Understanding Links between Children's Health and Education

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UNDERSTANDING LINKS BETWEEN CHILDREN'S HEALTH AND EDUCATION*

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Abstract

This paper provides an in-depth examination of the link between health during adolescence and educational attainment in early adulthood. Using data from the National Longitudinal Survey of Youth (NLSY) 97 and the Children/Young Adults of the NLSY79, I address three questions. 1) Is there variation by social status in the link between health and education? 2) What are the social mechanisms that mediate the connection between adolescent health and educational attainment? 3) Do infant, adolescent and maternal health disparities account for racial/ethnic and socioeconomic disparities in educational achievement? The results show that the adverse educational consequences of poor health span the socioeconomic spectrum: rather than avoiding the adverse educational consequences of poor health, children with high social status suffer more educationally than their disadvantaged peers. Secondly, I find that differences in school attendance and performance go furthest in explaining the health/education link. Finally, the findings suggest that researchers must continue to look for the sources of the elusive racial/ethnic and socioeconomic achievement gaps, since infant, adolescent and maternal health do not explain them.

Understanding Links between Children's Health and Education

INTRODUCTION

In his 2006 presidential address to the Population Association of America, Alberto Palloni (2006) emphasized the need for research on the role of childhood health as a mechanism in the intergenerational transmission of socioeconomic status. He pointed to the steady increase in research attention paid to early life conditions as an important contributor to later-life health and social status. While poor health has often been studied as a consequence of childhood and/or family socioeconomic conditions, it is also clear that illness and poor health during childhood have lasting socioeconomic effects (Conley and Bennett, 2000; Case et al., 2005; Smith, 2005). What is less clear is the extent to which the effects of health on future social status differ across socioeconomic groups, or what it is about health during childhood that influences educational success in young adulthood and beyond. Do children with a health disadvantage graduate from high school at lower rates, for example, because they are less able to focus on school than other children or because they and their families develop reduced expectations for their future? In addition, while childhood health disparities may contribute to socioeconomic disparities among the general population, we know little about the role they may play in creating and maintaining the racial/ethnic and socioeconomic achievement gaps that are so persistent in the U.S.

This paper has several goals. It confirms the common finding that health during childhood and adolescence is strongly negatively associated with later educational success. It then goes on to study this relationship in greater depth than is typical. First, I examine variation in the link between health and education by social status. Are the

families of children with a health disadvantage more able to mitigate the negative consequences of that condition if they are socially advantaged? Or do children in these families suffer an equal or greater disadvantage? Secondly, I evaluate the role of two social mechanisms that may mediate the connection between children's health and their educational attainment. Finally, I consider the extent to which health disparities among children account for racial/ethnic and socioeconomic disparities in educational achievement. I examine these questions with data from the National Longitudinal Survey of Youth (NLSY) 97 and the Children/Young Adults of the NLSY79. Understanding the role of early-life health in creating and maintaining educational disparities among young adults, as well as the role of socioeconomic status and race/ethnicity in this process, will facilitate the development of effective interventions.

BACKGROUND

The Nature of the Socioeconomic Status/Health Relationship

Research on the relationship between socioeconomic status and health is abundant, both in the United States and abroad. In the U.S., there is a strong positive association between financial, non-financial and contextual indicators of individuals' socioeconomic environments (education, income, family and neighborhood environment) and many health measures, including self-reported health and the incidence and prevalence of acute, chronic and disabling conditions (e.g., Kitigawa and Hauser 1973; Lynch, 2003; Marmot, 2001; Moore and Hayward 1990; Morenoff, 2003).

More recently, researchers and policymakers have begun to pay attention to the bidirectionality of this fundamental relationship. Often dubbed the "health selection"

debate, researchers have raised the possibility that, just as aspects of a child's socioeconomic environment may affect health, health status during childhood may influence individuals' odds of socioeconomic success later in childhood and into adulthood (Smith 2005). The bidirectionality of this relationship has led to a steady increase in attention to the role of childhood health as a mechanism in the intergenerational transmission of socioeconomic status, and to early life conditions as an important contributor to later-life health and social status. There is a reciprocal relationship between socioeconomic status and health, whereby socioeconomic disparities act as "fundamental causes" of health disparities (Link and Phelan 2000), which in turn generate additional socioeconomic disparities (e.g., Case et al. 2005; Conley and Bennett 2000).

This seemingly common-sense notion has posed conceptual and methodological challenges for researchers who hope to draw causal and policy conclusions from their work. If children's socioeconomic status and health affect one another, than we might, for example, mistakenly attribute unhealthy children's decreased education solely to their health rather than to unmeasured characteristics of their socioeconomic environment. This challenge has been addressed both conceptually and methodologically. Conceptually, researchers studying the interplay between health and socioeconomic status have tried to "measure the unmeasured" as much as possible by thinking carefully about potential extraneous circumstances in children's lives that might drive the relationships in which they are interested, and measuring these circumstances as much as possible in their analyses. Methodologically, randomized control trials have begun to track the effect of health over time (e.g., Thomas et al. 2003). In addition, the use of

statistical methods such as fixed effects models allows researchers to control for at least the unobserved characteristics of individuals that do not change over time.

By combining these conceptual and methodological approaches, studies have begun to show that the path between socioeconomic status and health in fact works in both directions. A health disadvantage in childhood, most often defined by low birthweight, adversely affects academic achievement and attainment later in childhood (Boardman et al. 2002; Conley and Bennett 2000; Currie and Hyson 1999; Currie and Stabile, forthcoming; Hack et al. 2002). While this relationship is still debated (e.g, Gorman 2002; Kaestner and Corman 1995), health status early in life may play a significant role in determining individuals' socioeconomic trajectories (for a good review, see Palloni and Milesi forthcoming). It is not clear, however, which children are most affected by poor health, or how children with a health problem early in life end up educationally disadvantaged down the road relative to their healthy peers.

Is Poor Health Equally Detrimental for All Children?

Much is known about the link between physical and mental health early in life and later socioeconomic success. We know much less about how this relationship varies according to children's own characteristics, as well as those of their families and social environments. It is clear that the relationship between socioeconomic status and health varies with age over the course of childhood. Boardman et al. (2002), for example, examine the extent to which the relationship between birth weight and educational achievement varies by age, and find that the gradient increases with age. Currie and Stabile (2003) find that the relationship between SES and health during childhood varies with age, and that this is primarily because low-SES children experience more health

shocks, not that they respond differently to these shocks.

