatal and infant health on socioeconomic attainment may be reduced after adjusting for cognitive skill.

School-Age Health—A health problem before an important educational placement decision may make it harder for children to perform well on the exams necessary to advance to rigorous academic curricula. Young children exposed to lead suffer cognitive deficits (Schwartz 1994), and children and adolescents who are anemic face debilitating fatigue that may limit their capacity to learn effectively (Haas 2001). Similarly, in late childhood and adolescence, poor health may influence adolescents' decisions and ability to continue in school versus enter the labor market, independent of their performance at earlier ages. Limitations like these may manifest in a strong explanatory role for academic performance: children in poor health may not participate as fully in the educational system due to school absence, and they may exhibit lower educational expectations and skill development. Using U.S. data, Jackson (2009) finds that although school absence plays a small role in explaining the link between adolescent health and educational attainment, its independent influence is small relative to cognitive achievement; educational expectations play a negligible explanatory role.

Persistent vs. Transitory Health Problems—In addition to observing health at multiple points in the schooling process, it may be important to distinguish short-lived health conditions from those persisting across ages. Poor health may be especially consequential for the educational progress of children experiencing limitations at multiple points. Health conditions during schooling ages may reflect compounded health problems from earlier childhood or negative exposures during the prenatal period, as discussed above. Measuring health in one snapshot assumes that the effects of health are uniform for all children, rather than being concentrated among those in persistently poor health. Existing research considering children's health longitudinally highlights the importance of examining the early life course in its entirety. Case et al. (2005) find that both infant and adolescent health have lasting associations with the socioeconomic status of a British cohort (the same cohort examined here) in middle age, and that the timing of a health problem is important: the presence of a chronic condition at age 7 is more strongly associated with educational performance at age 16 than is an age 16 chronic condition.

Compensation and Exacerbation—Outside of school, children's pre-existing circumstances may compensate for or exacerbate the negative influence of a health problem. Children with greater access to resources outside of school may be able to compensate for a health problem because they do not bear the "double jeopardy" of both economic and health disadvantage (Conley and Bennett 2001; Pampel and Rodgers 2004). Alternatively, advantaged children may be equally or more adversely affected by poor health than less well-off children because poor health may lead to a decrease in the advantages that these children hold over their peers both in and out of the classroom (e.g., Currie and Hyson 1999; Jackson 2009). High access within the British health care system provides an opportunity to examine socioeconomic variation in the relationship between health and education, controlling for differences in health care access.

Navigating the Educational System: The British Case

Great Britain provides a useful case for studying how children's health may generate disparities in educational and professional qualifications by limiting their ability to effectively navigate a rigid educational structure. The United Kingdom shares a similar

economic profile to the U.S. despite lower levels of income and wealth inequality (Banks et al. 2003). In addition, strong socioeconomic gradients in health exist in the U.K., although U.K. adults are, on average, in good health (Banks et al. 2006). There are also unique features about the U.K. that inform a study of health and social status over the life course in that context. First, the U.K.'s national health service provides basic health care as a benefit for all citizens, clearly increasing access to preventive and therapeutic care. Secondly, and most salient for this study, the educational system has historically been quite rigid in the U.K. Turner (1960) describes the role of education in the British mobility process as a system of "sponsored" mobility. In a "contest" system (e.g., the U.S.), access to educational opportunity, and therefore socio economic stability, is theoretically meritocratic and is open to everyone on the basis of effort. In contrast, educational opportunity in the sponsored system of the U.K. has historically been determined at a young age through a more defined sorting process.

Although the degree of sorting has decreased over time, this article considers educational progression during the 1970s, when the educational system was still fairly deterministic: a series of crucial decision points in students' educational careers had important consequences for their socioeconomic trajectories. After completing primary school the age of eleven, students took exams (the "eleven plus") that determined, along with their performance in primary school and an interview process, whether they entered an academically rigorous grammar school or a vocational secondary school track focused on basic training (Kerckhoff, Haney and Glennie 2001; Turner 1960). Students in grammar schools took "O-level" achievement exams at age sixteen and, depending on the result, continued until age eighteen, when they took "A-level" university entrance exams. Students in the non-university track generally left school at age 16. Beginning in the late 1960s, the decline of the Tripartite system decreased the rigidity of this tracking process and increased the prevalence of comprehensive schools, which combined grammar and secondary schools so that all children in the publicly funded school system attended school together. Students could therefore attend grammar, secondary, comprehensive or private schools after completing primary school, although performance-based sorting remained a pronounced feature of the educational system.[1]

The Current Study

The 1970s British educational structure provides a useful framework for examining how experiences before and during the schooling process may hinder the progress and eventual qualifications of children in poorer health. I use rich longitudinal data spanning early through midlife to consider children's health, achievement and occupational skill qualifications in adulthood. Specifically, I study: 1) health limitations before and during the educational process as predictors of mid-adulthood qualifications, and whether those consequences are strongest for children experiencing persistently poor health or socioeconomic hardships; and 2) whether differences in cognitive achievement explain the observed associations. I do not aim to understand whether childhood health limitations explain the intergenerational transmission of socioeconomic status; that is, whether accounting for health differences between children reduces the relationship between parents' and children's occupational skill attainment. This is an important question that has received

[1]One final element of the 1970s British educational systems warrants mentioning: access to post-secondary education. Although British students' educational futures were largely determined a young age, it was not the case that students had no possibility of higher education if they did not attend grammar schools; exam opportunities were offered at some secondary schools and A-level credentials could be obtained in formal vocational programs after the end of required schooling. Although participation in diploma-based higher education was uncommon in the U.K., the British system allowed for a variety of professional training certificates; these certificates were, and continue to be, rewarded by employers and served as a means of mobility apart from traditional academic qualifications (Kerckhoff 1993).

some research attention (Palloni et al. 2009) and deserves further study. This article, however, focuses on better understanding the relationships among health, skill development and socioeconomic attainment from an *intra*-generational perspective.

Following previous work with these data (Case, Fertig and Paxson 2005), I expect to observe a strong relationship between childhood health and adulthood qualifications. Extending existing work, I expect differences in cognitive achievement to play a large role in explaining the influence of children's health on their occupational qualifications, even at early points in the educational process. Unlike previous research, I examine both health and educational performance at multiple points in childhood; I distinguish short-lived and persistently poor health; and I consider whether health's influence varies by socioeconomic background. Separately considering different points in the educational system affords a more precise understanding of how and when health begins to have educational consequences. Although cognitive achievement and educational attainment are correlated, there is evidence that they independently predict economic and occupational success (Kerckhoff, Raudenbush and Glennie 2001). It is therefore important to understand how health influences not only educational attainment, but also the skill development that precedes it.