The extent to which the relationship between health and education varies by social status is less clear than the age gradient in the relationship. Variation by social status could appear in one of several forms, as shown in Figure 1. First, as shown in Panel A, high social status may mitigate any negative consequences of poor health, so that the relationship between health and subsequent social status is stronger and more negative for disadvantaged populations.[1] There may be a "double jeopardy" associated with having multiple marginalized statuses, such being old and a member of a disadvantaged racial/ethnic group (e.g., Ferraro and Farmer 1996), or being poor and a minority. There may also be a double jeopardy that comes with facing both a health and a socioeconomic disadvantage. Children who experience advantaged surroundings are not exposed to the routine stressors associated with financial hardship, discrimination, or crime and may be better able to thrive from an early age, even with a health disadvantage (e.g, Escalona 1982). In addition, parents of children with a health condition may be more able to compensate for what would otherwise be adverse consequences by investing greater financial, social and cultural resources toward the child (Becker and Tomes 1976). Pampel and Rogers (2004) find some support for the double-jeopardy, or "vulnerability" hypothesis in their examination of SES, smoking and health. Conley and Bennett (2001), looking at birth weight and education among adults in the Panel Study of Income Dynamics, find that high income children do not suffer the same adverse educational consequences of low birth weight as lower-income children within a ordinary least

[1] While this concept of mitigation refers to the interaction between health and social status, note that "mitigation" is also possible in the additive sense. Stronger effects of social status than of poor health on later education, for example, may mitigate the negative effect of poor health so that across social status groups, the adverse effects of poor health can be offset by high social status.

squares framework, but not within a stricter model that controls for unobserved, family-specific characteristics.

An alternative possibility is that advantaged children are equally or even more adversely affected by poor health than less well-off children, as shown in Panel B of Figure 1. Children with higher social and economic status may have more to lose. A health problem may lead to the loss of the advantages that these children hold over their peers both in and out of the classroom. In other words, a health problem will certainly not help the educational progress of low SES children, and may exacerbate the difficulty of progression, but it may do the same for high SES children, with greater consequence. This possibility is sometimes referred to as the "Blaxter hypothsis," stemming from Blaxter's (1990) finding that the adverse health consequences of smoking are most pronounced among those with high SES. Currie and Hyson (1999) find in a sample of British adults that low SES children are not always more harmed more by low birth weight than their wealthier peers—high SES boys, for example, are more adversely affected by low birth weight than low SES boys. Other studies examining interactions among SES and smoking behavior have come to mixed conclusions about how health behaviors and status interact with social status to influence later-life well-being.[2] Adda and Lechene (2001) argue that social class differences in life expectancy explain higher smoking rates among low-SES populations, since the longevity cost of smoking is higher among higher-SES people. Marang-van de Mheen et al. (1999), in contrast, find that the

[2] Also possible is that well-off children born with a health problem may be more likely to survive than lower SES children, since they have greater access to expensive and current technology. If this is true, then the babies that do survive may suffer greater cognitive and educational consequences later in life. Currie and Hyson (1999) examine this in a British sample, however, and find no evidence that this is the case, at least for birth weight. This possibility is also less likely in a society with such low mortality at the United States.

influence of smoking cessation on mortality does not differ by SES.

Studies examining the variation that exists by social status, or "contingencies" (Palloni 2006: 601) in the relationship between health and education, have not reached consistent conclusions. The mixed evidence on this topic suggests the need for further examination with measures of health during childhood (as opposed to birth weight and measures of adult health) and with data from the United States, in order to gain a greater understanding of how the relationship between early-life health and educational success is contingent upon social status.

Why Should Health Matter for Educational Achievement?

Clarifying how childhood health exerts its influence is equally important to identifying the presence of an association, since an understanding of mechanisms exposes concrete areas for intervention. It is unclear if indirect social factors mediate the influence of poor health, or if there is a direct link, perhaps related to physiology and physical/brain development, between health and social status. Those who argue that there is a direct, or a lasting distant effect of health on well-being later in life, argue that conditions early in life, even in utero, permanently alter physiological and cognitive functioning. The influence of early-life development and health on later-life health and social status may be attenuated somewhat by intervening environmental experiences, but a lasting effect of early-life health should still remain. Barker and colleagues (1994, 1995, 2001), for example, argue that the fetal development stage is key, since fetuses is exposed to risk factors (e.g., reduced blood flow to the placenta) could experience long lasting physiological and cognitive disadvantage during childhood and into adulthood. There have been some tests of this fetal "programming" (Lucas 1991) hypothesis,

particularly in relation to health later in life. Case et al. (2005), for example, find that there is an effect of the uterine environment on health in middle age, independent of education, health and income in earlier adulthood. Similarly, Bengtsson and Lindstrom (2000) find that "disease load" experienced during the first year of life influences mortality in old age. There have been fewer tests in the social sciences of the long-run cognitive and economic effects of the uterine environment, independent of intervening social status.

Another possibility is that health might be an indirect, distant influence on later social status and health, by shaping more proximate social characteristics of people's environments, such as performance and success in school, social and family relationships, and ultimately, earnings, education and health status. The large body of evidence uncovering relationships between early-life health and development of verbal/math skills, performance on achievement tests, assessments of motor and social development, and social functioning raise the possibility that health may act as an indirect determinant of later-life success through more proximate social factors, but that health does not have a lasting influence in its own right. There is very little empirical work testing this possibility.

Conceptually, these indirect social pathways linking health and education can be separated into practical and perceived routes. While their educational consequences may be equal, these two routes imply different processes from health to educational status and should therefore be considered separately. Practically, experiencing a health disadvantage during childhood may cause a child to miss more days of school than his healthy peers. Without the proper safety net to compensate for missed schoolwork and

learning, children may fall behind academically over time. In addition, children with poorer health may experience slower cognitive development. There is evidence that children's health influences cognitive development and academic performance, with unhealthier infants and children scoring lower on achievement tests and assessments of motor and social development (Boardman et al., 2002; Hack et al. 1995; Matte et al. 2001; Wadsworth 1986). If so, does this partially explain disparities in educational attainment? Of course, the cognitive pathways through which health leads to reduced educational success may be highly dependent on the particular health problem. There may be lasting cognitive effects associated with being born under a normal birth-weight, for example: even at very young ages, there is evidence that low birth weight babies are not as adept at handling objects or reacting to visual information (Ruff et al. 1984; Scott et al. 1989). Such subtle deficiencies may deter young children from learning and developing intellectually, resulting in reduced academic success. Or, in another example, children who suffer from anemia may become easily fatigued, which may alter their capacity to learn effectively and to perform well. Nonetheless, there may also be a general effect of poor health on cognitive development, which could explain the lower educational attainment of less healthy children.