DATA AND METHODOLOGY

Data

Although no existing U.S. data allow researchers to follow the same people from before birth through adulthood, there are several U.K. life-course surveys. The National Child Development Study (NCDS) provides information on the same people at birth and ages 7, 11, 16, 23, 33, 42 and 46. The survey follows members of the cohort born in one week in 1958 and is ongoing, with the most recent wave (age 46) conducted in 2004. It began with the goal of understanding the causes and consequences of child development, collecting information on health, cognitive and social development, educational progress, income, and family relationships. NCDS data have been used extensively to study the transition to adulthood (Case et al. 2005; Schoon et al. 2002). The data are quite valuable for the questions considered in this article, in that they permit a more comprehensive examination of childhood health than other population studies, as well as its consequences into mid-adulthood, when final qualifications are the most likely to be attained.

Measures and Descriptive Statistics

Occupational Skill Qualifications—Table 1 lists all of the measures used in the analysis. I focus on adults' occupational skill qualifications. The NCDS includes several markers of educational and professional qualifications in each wave. I combine measures to create age-specific markers corresponding to the current U.K. qualification scheme: the National Vocation Qualification (NVQ) system. NVQ levels denote the degree of competence required by an employee to perform a particular job. There are five levels (1-5), each including both academic and vocational qualifications.[2] Higher levels indicate a more complex occupational skill set. I use the NVQ scheme used by Makepeace et al. (2003). Level 1 (reference category) includes low-scoring O-level grades and the lowest vocational certificates; level 2 includes passing O-level grades and vocational equivalents; level 3 includes at least two A-level exams and vocational equivalents; level 4 includes "sub-degree" qualifications and certificates, and level 5 includes university diplomas, teaching

[2]I also create a measure of adults' strictly academic qualifications to separate them from those obtained in professional training programs. Because the findings with this measure are quite similar, I only present findings for the combined academic/professional NVQ measure.

and nursing degrees and post-university education. Because of small numbers of respondents with university and advanced degrees in 1958, I combine NVQ levels 4 and 5 to reflect the period's schooling distribution (Blanden and Machin 2004).[3]

Health—The NCDS contains a large number of childhood health measures. As in the U.S. and other industrialized settings, small numbers of children with any particular health problem preclude investigation of most specific conditions within a population survey. I measure child health *before educational entrance* with a measure of infants' *low birth weight* and two maternal behaviors: whether the mother *breastfed* the child and whether she *smoked* after the fourth month of pregnancy. [4] I differentiate among no, medium/variable and heavy levels of smoking, as reported by mothers.[5] Low birth weight is defined as weight below 5.5 lbs, a widely accepted cutoff (Conley and Bennett 2000).

For the *school-age years* I create global measures of health status by aggregating specific conditions.[6] A key aim in the construction of this measure is to separate short-lived and persistently poor health. I create variables indicating whether a physician diagnosed the child as having any *physical or mental/emotional* health problem at no ages; only age 7; ages 7 and 11; only age 11; only age 16; ages 11 and 16; or all schooling ages (7, 11, 16).[7] Children with health problems at multiple ages do not necessarily have the same conditions at each time point. Those missing the full set of health measures (e.g., because of non-participation in a particular wave) are included in a separate category. Physical and mental conditions are diagnosed during a medical exam and reflect a slight, moderate or severe condition impeding normal functioning, rather than self-evaluation. Physical health conditions include genetic conditions, physical abnormalities (e.g., spinal or limb disfiguration) and systemic abnormalities (e.g., heart, respiratory, blood conditions). Mental health conditions include mental retardation, emotional and behavioral problems.

Cognitive Achievement and Academic Factors—I separate educational experiences at different schooling ages and consider their respective explanatory contributions to the relationship between health and mid-adulthood qualifications. At age 7, shortly after children enter the educational system, I measure cognitive achievement with scores on the Southgate Reading Test (word recognition and comprehension) and the Problem Arithmetic Test (Pringle, Butler and Davie 1966; Southgate 1962). Secondly, at the time of the first educational transition (age 11), the NCDS administered an achievement test; although not a direct measure of tracking, achievement scores on math and reading comprehension assessments serve as a proxy for placement at the next academic level. Measures at ages 7 and 11 are converted to *z*-scores to measure performance relative to the age-specific sample

[3]Separately categorizing NVQ levels 4 and 5 does not produce different findings, nor does disaggregating the analysis by sex.

[4]Low birth weight is the least compelling measure of maternal health behaviors, as it reflects behavioral, environmental and genetic factors. Because analyses with and without this measure produce very similar findings, I leave it in. I also examine birth weight continuously and find no meaningful non-linearities in its influence.

[5]I use likelihood ratio tests to compare a model dichotomizing smoking into some vs. none with a model disaggregating smoking into three levels. The disaggregated variable fits the data more closely than the dichotomized variable, suggesting that the amount that mothers smoke is important. I proceed with the disaggregated measure.

[6]Another possibility is to create broad categories of health conditions from the medical histories, by separating physical, mental/emotional and systemic impairments (Case et al. 2005); this permits some degree of specificity. I do not do this for two reasons: 1) the health module at age 11 is different than at ages 7 and 16. Whereas I create health measures at age 7 and 16 by aggregating physicians' responses about whether children had specific conditions that could be a handicap to ordinary schooling, the data do not provide this option at age 11. At age 11 physicians are asked whether a child has any congenital or acquired condition that could interfere with normal functioning at school or home. I use this information to create a measure equivalent to those at ages 7 and 16; 2) Disaggregating health into types of conditions yields sample sizes too small to analyze the influence of persistent illness across ages. In work not shown, I disaggregate health into types of conditions (without distinguishing between transitory and persistent health problems) and find a relationship between health and attainment across different types of conditions.

[7]Although socioeconomically disadvantaged children may be less likely to be diagnosed with a mental or physical health condition because they lack access to health care, all children in the NCDS receive a medical exam as part of the survey. In addition, the U.K.'s national health service makes it less likely that low-income children will go without health care.

mean. Third, the data also provide a more direct measure of tracking in the type of school attended at age 16. This measure is limited because many schools became comprehensive (i.e., primary and secondary schools merged) by 1974.[8] Nonetheless, I use it to distinguish among different types of schools because not all schools had merged by 1974: school types include secondary modern/vocational (reference category), grammar, comprehensive, "other" schools (for children with special educational needs), and non-publicly run schools. I consider this measure separately from age 11 performance to test whether it provides additional explanatory power. Fourth, I measure parents' and children's educational expectations at age 11. Although U.S. data suggest that educational expectations do not play a significant role in explaining the lower attainment of less healthy children (net of performance), I examine its incremental contribution in the context of a more rigid educational system. Finally, to capture educational performance and tracking closer to the completion of secondary schooling, I measure the number of O-level exams passed by age 16 and the number of A-level exams by age 18.

Childhood Characteristics—NCDS data permit measurement of many characteristics of children's home environments. I control for *sex* and *region* within the U.K. (Wales, Scotland and England—the reference category). Boys and girls experience different health problems as they age; boys are more likely to be diagnosed with externalizing behavior problems (e.g, aggression), for example. In addition, broad geographic variation exists in children's exposure to health hazards, overall levels of health and socioeconomic conditions. I do not control for race/ethnicity because the NCDS is an overwhelmingly white sample (over 98%).

At birth and at each follow-up, the NCDS measures aspects of children's home environment that are correlated with health and adult social status. *Father's social/occupational class* in each year, following the registrar general's class scheme, indicates employment in professional, intermediate, skilled non-manual, skilled manual, partly skilled or unskilled professions (professional=reference category). The *maternal grandfather's social class* at birth measures long-standing family class. Children's *access to basic resources* in each year indicates sole access to hot water, a bathroom and indoor lavatory (higher score equals less access). Dummy variables measure mothers' *paid work outside of the home* in each year and her *marital status* at the time of the child's birth. The only childhood measure of family *income* is a bracketed measure at age 16. I create a continuous variable by computing the midpoint of the bracketed income category and logging it. Parental educational attainment is measured by categorical variables indicating *mothers' and fathers' school-leaving age*. The *number of children in the household* is reported at each wave. Finally, geographic stability is measured with the average number of *residential moves* during childhood. In place of age-specific measures of children's socioeconomic background, for questions asked in multiple waves I create measures spanning the four ages in childhood, through age 16.[9]

Attrition/Missing Data—Like all longitudinal studies, the NCDS has experienced attrition over time. Of the 17,415 children in the 1958 survey, 9,534 participated in any module at age 46 (2004). If this attrition is systematically associated with children's health or socioeconomic status (e.g., if the unhealthiest children drop out), the remaining sample could be positively selected on health and the observed influence of poor health on qualifications in adulthood may be downwardly biased. I address this in a few ways. First,

[8]Some children who attended a secondary or grammar school for many years before the merge, for example, could have been in a comprehensive school by age 16.

[9]I also estimate models with age-specific measures of childhood socioeconomic status. Unlike the age-specific health measures, the SES measures do not significantly differ from one another in their associations with adult qualifications. I therefore aggregate across ages to obtain a more parsimonious model; doing so does not meaningfully change the health coefficients.

because of the very small amount of change in NVQ qualifications between ages 42 and 46 I present findings for age 42 only, retaining almost 2,000 additional respondents. Secondly, the data suggest no substantial attrition differences by childhood health or socioeconomic status. Children born with a low birthweight are more likely to drop out before age 7 but this pattern does not persist in subsequent waves or for maternal smoking during pregnancy, breastfeeding or school-aged health measures. Attrition is also not systematically associated with childhood social status. Third, instead of dropping children who do not participate in a particular module of a wave I use multiple imputation to replace missing values on independent and dependent variables, based on predictions from a set of theoretically relevant variables. Values are not imputed if a child is entirely missing from that wave. It is reassuring that analyses using multiple imputation produce substantively similar findings to those handling missing data in other ways, including imputation at the mean and a "missing" category.

Empirical Strategy

I model NVQ level ordinally to account for unequal distances between each category. Although I present and discuss the parameter estimates, changes in relationships across models are better assessed by comparing changes in predicted values; in a nonlinear model changes in the coefficients depend on changes in the other model coefficients. From the parameter estimates I calculate the predicted probability of being in the highest NVQ levels (4 or 5), *m*:

$$P\left(Q_A{=}m|x\right){=}F\left(\tau_m-\widehat{\beta}x\right)-F\left(\tau_{m-1}-\widehat{\beta}x\right) \quad (1)$$

where $\widehat{\beta}x{=}\widehat{\beta}_{PI}H_{PI}{+}\widehat{\beta}_7H_7{+}\widehat{\beta}_{11}H_{11}{+}\widehat{\beta}_{16}H_{16}{+}\widehat{\beta}_BX_B{+}\widehat{\beta}_{16}X_{16}{+}\widehat{\beta}_C\overline{X}_C$

First, I predict occupational skill qualifications at separate ages in adulthood, Q_A (ages 23, 33, 42), as a function of maternal health behaviors during the prenatal and infant periods (*PI)* and school-age health at ages 7, 11 and 16 (separating short-lived and persistently poor health). X_B is a vector of observed child and family-specific characteristics at birth (mothers' marital status, grandfathers' social class, parental education). X_C includes variables whose values are averaged across the four childhood waves (social class, number of children, access to basic resources, mothers' workforce participation).[10] X_{16} is logged family income at age 16. The $\widehat{\beta}$s are the parameters to be estimated. τ_m are the cutpoints between categories. After estimating equation (1) I extend it to test for compensation and exacerbation, allowing the health parameters to vary by social background; I interact the age-specific health measures with fathers' occupational standing.

Although equation (1) identifies associations between early-life health and adult qualifications, it does not consider the cognitive and educational factors accounting for the relationships. I next focus only on qualifications at age 42 and the respective explanatory contribution of schooling experiences throughout childhood. I adjust successively for differences in cognitive performance at age 7; age 11; school type at age 16 (imperfect measure of age 11 tracking); educational expectations at age 11; exam performance at ages 16 and 18; and smoking in early adulthood (to account for the possibility that any persistent influence of prenatal maternal smoking on mid-adulthood qualifications is explained by the intergeneration transmission of smoking behavior). I compare changes in the predicted probabilities to evaluate the contribution of each mediating factor.

[10]Again, I include these averages because the age-specific measures of social background do not significantly differ from one another.

Unobserved heterogeneity and simultaneity are persistent problems in studying the relationship between social status and health. With regard to simultaneity, because health and socioeconomic status affect one another, attributing effects to one component in a cross-sectional framework assumes a direction of causality. I address biases from simultaneity measuring health long before adulthood. Unobserved heterogeneity remains a concern. Children's asthma, for example, may be caused in part by living in poor-quality housing and neighborhood conditions, which may also be related to educational achievement. Although the measures included here should capture many aspects of children's environments (e.g., family income, parental education, grandfathers' occupational status, access to household resources), omitted factors could exist and these findings should be interpreted as upper bounds. Although including individual or family-level fixed effects provides one way of controlling for the effects of time-invariant unmeasured factors, these data are not well suited for fixed effects analyses. The lack of siblings prohibits within-family analyses and the very long time span renders individual fixed effects less useful—the assumption that the value of the unobserved variable does not change over time is unrealistic with ten-year gaps between data points. I attempt to minimize this potential bias by including a rich set of measures capturing circumstances correlated with both child health and adult qualifications.