While missed school and reduced cognitive development fall under the school attendance/performance domain, there are also perceived limitations associated with poor childhood health that may translate into reduced educational attainment. Mirowsky et al. (2000), drawing from Seeman's (1983) discussion of powerlessness, argue that the link between socioeconomic status and health may be explained in part by differential levels of perceived control, or beliefs in the extent to which people can affect their outcomes by

making particular choices. As the authors argue, those in low-status conditions have a weaker sense of external control and a stronger belief that their outcomes are not in their hands. While this argument has typically been put forth to explain socioeconomic disparities in health status, it may also be relevant in explaining the converse: health-generated disparities in socioeconomic status. Experiencing a health disadvantage during childhood may alter personal and family expectations related to education, as well as the nature of school-based social relationships. Children who struggle with illness may reduce their educational expectations, believing that they cannot control what happens to them in the future, and that they are in large part limited by their poor health. The same may be true on the part of parents. As a result of a child's sickness relative to other children, parents may reduce their expectations for his or her future, leading them to decide that it is more important and hard enough to keep the child healthy than to push him to excel academically. Finally, just as children may develop a sense of hopelessness about their educational future due to their health, they may function less well in social relationships at school and be more likely to be bullied. Other work demonstrates that children in poor health exhibit lower social functioning than their healthier peers (Gortmaker et al. 1990; Meijer et al. 2000).

I will consider these two social pathways, school attendance/performance and perceived control. The data I use do not permit a life-course analysis of the "fetal programming" hypothesis, but they do allow for a comprehensive examination of social pathways, which are often the subject of speculation but not of empirical investigation. In their work in this area, Haas and Fosse (2006) examine the role of academic achievement and psychosocial factors in explaining the relationship between health and

education, and find that both factors, especially achievement, contribute to the gap.[3]

Implications of Health Disparities for Inequality in Educational Achievement

One important question underlying the childhood health/young adult educational outcomes relationship is whether or not health explains the persistent racial/ethnic and socioeconomic gaps in educational achievement. Researchers have begun to pay close attention to the sources of racial/ethnic disparities in test scores and school readiness (Currie 2005; Duncan and Magnuson 2005; Jencks and Phillips 1998). In addition, it is clear that race/ethnicity and socioeconomic status are important predictors of health status in the U.S. Strong socioeconomic gradients in health exist among children (Case et al. 2002; Finch 2003). Black children have higher rates of chronic and infectious conditions, as well as lower rates of diagnosis and proper treatment (National Center for Health Statistics 2004: pg. 21). The health status of Hispanics is less clear, given the "Hispanic mortality paradox," whereby Hispanics exhibit lower rates of many diseases and conditions, despite their socioeconomic disadvantage relative to non-Hispanic whites (e.g., Landale et al. 1999). This effect diminishes with generation and length of time spent in the U.S., however, meaning that many Hispanic children have equal or higher rates of disease and illness than their non-Hispanic white peers. While gaps in overall attainment are often fully explained by socioeconomic characteristics that differ between groups, the sources of the achievement gap are much more elusive. Currie (2005) suggests that health problems of children and their mothers may contribute substantially

[3] The authors examine the role of adolescents' cognitive development and "psychosocial relationships to peers and school" (11) in explaining the link between adolescent-reported health and educational attainment. Here I focus not on adolescents' school relationships, but on the expectations that they and their families have related to education. In addition, I examine variation in the relationship between adolescent health and later education, and I consider the role of health in explaining the U.S. academic achievement gap.

to the observed gap in academic achievement between blacks and whites. There have been very few empirical examinations of this possibility, however, with the few existing studies limiting their consideration of health to birth weight (Brooks-Gunn et al., 2003; Padilla et al. 2002; Reichman 2005). In an effort to consider the impact of childhood health for one dimension of socioeconomic and racial inequality, the last part of this paper will examine the contribution of socioeconomic and race-based infant, maternal and childhood health disparities to educational disparities.

The next section presents the data, variables and statistical methods used in the analyses. I then present results from each of the three questions discussed above: 1) the association between adolescent health and educational attainment, and variation in that relationship by social status, 2) the social pathways that explain the health/education link, and 3) the role of health disparities in explaining U.S. academic achievement gaps. Finally, I end with conclusions and implications.

METHODS

Data

Data from the National Longitudinal Survey of Youth 97 and Child/Young Adults (CYA) files provide the basis for this examination of the relationship between health and educational attainment/achievement in young adulthood. I use the NLSY97 to examine the relationship between health and educational attainment, the social pathways mediating this relationship, and the contribution of health to SES and racial differences in educational achievement. I use the NLSY79-CYA to complement the NLSY97 in the last part of the analysis. The NLSY-CYA contains measures of infant and maternal

health, allowing me to consider the contribution of earlier-life and maternal health to disparities in achievement.

The NLSY97 is a nationally representative panel survey of 9,000 U.S. children/adolescents aged 12-16 in 1997. The survey has continued on an annual basis since 1997, and now consists of seven waves of data available for public use. Information is collected from adolescents with the goal of studying the transition from childhood and school into adulthood. The survey collects extensive information from youths about their health (in 1997, information about the youths' health was also collected from parents), educational experiences, relationships and expectations, rendering it very useful for a study of the pathways that mediate the link between health and education.

The NLSY79 is a nationally representative panel survey of U.S. men and women born in the years 1957-1964. Beginning in 1986, a separate survey of the children of the female NLSY79 respondents was begun, which has been repeated biennially. Information is collected from both mothers and children (depending on their age). Beginning in 1994, children ages 15 and older also complete a young adult survey that includes the same information. As of 2002, a total of 11,340 children were born to the original 6,283 NLSY79 female participants (NLSY79 Child and Young Adult User Guide, 2002). The Child/Young Adults files of the NLSY79 contain information on children's health and on maternal health behaviors, as well as on children's educational achievement. The data also contain large numbers of blacks, whites and Hispanics, permitting the examination of the sources of racial disparities in achievement. I pool data for 1986-2002 and limit analyses of educational achievement to children ages 14 and

below, since young adults did not complete educational assessments.