FINDINGS

Sample Characteristics

Table 2 shows that the average respondent's NVQ qualifications consist of some passing O-level exams and vocational equivalents by age 23, with qualifications increasing gradually but only slightly through adulthood. Most mothers were married (96%) at the time of their child's birth. The average social class of children's fathers was a skilled manual position, and the average social class of maternal grandfathers at birth was a skilled manual or non-manual position. On average, mothers and fathers finished school between ages 15 and 16. About half of mothers worked over the course of childhood, and most children experienced a residentially stable childhood environment, with an average of 1.63 moves.

With respect to health, Table 2 shows that about 5% of children in the analytic sample were low-birthweight, the majority of children were breastfed (68%), and about a third of mothers smoked after the fourth month of pregnancy: 13% of mothers report heavy smoking during this period. About 3% of children had a physician-diagnosed health condition at only age 7. This number gradually increases during childhood, to 4% at only age 11 (5% who also had a limitation at age 7), and 10% at age 16. 1% of children had a health limitation at all childhood ages.

Table 3 disaggregates educational characteristics by health status across childhood ages. There is a clear health gradient in cognition and academic factors. Respondents with no serious childhood health limitations, as well as those breastfed as infants, score highest on assessments of performance/tracking at ages 7, 11 and 16, and are the most likely to attend a grammar school at age 16. These respondents are also the most likely to have higher education plans and to have parents expecting them to stay in school for as long as possible. In contrast, low-birthweight respondents, those exposed to heavy prenatal smoking late in pregnancy, and those with childhood health limitations perform more poorly and have lower educational expectations; these differences are often larger than 1 standard deviation. Children with health problems at all school ages, for example, perform a full standard deviation lower than their healthiest peers at ages 7 and 11; they are less than half as likely to attend a grammar school at age 16; and they about half as likely to have plans for higher education. In some cases, those in poorer health are more likely to attend "other" types of schools at age 16 (schools that are not vocational, grammar or comprehensive schools); one

possible explanation for this is that parents try to compensate for children's health limitations by sending them to smaller private schools.

Relationships between Childhood Health and Adult Qualifications

Table 4 presents parameter estimates of the association between early-life health and adulthood NVQ qualifications. Models 1-3 show the findings for ages 23, 33 and 42, respectively. Birth weight, breastfeeding and prenatal smoking behavior all have a consistently strong relationship with NVQ levels at ages 23, 33 and 42: the odds of are high NVQ attainment at age 23 are significantly lower among lowbirthweight and nicotine-exposed infants, and significantly higher among those who were breastfed. School-aged health is also related to NVQ levels. There are strong associations between both persistent and transitory health problems and NVQ levels in early adulthood, as shown in Model 1: children with a health problem at one or multiple ages are less likely than their healthiest peers to be in higher NVQ levels at age 23. These differences are largest among persistently unhealthy children. It is reassuring that there are no significant differences in NVQ attainment between children missing the full set of health measures and their peers with no health problems.

By mid-adulthood the influence of prenatal and infant health remains while that of transitory, school-age health problems dissipates somewhat, as shown in Model 3; strong relationships persist among children in persistently poor health. This finding suggests that even short-lived health problems play a role in determining early adult status but that beyond that point, other circumstances become more important in determining adults' advancement.[11] Wald tests of coefficient equality, shown in the bottom rows of the table, confirm that significant differences remain among the health behavior and school-age health coefficients, as well as among just the school-age health coefficients.

Because these models are nonlinear and involve evaluating coefficients relative to ordinal thresholds, it is most appropriate and intuitive to visualize the magnitude of the relationships using predicted probabilities. I compute the predicted probability of achieving NVQ levels 4 or 5 at age 42; probabilities are computed across health categories, with all other characteristics held constant at their means. Health limitations at all ages are related to a lower likelihood of high NVQ attainment at age 42: the probability of being in the 4^{th} or 5^{th} NVQ level by age 42 is about 0.32 for those with no significant health limitations during childhood. In contrast, this likelihood is about 21% lower (0.245 vs. .319) for low-birthweight children; 13% lower for those exposed to medium/variable smoking during late pregnancy; and 17% lower for those whose mothers smoked heavily. These probabilities are also shown in Table 6 and will be discussed in greater detail in the next stage of the analysis. Unhealthy children during school ages are also much less likely to achieve the highest NVQ levels by age 42. Those with a health condition at age 7 are about 25% less likely to attain NVQ levels 4 or 5 (0.245 vs. 0.319). Smaller and statistically insignificant differences are observed at ages 11 and 16. The most striking differences, however, are observed among children with persistently poor health later in the schooling process. Children with health limitations at both ages 11 and 16 are predicted to have a 27% lower likelihood (0.254 vs. 0.319) of the highest NVQ qualifications than their peers with no school-age health limitations. This difference is 64% (0.117 vs. 0.319) among those with poor health at all

[11]This speculation is additionally supported by a latent growth curve analysis in which I examine change and stability in the relationship between early-life health and adulthood social status. Although health is significantly related to qualification levels at age 23, it does not predict *change* over the course of adulthood, net of observed child and family characteristics. Again, these findings suggest that childhood health is related to qualifications in early adulthood but that other factors then become more important in determining trajectories. This finding is likely also driven in part by the relatively stable pattern of educational and professional qualifications during this period, opportunities for professional certification notwithstanding.

ages during the schooling process. These findings provide strong evidence for the idea that children with persistently poor health suffer particularly negative consequences for socioeconomic attainment. In addition, the significance of the differences among the health and health behavior coefficients highlights the importance of considering health across a variety of ages in the early life course, and suggests that the influence of health on eventual attainment may be larger than would be predicted from a static measurement of health.

It is instructive to note that the predicted gaps in NVQ qualifications across categories of child health are similar in size to the gaps predicted by markers of children's social status. The probability of being in the highest NVQ levels at age 42 for those whose grandfathers were unskilled manual laborers, for example, is about .27, versus .34 for those whose grandfathers were professionals—a difference of about 21% (results not shown). This suggests that the size of the long-term influence of childhood health, even if indirect, may be comparable to the influence of childhood social status and other factors known to be important in social mobility processes.

The final column (Model 4) in Table 4 examines interactions among maternal health behaviors, school-age health and fathers' occupational class. Because of small sample sizes in some health categories, I combine all children with a health problem at more than one age into a "chronic health problem" category. The coefficients show no evidence for meaningful socioeconomic variation in the relationship between health and NVQ qualifications; I therefore proceed from the additive model (Model 3) for the remainder of the analyses. Although the coefficients are generally in the direction suggested by a "compensation" model, with a weaker relationship between health and attainment among children with a higher social class, this finding is not statistically meaningful.[12] These findings provide evidence for neither socioeconomic compensation nor exacerbation of the relationship between health and occupational skill qualifications.