Measures

Dependent Variables. Table 1 lists the variables used in all parts of the analysis. Educational attainment is the dependent variable in the first part of the analysis, which uses the NLSY97 to examine two pathways in the health/education relationship. A commonly used measure of educational attainment is whether someone receives a high school diploma. I construct an indicator of timely high school graduation—that is, whether or not the adolescent received a regular high school diploma by the age of 19. I limit my definition of high school completion to regular diplomas, as opposed to GEDs, since there is evidence that those who receive GEDs experience less favorable socioeconomic trajectories than those who receive a traditional diploma (e.g., Cameron and Heckman 1993). Since high school graduation may not be the best indicator of educational success, given high rates of high school completion in the U.S. today (Mare 1995), I also include a measure of whether or not the adolescent attends at least some college after high school graduation.[4] All seven waves of data (1997-2003) are used in constructing these two measures of attainment.

In the last part of the analysis, where I examine the contribution of health to disparities in educational achievement, the dependent variable is academic achievement. Two broad indicators of academic achievement are used. In the NLSY97, I look at adolescents' scores on the Armed Services Vocational Aptitude Battery (ASVAB). The ASVAB is an assessment of math (knowledge and arithmetic reasoning) and verbal

[4] I also construct a measure indicating whether or not the adolescent completed the SAT during the seven waves of the survey (1=yes). I do not present the results of this measure, since it has a greater risk of endogeneity with the measures of achievement and school performance. Results are substantively similar with this measure, however.

(word recognition and passage comprehension) skills. I use the age-adjusted math-verbal percentile score, with a score ranging from 0-99. From the NLSY79-CYA, I use children's math and reading recognition scores on the Peabody Individual Achievement Test (PIAT). The math assessment tests skills in mathematics topics taught in mainstream education, including basic concepts such as number recognition and also more advanced concepts in geometry and trigonometry (NLSY79 Child and Young Adult User Guide, 2002: 106). The reading recognition test measures word recognition and pronunciation ability to gauge reading achievement. Age-normalized percentile scores are used for both assessments. Children with missing data on the NLSY97 ASVAB (1,891 people) or the NLSY79-CYA PIAT assessment scores (19,005 person-years) were dropped from analyses where these variables are dependent variables.

Independent Variables. In the first part of the analysis I include several independent variables. Health is measured by adolescent and parent self-reports. The NLSY97 contains substantial detail about physical and mental health conditions and the date of their onset. For any given health problem, however, there is very little variation among children, making it hard to examine the effects of any particular condition. Instead, I use two measures of adolescent health: adolescent-reported health and parent-reported health (of the adolescent).[5] The two health measures are included in the models together, and are presented as dummy variables, with a value of 1 indicating those in

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[5] I also tested a parent-reported indicator of whether or not the adolescent has ever had a chronic illness (not necessarily at the time of the interview or in the recent past). In contrast to the other health measures, this measure is not a significant predictor of the odds of attending some college. This measure is problematic and vague, however, as it does not necessarily measure general health, but could in some cases measure isolated instances of poor health that do not persist. In contrast, the self-reported measures may more accurately capture prior, present and future health status. I do not report the results of the chronic illness measure analysis here.

good/fair/poor health relative to those in excellent/very good health.[6] Research has shown that self-reported health is predicted by clinical factors such as body mass index, type II diabetes and cardiovascular health (Goldman et al. 2003), and that it is a strong predictor of future survival, morbidity and health care need (Idler et al. 1997; Moller et al. 1996). In addition, it is likely that self-reported health is a more holistic measure of health. In contrast to objective, clinical measures of health, self-reports capture people's perceptions of their own health, and may capture both physical and psychological/emotional aspects of health among both adults and children/adolescents (Boardman 2006; Goldman et al. 2003).[7] In addition to the health measures, I include a number of social and demographic variables that may be correlated with health and with educational attainment. These variables are described in Table 1.

Finally, I include measurements of the two pathways between health and educational attainment. I use several indicators of school attendance/performance, broken up into two domains: health-related school limitations, and academic achievement. Health limitation measures include whether or not the adolescent has experienced school and work limitations due to his or her health, and the number of days absent from school in the last term. Academic achievement/cognitive development measures include the ASVAB percentile score (described above), whether or not the adolescent has ever repeated a grade, and the child's grade performance in the most

[6] The correlation between the two health measures is about .3. Results are not sensitive to the addition of "good" health to the "excellent"/"very good" category, to a linear term for health, or to a multiple category representation of health.

[7] Previous work has also shown that Hispanics tend to report poorer health, even after controlling for clinical measures of physical and mental health (Franzini et al. 2004). To eliminate any bias introduced by this possibility, I conduct analyses both with and without Hispanics (where the sample is limited to non-Hispanic blacks and whites). Results do not differ in substantive and statistical significance, so the results I present here include Hispanics.

recent full year of school prior to 1999. A higher value on this variable indicates poorer performance (1=mostly As, 2=Mostly As and Bs, 3=mostly Bs, etc.). To assess perceived control, I include three expectations questions: adolescents' estimate of the likelihood that will graduate from high school in a timely way, their responding parent's expectation that the youth will finish high school, and adolescents' estimate of the likelihood that they will be enrolled in regular school next year. The expectations variables range from 0-100%, with higher numbers indicating a greater expectation of completion.[8] Since the three expectations questions were only asked to adolescents born in 1980 and 1981 (not those born in later years), models with the perceived control variables are based on a smaller subset of the sample, and are therefore compared to a different gross model than the school attendance/performance variables. The perceived control models therefore examine an older age group than the school attendance/performance models, which include all ages.

The last part of the analysis—the contribution of health to disparities in educational achievement—uses all of the NLSY97 variables mentioned above, with the exception of the school-readiness and perception variables. Independent variables from the NLSY79-CYA for this part of the analysis, described in Table 1, include the child's birth weight, mother's age at birth, and whether or not: the child was breastfed as an infant, the mother smoked during pregnancy, the child was brought to a doctor for an illness during the first year of life, and the child went to the doctor for an illness in the past year.