What Explains Health's Influence on Qualifications?

Table 5 presents parameter estimates of the relationship between early-life health and mid-adulthood NVQ qualifications. I focus on age 42 to extend the temporal window as far as possible, in order to understand any far-reaching consequences of childhood health beyond early adulthood. Model 1 is equivalent to Model 3 in Table 4. Models 2-7 successively adjust for age 7 cognitive achievement; age 11; school type at age 16; parents' and children's educational expectations at age 11; O-level and A-level performance at ages 16 and 18, respectively; and respondents' smoking behavior at ages 23 and 33. Table 5 shows the expected relationships between educational factors and NVQ attainment. Higher performance on exams at ages 7, 11, 16 and 18 is significantly related to higher NVQ attainment, as are positive expectations about higher education. Students attending selective grammar schools at age 16 are more likely than their peers in vocational secondary schools to attain high NVQ levels.

As in Table 4, changes in the health parameters across models must be evaluated while accounting for changes in the values of other model variables; these comparisons are best achieved with predicted probabilities. Models 2-7 in Table 6 build on the baseline model and allow for comparison of differences between health categories across models. Model 2 shows that differences in age 7 cognitive skill explain a sizeable majority of health's relationship with age 42 NVQ qualifications: children with an age 7 health problem have a 9% lower likelihood of the highest NVQ attainment, contrasting the 23% gap before adjusting for cognitive skill. Similarly, children with health limitations at both ages 11 and

[12]Interactions between health and parental education instead of fathers' occupational class yield similar results.

16 are about 10% less likely to be in NVQ levels 4/5, compared to the previous difference of 20%. The most persistently unhealthy children, those with health problems at all school ages, are about 41% less likely to attain the highest qualifications than their healthiest peers: still a large and significant difference, but a reduction of over a third. Tests of coefficient equality, shown at the bottom of Table 5, indicate that the school-age health coefficients are no longer significantly different from one another.

Adjusting for age 7 achievement also produces less sizeable, though still meaningful, reductions in the influence of maternal health behaviors on NVQ attainment, with the exception of maternal smoking. Although the difference between the healthiest and low-birthweight children is sizably reduced (from 20% to 8%), children exposed to medium/variable and heavy prenatal smoking remain 10% and 13% less likely to attain the highest NVQ levels, respectively, compared to 14% and 16% lower likelihoods before adjusting for age 7 achievement. In addition, tests of coefficient equality in Table 5 (Model 2) show that significant differences remain among the health coefficients when health behaviors are included; these differences are driven by the smoking coefficients. Adjusting for age 11 performance further reduces some gaps in the likelihood of high NVQ attainment, particularly among those born with a low birthweight and those with a health problem at all ages. The disadvantage associated with maternal smoking remains sizeable and significant, however.

Net of the important explanatory role played by cognitive performance early in the educational career, tracking (Model 4), parents' and children's educational expectations at age 11 (Model 5), and performance at ages 16 and 18 (Model 6) add little additional explanatory power to the remaining lower likelihood of high NVQ attainment for children exposed to prenatal smoking and who have persistently poor health. Model 6 in Table 5 shows that sizeable differences in the probability of high NVQ attainment remain between the healthiest children and those exposed to prenatal smoking (9% for those exposed to heavy prenatal smoking); Wald tests confirm that these coefficients still differ significantly from those for health at other ages. Only after adjusting for respondents' own smoking behavior in early adulthood (Model 7) do the differences between the maternal smoking coefficients and the other health behavior/health coefficients become insignificant, as shown in the Wald tests at the bottom of Table 5. Although this finding implies that the intergenerational transmission of smoking behavior explains the lower attainment of children in poorer health, gaps in the probability of high NVQ attainment remain essentially unchanged (Table 6).

Overall, the findings suggest a very important role for cognitive achievement in explaining the lower eventual occupational skill qualifications of children in poorer health. By the end of primary school, performance disparities may be large enough to lead children into substantially different academic paths. In addition, markers of cognitive performance at ages 7 and 11 appear to be a strong enough proxy for future curriculum tracking such that measures of later performance do not add substantial explanatory value.

DISCUSSION

Examining a temporal window spanning early and mid-life, within a rigid educational structure, permits consideration of both health and educational performance at multiple points and ultimately affords a better understanding of when and how health influences attainment. Adults' occupational skill qualifications are strongly related to mothers' health behaviors and to children's school-age health. Four main findings emerge. First, children in persistently poor health face the most severe educational detriment during the schooling process and as adults; by mid-adulthood, attainment gaps are largest between those who

were the healthiest and most persistently unhealthy children. Although unsurprising, this finding is important and suggests that researchers studying the reciprocal connections between health and social status should consider not only the presence of health conditions, but also their duration and severity. The fact that early-adulthood NVQ attainment is strongly related to both transitory and persistent health problems, but that only persistent conditions are related to mid-adulthood attainment, suggests that children with short-lived conditions may be better able to make use of opportunities for educational advancement in early adulthood. In contrast, a “permanent” state of poor childhood health may have a more lasting influence.

Secondly, differences in achievement early in children's educational careers largely explain school-age health's relationship with mid-adulthood attainment. Adjusting for differences in age 7 and 11 performance substantially reduces the magnitude and significance of predicted attainment differences across school-age health categories. Cognitive measures early in children's schooling may act as markers for future tracking and performance, since neither age 11 educational expectations nor age 16 and 18 exam performance offer further explanatory purchase. The large explanatory role of achievement does not suggest that health is unimportant; rather, it suggests that unhealthy children may need extra attention to excel cognitively and academically, and in turn to avoid occupational disadvantage in adulthood. This finding should be qualified in at least two ways. First, these measures are meant to be markers of *achievement* rather than *ability.* Given evidence that cognitive achievement is less stable than ability, it is sensible that achievement is related to childhood health. Secondly, the strong explanatory role of early achievement does not preclude an important influence of later educational expectations and performance on socioeconomic attainment; indeed, children's educational expectations are significantly associated with their later occupational skill qualifications. Instead, it may be that even before youth form educational expectations, those in poor health have fallen substantially enough to attainment disparities.

The rigid sorting within the 1970s British educational structure provides a pronounced context in which to examine these questions, but the findings also have relevance to other contexts. A weaker and less homogenous process exists in the United States, for example, where children take tests determining placement into gifted and accelerated programs. Whether the sizeable explanatory role of academic performance is driven by differences in classroom environments, non-cognitive skills, physiologic deficits or something else entirely remains an important topic for future inquiry. In addition, although the health measures used here allow for important new detail in our understanding of the life-course relationship between health and attainment, examining specific conditions will be useful in pinpointing precise pathways through which health is of cognitive and socioeconomic importance.

Third the explanatory role of academic achievement is not as strong for mothers' prenatal smoking behavior. After adjusting for respondents' own smoking behavior, the lower predicted attainment of children exposed to smoking late in utero become less statistically meaningful but not smaller in magnitude. This finding suggests two possible explanations. First, mothers' prenatal smoking behavior may reflect family differences in parenting behavior. If so, environmental factors such as childhood smoke exposure or differences in parental involvement could be driving this finding. This may be less likely in this cohort than in later cohorts, as the harmful effects of smoking were just beginning to be widely known. Differences in smoking behavior may nonetheless reflect attitudinal differences. Some of these differences should be reflected in the measures used here. If children exposed to smoking in utero are also more likely to be exposed to smoke during childhood, for example, this should manifest in poorer childhood health. Childhood smoke exposure is also correlated with many socioeconomic and family markers measured here. This

notwithstanding, this finding should be interpreted as an upper bound. A second explanation is that the prenatal environment has lasting health and cognitive effects, as has been found in work linking prenatal conditions to adults' health and cognitive outcomes (Almond , Edlund and Palme, forthcoming).

Finally, there is no evidence that compromised health differs in its consequence for children lacking socioeconomic resources; that is, there is no support for socioeconomic compensation or exacerbation. Although this article does not directly compare to the U.S., this finding raises the question of whether intensely socially patterned access to health and social services in the U.S. increases inequalities in both children's receipt of care and in families' ability to compensate for children's health problems using available services.

As a whole, the findings support the idea that health contributes to intergenerational socioeconomic inequalities. The strong indirect association between childhood health and adult qualifications through cognitive achievement suggests a role for early-life health in processes of social mobility and reproduction. It is equally suggestive that the predicted gaps in qualifications according to childhood health are similar in magnitude to those according to markers of childhood social status known to be key components in the process of stratification, such as parental education and occupational class. Social background is a strong determinant of health; in turn, poor health can set children onto particular paths of achievement and attainment, independent of their social background. The consequences of health for socioeconomic inequality, both intra- and intergenerationally, are therefore potentially quite meaningful and should not be ignored.

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Table 1

Variable List and Coding: NCDS, 1958-2000

Variables	Coding
Maternal Health Behaviors and Child Health	
Low birthweight	1=yes
Mother smoked heavily after month four	1=yes
Mother smoked “medium/variable” amount	1=yes
Breastfed as infant	1=yes
Health Problem at Age 7	Reference: No health problems during childhood
Health Problem at Age 11	Reference: No health problems during childhood
Health Problem at Ages 11 and 7	Reference: No health problems during childhood
Health Problem at Age 16	Reference: No health problems during childhood
Health Problem at Ages 16 and 11	Reference: No health problems during childhood
Health Problem at All Ages	Reference: No health problems during childhood
Missing full childhood health information	Reference: No health problems during childhood
Child Characteristics	
Sex	0=female 1=male
Region in 1958, 1965, 1969, 1974	0=England 1=Wales 2=Scotland
Average class of father during childhood	1=professional 2=intermediate 3=skilled non-manual
	4=skilled manual 5=partly skilled 6=unskilled manual
Mother's marital status in 1958	0=unmarried 1=married
Maternal grandfather's social class in 1958	1=professional 2=intermediate 3=skilled non-manual
	4=skilled manual 5=partly skilled 6=unskilled manual
Age mother/father finished school	1=<13 2=13-14 3=14-15 4=15-16 5=16-17 6=17-18
	7=18-19 8=19-21 9=21-23 10=23+
Childhood avg. number of kids in household	0=1 1=2 2=3 3=4+
Childhood avg. access to basic resources	1=sole use 3 2=sole use 2 3=sole use 1 4=none
Family income in 1974	monthly income in pounds
Childhood avg.: mom's paid work status	0=no 1=yes
Childhood avg. number of moves	0 through 22
School Type at Age 16	0=secondary 1=grammar/tech
	2=comprehensive 3=special needs
Parents expectations about school continuation	0=leave at minimum 1=stay past minimum
Child's expectations after mandatory school completion	0=get a job 1=continue schooling
Math and reading achievement scores	0-40, 0-35
Number of O-Levels Passed by 1974 , A-Levels Taken by 1976	0-9+, 0-6
Adult Characteristics	
NVQ Level at 23, 33, 42	Levels 1-5
Currently smokes at 23, 33	0=no 1=yes

Table 2

Descriptive Characteristics of Age 42 Sample: NCDS, 1958-2000 (N=10,590)[a]

Variables	
Maternal Health Behaviors and Child Health	
Low birthweight	5
Mother smoked heavily after month four	13
Mother smoked "medium/variable" amount	21
Breastfed as infant	68
Health Problem at Age 7	3
Health Problem at Age 11	4
Health Problem at Ages 11 and 7	1
Health Problem at Age 16	10
Health Problem at Ages 16 and 11	1
Health Problem at All Ages	1
Missing full childhood health information	1
Child Characteristics	
Sex (male=1)	52
Average childhood class	skilled manual
Mother's 1958 marital status	96
Maternal grandfather's 1958 social class	skilled manual or non-manual
Age mother finished school	15-16 years old
Age father finished school	15-16 years old
Average num. of children in household	1.77
Average childhood access to basic resources	sole use of one facility
Average 1974 Family income	5.04
Mother's average paid work status	0.55
Average num. of moves during childhood	1.63
Adult Characteristics	
NVQ Level at age 23	2
NVQ Level at age 33	2.66
NVQ Level at age 42	2.69
NVQ Level at age 46 (N=8,251)	2.8

[a]Numbers in cells are percentages unless mean is indicated.