[8] I also included two social functioning measures: the number of times the adolescent has been threatened/bullied at school, and the number of times that he/she has gotten into a fight at school. The correlations between these measures and children's health, however, are very weak, and so I do not include them in the analysis.

Analysis

The analysis is several-fold. Part one uses the NLSY97 to examine the association between adolescent health and educational attainment, and variation in that relationship by social status. Part two uses the NLSY97 to study the social pathways that explain the health/education link. Finally, part three uses the NLSY97 and the NLSY79-CYA to consider the role of health in explaining U.S. academic achievement gaps.

First, I establish an association between adolescent health and educational attainment in late adolescence/young adulthood, net of socioeconomic and family characteristics. Although I use all seven waves of the NLSY97 to construct the dependent variables, my analysis sample only contains one observation per person, since the dependent variables do not vary within individuals. All independent variables are measured at round 1 (1997) of the survey. I use logistic regression models to examine the relationship between adolescent health and education in early adulthood. These models can be represented by:

$$\log[\frac{p_i}{1-p_i}] = \beta_0 + \beta_1 X_{ih} + \beta_2 G_h + \varepsilon_i \qquad (1)$$

where $\log[\frac{p_i}{1-p_i}]$ equals the log odds of *p,* the probability that each adolescent, *i,* within a household, *h*, graduates from high school in a timely manner or attends some college. G_h is a vector of household-specific characteristics, X_{ih} is a vector of adolescent-specific characteristics (including health). ε_i is an adolescent-specific error component. Standard errors in these regressions are computed using the Huber/White/Sandwich estimator to account for the clustering of adolescents within households (Huber, 1967; White, 1980).

I also conduct several additional analyses to test the sensitivity of the results. First, I estimate random-effects logit models, which account for the clustering of adolescents within families and reduce bias in standard errors. Random effects models allow intercepts, and sometimes slopes, to vary as a function of adolescent and family characteristics and a random error component, and can be written generally as:

$$Y_{ih} = \eta_0 + \eta_1 G_h + \eta_2 X_{ih} + \alpha_{0h} + \varepsilon_{ih} \quad (2)$$

where *i* indicates an adolescent within a household, *h*. G_h is a vector of household-specific characteristics, X_{ih} is a vector of adolescent-specific characteristics (including health), α_{0h} is a random error component and ε_{ih} is an adolescent-specific error component.

While these models account for bias due to clustering, they assume that the errors are uncorrelated with the regressors; that is, they assume that there are no unmeasured factors that are correlated with both the measured characteristics and with educational attainment. Failing to account for these characteristics, if they exist, may bias coefficients. As a final analysis, I therefore take advantage of the fact that there are multiple children within the same household by estimating household-level fixed-effects models, which can be represented as:

$$Y_{ih} = \beta_0 + \beta_1 X_{ih} + \mu_h + \varepsilon_{ih} \quad (3)$$

where X_{ih} is a vector of child-specific observed characteristics (including health) that vary within households, and μ_h is a household-specific fixed effect. This modeling strategy controls for the linear and additive effect of factors that do not vary between

siblings, even if they are not observed. Unobserved family-level characteristics that do vary within households are not accounted for, however.

After the first step of establishing the presence of an association between health and educational attainment, I then assume a causal relationship and look for variation in this relationship by social status. I test for interactions between health and parental education, health and household income, and health and race/ethnicity. Following this, I move on to part two of the analysis and successively add the social pathway variables to the logit models specified in (1), in order to test the school attendance/performance and perceived control pathways in explaining the relationship between health and education. I compare changes in the relationship with the addition of mediating variables by computing predicted probabilities. Finally, part three of the analysis uses random-effects logit models to examine the contribution of infant, adolescent and maternal health disparities to gaps in educational achievement, using the NLSY97 and the NLSY79-CYA.

RESULTS

Sample Characteristics

Table 2 presents descriptive characteristics of the NLSY97 sample, by race. Non-Hispanic whites make up a little more than half of the sample, with blacks and Hispanics composing 25% and 18% of the sample, respectively. The mean age is about 14 years. The mean education of the responding parent is about 13 years, although this varies by race, with non-Hispanic whites' parents having a year more of education than blacks' parents, and almost 3 more years than Hispanics'. The mean health adolescent rating given by both adolescents and parents is "very good" (2 on a scale of 1 to 5); this does

not vary substantially by race. The majority of the sample graduates from high school in a timely way (87%) and 52% attend some college. These patterns vary somewhat by race, with blacks and Hispanics less likely to experience timely high school graduation and attend some college than whites. One striking racial difference is in the likelihood of repeating a grade: 22% of blacks have ever repeated a grade, compared to only 12% of non-Hispanic whites and 18% of Hispanics.

Is Health Associated with Educational Attainment? And Is Poor Health Equally Detrimental for All Children?

Tables 3 and 4 present the relationship between adolescent and parent-reported health and timely high school completion and attendance of some college, respectively. Using likelihood ratio and Wald tests, I compare an unconstrained model with three interactions (health and parental education, health and household poverty ratio, health and race) to a series of more constrained models. The best-fitting model is found to be one with two interactions—one between health and household poverty ratio, and one between health and race/ethnicity. The results for that model are discussed.[9] Models 1 and 3 in Tables 3 and 4 are relevant for this portion of the analysis. Model 1 shows the association between health and educational attainment, with the two interactions, for the entire sample, while Model 3 shows the association for the older subset of the sample who answered the questions about future educational expectations.

Tables 3 and 4 demonstrate that there is a strong association between adolescent-rated health during adolescence and educational attainment in young adulthood, net of important observed characteristics of individuals and families, and that this relationship

[9] The logistic regression models are presented in the tables, since the random-effects estimates were quite similar.

varies significantly by social status. Interestingly, with one exception, parent-rated health is not a significant predictor of adolescents' educational attainment in young adulthood. Parent-rated health is strongly associated with education in a model without adolescent-rated health, but this relationship disappears when adolescent-rated health is introduced into the model. While there are a number of reasons for this pattern, one possibility is that parents' rating of their adolescents' health depends to some extent on how the adolescent views his own health. Once this is accounted for, the parental rating does not capture additional information about adolescents' health, and therefore does not independently predict educational success. I focus the discussion around the adolescent-rated measure of health, given its greater significance.