Table 3

Educational Characteristics of Age 42 Analytic Sample: NCDS, 1958-2000 (N=10,590)[a]

Educational Performance	**No Health Limitations**	**Breastfed**	**Low BW**	**Heavy Prenatal Smoking**	**Age 7 Limitation**	**Age 11 Limitation**	**Ages 11/7 Limitation**	**Age 16 Limitation**	**Ages 16/11 Limitation**	**All Ages**
Age 7 Performance										
Mean Reading Comp. (S.D.)	24.3 (6.4)	24.1 (6.6)	21.9 (7.5)	22.8 (7.1)	20.8 (8.1)	22.8 (7.8)	17.6 (10.3)	23.7 (6.9)	21.5 (8.9)	15.8 (10.9)
Mean Math (S.D.)	5.3 (2.4)	5.3 (2.4)	4.5 (2.4)	4.9 (2.5)	4.6 (2.6)	4.9 (2.6)	3.9 (3.1)	5.2 (2.5)	4.5 (2.8)	3.2 (3.0)
Age 11 Performance										
Mean Reading Comp. (S.D.)	16.7 (6.0)	16.8 (5.9)	15.0 (6.1)	15.4 (6.1)	14.3 (6.5)	15.5 (6.7)	12.8 (7.6)	16.2 (6.3)	13.4 (7.6)	11.2 (8.8)
Mean Math (S.D.)	17.8 (10.1)	18.1 (9.9)	14.5 (9.4)	15.7 (9.8)	13.8 (10.2)	16.2 (10.8)	12.8 (10.9)	16.2 (10.8)	13.7 (11.3)	10.2 (10.9)
School Type at Age 16										
Secondary Modern	17	19	21	21	19	17	12	18	15	5
Grammar/Technical	10	12	6	6	7	9	2	11	7	4
Comprehensive	46	49	55	52	45	45	43	49	41	43
Other	27	20	18	21	29	29	42	21	37	49
Post-School Expectations										
Will get a job	18	20	20	26	27	22	26	20	29	29
Will continue full-time educ.	32	30	25	27	26	31	27	30	23	17
Not sure	51	50	55	47	47	47	48	50	48	54
Parental School Expectations										
Will leave at minimum age	21	21	29	28	29	28	35	24	29	25
Will stay past minimum age	78	79	71	72	71	72	65	76	71	75
Age 16/18 Performance										
Avg. Num. O-Levels by Age 16	1.9 (2.8)	2.0 (2.6)	1.4 (1.7)	1.2 (2.3)	1.3 (2.2)	1.7 (2.5)	1.1 (2.1)	1.8 (2.7)	1.3 (2.4)	0.9 (2.1)
Avg. Num. A-levels by Age 18	0.4 (0.9)	0.4 (0.9)	0.2 (0.5)	0.2 (0.6)	0.2 (0.7)	0.4 (0.9)	0.2 (0.6)	0.3 (0.9)	0.2 (0.7)	0.15 (0.7)
N	8453	7336	522	1225	360	430	74	1002	129	66

[a]Numbers in cells are percentages unless mean is indicated.

Table 4

Ordered Logistic Regression of NVQ Level on Childhood Health[a]

	Age 23 (1)	Age 33 (2)	Age 42 (3)	Age 42 (4)
Prenatal/Infant Maternal Health Behaviors				
Low BW	−0.281** (3.13)	−0.271** (3.13)	−0.292** (3.17)	−0.376 (1.61)
Mother Breastfed	0.173** (4.31)	0.137** (3.32)	0.147** (3.43)	0.098 (0.84)
Late Pregnancy Smoking: Variable/Medium	−0.241** (5.31)	−0.206** (4.49)	−0.187** (4.13)	−0.170 (1.29)
Late Pregnancy Smoking: Heavy	−0.343** (5.72)	−0.297** (5.07)	−0.237** (3.97)	−0.248 (1.45)
School-Age Permanent/Transitory Health				
Health Problem at Age 7	−0.605** (5.35)	−0.323** (2.97)	−0.365** (3.43)	−0.558† (1.83)
Health Problem at Age 11	−0.123 (1.33)	−0.164 (1.45)	−0.060 (0.52)	−0.040 (0.15)
Health Problem at Ages 11 and 7	−0.956** (4.04)	−0.482† (1.87)	−0.306 (1.18)	
Health Problem at Age 16	−0.196** (2.90)	−0.040 (0.552)	−0.110 (1.60)	−0.463* (2.11)
Health Problem at Ages 16 and 11	−0.727** (4.04)	−0.491** (2.70)	−0.317† (1.77)	
Health Problem at All Ages	−1.647** (5.60)	−1.118** (3.83)	−1.261* (4.33)	
Incomplete School-Age Health Data	−0.440 (3.84)	−0.080 (1.05)	−0.094 (1.19)	0.151 (0.69)
Chronic Health Problem (More than 1 age)				−0.818** (2.45)
Average Social Class				−0.462** (11.13)
Medium Smoking * Average Social Class				−0.007 (0.14)
Heavy Smoking * Average Social Class				0.003 (0.06)
Breastfeeding * Average Social Class				0.020 (0.47)
Low Birth Weight * Average Social Class				0.033 (0.39)
Age 7 Health Prob. * Average Social Class				0.077 (0.65)
Age 11 Health Prob. * Average Social Class				−0.007 (0.08)
Age 16 Health Prob. * Average Social Class				0.134 (1.50)
Chronic Health Prob. * Average Social Class				0.107 (0.96)
Incomplete Health Data * Average Social Class				−0.102 (1.16)
Cutpoint Parameters: Cut 1				
Cut 1	−0.517	−1.014	−1.071	−1.117
Cut 2	1.616	0.334	0.235	0.189
Cut 3	2.300	1.418	1.187	1.141
Tests of Coefficient Equality				
All Health and Health Behaviors				
x^2 (9)	140.71	88.26	75.13	
$p>x^2$	0.00	0.00	0.00	
Ages 7-16 Health				

	Age 23 (1)	Age 33 (2)	Age 42 (3)	Age 42 (4)
x^2 (5)	48.07	24.22	22.11	
$p>x^2$	0.00	0.00	0.00	
Log Likelihood	−13044.3	−13700.1	−13499.6	−13496.9
N	12,047	10,704	10,590	10,590

[a] Ordered logistic regression (1=NVQ Level 1, 4=NVQ Levels 4/5). t-ratios (|β/s.e.|) in parentheses. Reference category for school-age health is no childhood health problems. All models include controls for Table 1 child and family characteristics.