In the case of timely high school graduation, as Model 1 in Table 3 shows, adolescents who rate their health as "good" or worse health (relative to those in very good or excellent health) are expected to suffer the most significant educational disadvantage if they live in the wealthiest families. Among non-black, non-Hispanic adolescents, being in "good" or worse health, relative to very good or excellent health, is associated with a 54% ($e^{-.385-.399}$) decrease in the odds of timely high school graduation for the wealthiest adolescents, versus a 32% ($e^{-.385}$) decrease for their poorest peers. There is also significant variation in the relationship between health and timely high school graduation by race/ethnicity. Black adolescents do not appear to be as negatively affected by poorer health as their non-black peers. Among the wealthiest adolescents, being in "good" or worse health is associated with a 54% ($e^{-.385-.399}$) decrease in the odds of timely high school graduation for non-black, non-Hispanic (NBNH) adolescents, versus a 33% ($e^{-.385-.399+.380}$) decrease for blacks. The pattern of these results does not

change when the older subset of the sample, for which the future educational expectations questions were asked, is analyzed (Model 4 in Tables 3 and 4). In fact, the magnitude of the health coefficients is consistently larger, suggesting that there is an age gradient in the effect of health on educational attainment, with stronger associations observed at older ages.

The case of college attendance has both similarities and differences. The interaction between health and race persists, and is significant for Hispanic adolescents as well as blacks. Among the wealthiest adolescents, for example, those in good or worse health, relative to very good or excellent health, are expected to face a 55% decrease in the odds of attending some college if they are not black or Hispanic, relative to a 17% decrease for blacks and a 26% decrease for Hispanics. The interaction between health and household poverty ratio is not significant in the case of college attendance.

These results can also be understood by examining predicted values, as shown in Table 5 and in Figures 1 and 2. The probabilities show that health status contributes substantially to the gap in the likelihood of high school completion and college attendance within racial/ethnic groups, but not as much across racial/ethnic groups. Within the non-black, non-Hispanic group, for example, the difference in the probability of timely high school graduation between less healthy, wealthy children and the healthiest, poorest children is about 14% (.81 vs. .70). This difference is smaller than the 23% difference between wealthy and poor adolescents who are all in excellent health (.91 vs. .70). While wealthier children still have a higher likelihood than poorer children of completing high school on time, regardless of health status, health status does diminish the socioeconomic difference (within racial/ethnic groups). In the case of college

attendance, poor children in the best health actually have a slightly higher likelihood of attending some college than their wealthy peers in poorer health (.51 vs. .49). This stands in contrast to the initial 25% gap between wealthy and poor children who are all in the best health (.69 vs. .51).

Health status does not contribute as much to the racial/ethnic gap in the likelihood of high school completion and college attendance as it does to the socioeconomic gap, for a person with average values on all other individual and family characteristics. Among the wealthiest adolescents, for example, there is a 13% difference in the probability of timely high school completion between healthy, NBNH adolescents and their less healthy black peers (.91 vs. .78). This is greater than the 2% difference between NBNH and black adolescents who are all in very good or excellent health (.91 vs. .89). A similar pattern is observed for the case of college attendance.

Overall, these results suggest that there is not a "double jeopardy" associated with facing both a health and a socioeconomic disadvantage, but that poor health has educational consequences at all levels of the social status spectrum. Economic and social advantage does not allow families to mitigate the negative educational consequences of adolescents' poor health. In contrast, children who are the most advantaged along these lines appear to be more adversely influenced by their health problems in their educational progress. That is, advantaged families may be able to exploit their class or racial advantages when their children's health is good, but not when it is compromised. These results are not consistent with those of Conley and Bennett (2001) and of other studies supporting the double jeopardy hypothesis, but are in line with the findings of proponents of the "Blaxter hypothesis."

How Robust is the Relationship between Health and Education?

As a supplement to the logistic regression and random-effects estimates, I estimate models with household-specific fixed effects, to control for unobserved and invariant characteristics of children's households that may be correlated with both health and educational success. Model 5 in Tables 3 and 4 show the results of the fixed-effects analyses. When unobserved family factors that do not differ among children within the same household are differenced out of the model, the results are less consistent but still persist for the relationship between adolescent-rated health and college attendance. The estimated coefficient of college attendance is smaller but still highly significant in the fixed-effect specification (-.519 vs. -.742). In the case of timely high school graduation, the fixed-effects model limits the sample to families in which one child graduates from high school in a timely manner, and one does not. This is a very limited subset of the U.S. population. Logistic regression and random-effects models run on the sibling fixed effects samples for timely high school graduation and attendance of some college produce very similar results to the fixed-effects models. This suggests that the statistical insignificance of the high school graduation fixed effects model is due to the sample composition, and not to unobserved family characteristics. The differences in the composition of the sample between the random-effect and fixed-effects models should therefore be considered when interpreting the results of these models. These results suggest that unmeasured characteristics of families play a role in explaining the relationship between health and educational attainment, but that health may also have a significant influence on its own.

Do School Readiness and Perceived Control Explain the Link between Health and Educational Attainment?

Given that there is an association between adolescent health and educational attainment, Models 2 and 4 in Tables 3 and 4 examine whether or not these associations are generated by differences among adolescents in school attendance/performance or in levels of perceived control related to future expectations. These models are summarized concisely in Table 5, which presents adolescents' predicted probabilities of timely high school graduation and college attendance, with and without the school attendance/performance and perceived control pathways.

Models 1 and 3 in Table 5 present the predicted probabilities of each outcome based on the gross model (which controls for observed individual and family characteristics). As described earlier, Model 3 is the gross model for the older subset of children, those who completed the expectations module of the survey. Models 2 and 4, respectively, display the predicted probabilities after the addition of the school attendance/performance and perceived control mediators. The table demonstrates that the school attendance/performance pathway significantly reduces health-based disparities in educational attainment. Models 1 and 3 display significant gross disparities between adolescents in excellent health and those in poor health. Among high income non-black, non-Hispanic adolescents, for example, the predicted probability of timely high school completion is .91 for those in excellent or very good health, versus .81 for those in poorer health; adolescents in poorer health therefore have a 10% lower probability of timely graduation. When the school attendance/performance measures are included in the model, however, this gap decreases to a statically insignificant 7% gap. The results are

similar for the case of college attendance. The remaining gap is still significant, however, suggesting that there are additional factors explaining the lower college attendance of adolescents in poorer health. In line with previous research, school attendance/performance also explains the racial/ethnic gap in educational attainment. In fact, once these factors are accounted for, blacks are expected to have higher educational attainment.

The perceived control pathway plays a less significant role than the school attendance/performance pathway in explaining gaps in educational attainment between healthy adolescents and their less healthy peers. For example, the 8% lower probability (Model 3) of timely high school completion that adolescents in poorer health are predicted to experience persists when perceived control measures are considered (Model 4), with the gap increasing to 10%.

Do Health Disparities Contribute to the Racial/Ethnic and Socioeconomic Gaps in Educational Achievement?

A final question considered in part three of the analysis is whether health differences between adolescents explain the racial/ethnic and socioeconomic gaps in educational achievement. Unlike disparities in educational attainment, the sources of the achievement gap are elusive. Given documented racial and socioeconomic disparities in health and health-generated disparities in educational achievement, researchers have begun to suggest that the health of children and their mothers may act as one determinant of the observed gap in achievement. Table 6 presents predicted achievement test scores by race/ethnicity, both for the NLSY97, which contains adolescent health measures, and

the NLSY79-CYA, which also includes indicators of infant and maternal health.[10] Model 1 presents the gross relationship (adjusted for observed individual and family characteristics). Model 2 presents the relationship between race and achievement, net of health. I compare the gross and net predicted probabilities. As is clear from Table 6, the adolescent health behaviors considered here do not significantly reduce the racial achievement gap. Before accounting for health status, for example, black adolescents have a predicted ASVAB percentile score that is 24.3 points lower than non-Hispanic whites (29.7 vs. 54.0). After considering self-rated health and the presence of a chronic illness, the reduction in this gap is negligible—the gap is still 24.0 points.

The NLSY-CYA permits examination of the influence of health earlier in life and in utero, since it contains measures of infant and maternal health. As Table 6 shows, the 5.5 point gap in children's PIAT reading standard scores is reduced by almost a point when birth weight, breastfeeding, mother's prenatal smoking behaviors and doctors' visits during infancy and childhood are considered. A significant gap between blacks and whites still remains, however. Hispanics' predicted scores lie in between those of blacks and non-Hispanic whites; in both data sets, their scores are similarly affected by a consideration of health status.

These results suggest that racial/ethnic disparities in adolescent health, at least as defined by the measures used here, do not explain any of the racial gap in academic achievement. These results are not surprising, given that there are not substantial disparities in overall health in the NLSY97, as Table 2 shows. In the NLSY79, however, there are large race-based health disparities, especially in birth weight and breastfeeding

[10] Due to space limitations, I do not present the results from the analysis of the socioeconomic achievement gap. Results are similar, however.

behavior. This likely explains the slightly larger role played by infant/maternal health in explaining the racial achievement gap in the NLSY79. Despite the role of infant health and maternal health behaviors, however, there are clearly many factors explaining the persistent racial/ethnic gap that have not been considered here.

CONCLUSIONS

Early-life health may play a significant role in determining individuals' socioeconomic trajectories. It is increasingly clear that individuals' socioeconomic status and health are generated reciprocally, where each affects the other over the course of a lifetime and across generations. This study focuses on one half of the relationship by examining the association between adolescent health and educational attainment in greater depth than is typical. It exposes variation in the relationship according to children's social and economic status, and begins to explore how health may translate into lower educational attainment. Finally, it considers the extent to which disparities in health and health behavior among infants, children and mothers account for socioeconomic and racial/ethnic disparities in children's educational achievement. Just as it is important to understand how health disparities may contribute to socioeconomic disparities among the general population, it is also worth understanding if and how much they contribute to the ever-present achievement gap.

The analyses in this paper are not without limitations. Most importantly, caution is warranted in the interpretation of the results, since the methods here cannot address all possible sources of bias from omitted variables. The results presented here demonstrate strong associations; as in all non-experimental studies, however, they cannot be taken as proof. This notwithstanding, several findings emerge from the analysis. First, the results

add to the mounting evidence showing that the relationship between health and socioeconomic status is not unidirectional. They suggest that overall health status during childhood and adolescence does influence children's educational success. Secondly, the findings suggest that rather than avoiding the adverse educational consequences of poor health, children with high social status are hurt more by poor health than more disadvantaged children. These results go against what might be expected, but make sense. It is possible that a wealthy child who experiences a health problem loses the advantages that they hold over their peers both in and out of the classroom. Since children with fewer economic and social resources did not have these advantages in the first place, they stand to lose less from a health problem. These results highlight the reality that the adverse educational consequences of poor health span the socioeconomic spectrum. Future work should examine whether the educational disadvantage associated with poorer health among more advantaged children varies according to the level of financial and social compensatory efforts on the part of parents. What are the ways in which parents try to compensate for a child's health problem, and do they work?

Third, the results suggest that, although not necessarily unimportant, disparities in perceived control do not go very far in explaining health-generated gaps in educational attainment. Rather, it appears that the daily concerns that youth face—missing school due to illness, performing worse in school—play a larger role in explaining the gap. It is possible that the pathways considered in this analysis work together in some way, rather than operating in exclusion from one another. Children may develop low levels of perceived control about their educational futures, for example, not only because of their health but also because they are discouraged by performing poorly in school or from

missing a lot of school. The mediating effects of school-readiness and perceived control may therefore act together. Nonetheless, these results shed some light on the reasons why being in poor health may lead children to complete less schooling, which are often the subject of speculation rather than empirical study.

Finally, the findings from the analysis of the contribution of health to socioeconomic and racial/ethnic disparities in achievement suggest that researchers must continue to looks for the sources of this gap. Disparities in adolescent overall health do not explain any of the academic achievement gap. Socioeconomic and racial/ethnic gaps in infant and maternal health go slightly farther in explaining the achievement gap, but a large and significant difference still remains. Future work should consider a greater variety of health measures among both children and mothers. The analyses in this paper uncover differences in the predictive ability of two health measures—adolescent and parent-rated health—and raise the question of whether the two indicators, though both reported and not measured, are capturing the same thing. Researchers should also more comprehensively integrate the multiple contexts in children's lives into studies of the achievement gap. This is becoming increasingly possible as surveys collect detailed information about children's neighborhood and school environments, and may shed light on what thus far appear to be elusive differences.