† p<.10

* p<.05

** p <.01

Table 5

Ordered Logistic Regression of Age 42 NVQ Level on Childhood Health and Mediators[a]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Prenatal/Infant Maternal Health Behaviors							
Low BW	−.292** (3.17)	−.105** (1.11)	−0.070 (0.68)	−0.066 (0.65)	−0.070 (0.69)	−0.079 (0.77)	−0.097 (0.91)
Mother Breastfed	0.147** (3.43)	0.132** (3.14)	0.090† (1.90)	0.090† (1.90)	0.088† (1.90)	0.092† (1.90)	0.050 (1.02)
Late Pregnancy Smoking: Variable/Medium	−0.187** (4.13)	−0.170** (3.57)	−0.113* (2.18)	−0.112* (2.17)	−0.118* (2.27)	−0.108* (2.03)	−0.064 (1.17)
Late Pregnancy Smoking: Heavy	−0.237** (3.97)	−0.202** (3.28)	−0.225* (3.40)	−0.221* (3.34)	−0.222* (3.36)	−0.174* (2.60)	−0.168* (2.38)
School-Age Permanent/Transitory Health							
Health Problem at Age 7	−0.365** (3.43)	−0.142 (1.33)	0.024 (0.20)	0.022 (0.19)	0.005 (0.04)	0.040 (0.33)	0.043 (0.34)
Health Problem at Age 11	−0.060 (0.52)	0.028 (0.26)	0.028 (0.24)	0.037 (0.33)	0.029 (0.26)	0.027 (0.24)	0.045 (0.34)
Health Problem at Ages 11 and 7	−0.306 (1.18)	0.062 (0.23)	0.118 (0.42)	0.135 (0.48)	0.132 (0.11)	0.140 (0.48)	0.228 (0.83)
Health Problem at Age 16	−0.110 (1.60)	−0.054 (0.79)	−0.008 (0.11)	−0.012 (0.16)	−0.006 (0.08)	0.017 (0.22)	0.002 (0.02)
Health Problem at Ages 16 and 11	−0.317† (1.77)	−0.153 (0.85)*	−0.082 (0.45)	−0.038 (0.21)	−0.027 (0.15)	−0.055 (0.29)	−0.074 (0.37)
Health Problem at All Ages	−1.261* (4.33)	−0.693* (2.46)	−0.548† (1.88)	−0.378 (1.26)	−0.384 (1.29)	−0.420 (1.45)	−0.224 (0.72)
Incomplete School-Age Health Data	−0.094 (1.19)	0.007 (0.03)	0.053 (0.19)	0.077 (0.28)	0.049 (0.18)	−0.015 (0.29)	0.023 (0.08)
Age 7 Performance							
Reading Comp. Score at Age 7		0.398** (15.44)	0.066** (2.20)	0.062* (2.08)	0.051† (1.69)	0.047 (1.47)	0.066† (1.90)
Math Score at Age 7		0.334** (14.50)	0.119** (4.62)	0.114** (4.40)	0.111** (4.30)	0.093** (3.50)	0.064* (2.29)
Age 11 Performance							
Reading Comp. Score at Age 11			0.391** (11.99)	0.384** (11.75)	0.352** (10.74)	0.274** (8.02)	0.165** (4.45)
Math Score at Age 11			0.362** (10.01)	0.349** (9.56)	0.325** (8.95)	0.214** (5.54)	0.114** (2.69)
Age 16 School Type (Age 11 Tracking)							
Grammar/Tech. School at Age 16				0.258** (2.93)	0.204** (2.30)	−0.189* (2.05)	−0.309* (3.11)
Comprehensive School				0.040 (0.69)	0.014 (0.24)	−0.045 (0.77)	−0.099 (1.63)
Other LEA School				−0.596** (2.89)	−0.633** (3.06)	−0.786** (3.77)	−0.973** (4.49)
Age 11 Educ. Expectations							

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Parents Expect Child to Stay in School					0.361** (5.23)	0.308** (4.45)	0.128* (1.84)
Child Expects to Pursue Educ.					0.034 (0.59)	−0.000 (0.01)	−0.036 (0.60)
Age 16/18 Performance							
Number of O-Level Exam Passes						0.154** (13.05)	0.058** (4.36)
Numver of A-Level Exams Taken						0.404** (10.49)	−0.050 (0.87)
Early Adult Characteristics							
Regular smoker, age 23							−0.277** (4.30)
Regular smoker, age 33							−0.647** (3.50)
Cutpoint Parameters: Cut 1							
Cut 1	−1.071	−1.193	−1,416	−1.326	−0.989	−0.528	0.812
Cut 3	0.235	0.207	0.082	0.172	0.524	1.01	2.507
Cut 4	1.187	1.206	1.174	1.268	1.629	2.17	3.982
Log Likelihood							
Tests of Coefficient Equality							
All Health and Health Behaviors							
x^2 (9)	75.13	39.44	21.83	19.50	19.55	16.34	0.47
$p>x^2$	0.00	0.00	0.01	0.02	0.02	0.05	0.40
Ages 7-16 Health							
x^2 (5)	22.11	7.14	3.96	2.06	1.96	2.62	1.63
$p>x^2$	0.00	0.21	0.56	0.84	0.85	0.76	0.90
Log Likelihood	13499.6	−12331.5	−10422.6	−10412.1	−10357.0	−10094.3	−9919.0
N	10,590	10,590	10,590	10,590	10,590	10,590	10,590

[a] Ordered logistic regression (1=NVQ Level 1, 4=NVQ Levels 4/5). t-ratios (|β/s.e. |) in parentheses. Reference category for school-age health is no childhood health problems. All models include controls for Table 1 child and family characteristics. Models 2-7 successively adjust for age 7 educational performance; age 11 performance; educational tracking; expectations; age 16/18 performance; and smoking in earlier adulthood.

† p<.10

* p<.05

** p <.01

Table 6

Predicted Probability of High NVQ Attainment at Age 42: NCDS, 1958-2000[a]

Probability of NVQ Level 4/5	(1)	(2)	(3)	(4)	(5)	(6)	(7)
No Health Problems	0.319	0.297	0.283	0.283	0.281	0.282	0.274
Prenatal/Infant Maternal Health Behaviors							
Low Birthweight	0.254	0.274	0.269	0.27	0.267	0.267	0.262
Breastfed	0.319	0.303	0.288	0.288	0.286	0.288	0.279
Late Pregnancy Smoking: Variable/Medium	0.279	0.267	0.265	0.265	0.262	0.265	0.26
Late Pregnancy Smoking: Heavy	0.267	0.259	0.244	0.245	0.242	0.252	0.247
School-Age Permanent/Transitory Health							
Health Problem at Age 7	0.245	0.269	0.288	0.287	0.282	0.29	0.286
Health Problem at Age 11	0.306	0.303	0.289	0.29	0.286	0.288	0.28
Health Problem at Ages 11 and 7	0.257	0.311	0.308	0.311	0.265	0.311	0.304
Health Problem at Age 16	0.296	0.286	0.282	0.28	0.279	0.289	0.279
Health Problem at Ages 16 and 11	0.254	0.267	0.267	0.275	0.275	0.271	0.255
Health Problem at All Ages	0.117	0.175	0.186	0.212	0.21	0.205	0.223

[a]Probabilities are computed from estimates reported in Table 5. All models hold Table 1 child and family characteristics constant at their means. Models 2-7 successively adjust for age 7 educational performance; age 11 performance; educational tracking; educational expectations; age 16/18 performance; and smoking in earlier adulthood, at age 23.