Future work should begin to examine the specific biological pathways through which health might influence children's cognitive development and educational attainment. Biomarker data will provide important information on the cognitive and stress-related pathways explaining young adults' educational success. More generally, this paper stresses the importance of examining the role of childhood health in the status

attainment process. Researchers are now thinking seriously of early-life health as a vehicle for the intergenerational transmission of socioeconomic status. Given the importance of childhood health for later-life well-being, researchers should understand the intricacies of its formation and influence. This analysis works toward that understanding by focusing on one half of the relationship in depth. Pinpointing the exact nature of the relationship between socioeconomic status and health—when and how health and socioeconomic status are most important for one another, and for whom the relationships are strongest—will allow for a greater understanding of how and when to intervene.

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Table 1: Variables Used in Analysis, NLSY97 and NLSY79-CYA

NLSY97	**Description**
Timely HS Graduation	Graduated from HS by age 19
Attendance of Some College	Attended some college, conditional on HS grad
1997 Adolescent-Rated Health	1=Good/Fair/Poor, 0=Excellent/Very Good
1997 Parent-Rated Health of Adolescent	1=Good/Fair/Poor, 0=Excellent/Very Good
Parent Report of Child's Chronic Illness	1 if child has ever had a chronic illness
Race/Ethnicity	Non-Hispanic white, Non-Hispanic black, Hispanic
Adolescent Age	Years
1997 Number of Children Under 18 in HH	
Adolescent Sex	1=Male
1997 Parental Marital Status	1=Married
1997 Parental Education	Less than HS, HS, Some College, College or More
1997 HH Poverty Ratio	Below poverty, near poverty, 2-3 times above, 3+ above
Health-Related School or Work Limitations	1=adolescent has experienced limitations
Number of absent days from school	
ASVAB Score	Age-Adjusted Percentile (0-99)
Ever repeated a grade	1=yes
Academic performance	Grade performance in most recent full year before 1999
Parental Expectations for HS Grad	Percentage ranging from 0-100
Adolescent Expectations for HS Grad	Percentage ranging from 0-100
Adolescent Expectations for Staying in School	Percentage ranging from 0-100
NLSY79-CYA	
Sex	1=Male
Age	Years
Parental Marital Status	1=Married
Logged Family Income	
Mother's Education	Years
PIAT Math Score	Age-Normalized Percentile Score
PIAT Reading Score	Age-Normalized Percentile Score
Child's Birth Weight	Pounds
Mother's Age at Birth	Years
Did mother breastfeed	1=yes
Did mother smoke during pregnancy	1=yes
Was child sick in first year	1=yes
Did child attend doctor for illness in past year	1=yes

Table 2: Descriptive Characteristics of NLSY97 Sample, by Race

Variables	White	Black	Hispanic	Total
Individual Characteristics				
Race/Ethnicity	57	25	18	100
Sex				
Male	52	50	53	51
Female	48	50	48	49
Mean Age	14.3	14.3	14.3	14.3
Family Characteristics				
Mean Education of Responding Parent (Years)	13.7	12.7	10.9	12.9
Mean Household Poverty Ratio	3.7	2.3	1.9	3.1
Mean Number of Children in Household	2.2	2.5	2.6	2.4
Parents Married	79	46	72	70
Health				
Mean Self-Rated Health (Scale from 1-5)	1.8	2.0	2.0	1.9
Mean Parent-Rated Health (Scale from 1-5)	1.5	1.8	1.9	1.7
Has Had Chronic Illness	11	11	9	11
Educational Attainment				
Timely High School Graduation	83	69	70	87
Attends some college	34	24	25	52
School Attendance/Performance				
Mean Number of Absent Days	4.2	4.1	4.8	4.3
Mean Grade Performance (1=As, 8=Fs)	3.1	3.7	3.5	3.3
Mean ASVAB Percentile Score	58.8	35.5	42.6	50.1
Health Has Limited School Attendance	7.8	5.2	4.3	6.5
Ever Repeated Grade	12	22	18	13
Perceived Control				
Mean Expectation for Timely HS Graduation	97.1	95.7	94.5	96.3
Mean Parental Expectation for Timely HS Graduation	97.6	94.7	94.9	96.4
Mean Expectation that Will Be in School Next Year	95.8	93.9	91.7	94.6

Table 3: Association between Health and Timely High School Graduation, NLSY97[a]

Variable	(1)	(2)	(3)	(4)	(5)
Adolescent-Rated Good/Fair/Poor Health	-.385*	-.019	-.666**	-.448	-.042
	(.173)	(.198)	(.307)	(.330)	(.175)
Parent-Rated Good/Fair/Poor Health	-.264	-.162	-.529*	-.247	-.176
	(.182)	(.215)	(.315)	(.338)	(.253)
Pov. Ratio 1-2 * Health	-.167	-.157	.005	.102	
	(.196)	(.224)	(.348)	(.376)	
Pov. Ratio 2-3 * Health	-.0646	-.037	.148	.117	
	(.181)	(.203)	*.309)	(.339)	
Pov. Ratio >3 * Health	-.399*	-.414	-.044	-.294	
	(.223)	(.255)	(.384)	(.405)	
Pov. Ratio 1-2 * Parent-Rated Health	.176	.258	.390	.172	
	(.201)	(.231)	(.352)	(.377)	
Pov. Ratio 2-3 * Parent-Rated Health	-.207	-.118	.062	-.232	
	(.188)	(.218)	(.325)	(.351)	
Pov. Ratio >3 * Parent-Rated Health	-.545**	-.276	-.829**	-.882**	
	(.251)	(.297)	(.403)	(.429)	
Black*Health	.380**	.107	.585**	.506*	
	(.165)	(.189)	(.275)	(.291)	
Black*Parent-Rated Health	-.0052	.074	.115	.0051	
	(.177)	(.204)	(.293)	(.313)	
Hispanic*Health	.103	-.095	.205	.238	
	(.181)	(.205)	(.318)	(.352)	
Hispanic*Parent-Rated Health	.0810	-.026	.436	.320	
	(.193)	(.226)	(.335)	(.361)	
Constant	.887**	.047	-1.09	-9.33**	
	(.341)	(.388)	(1.24)	(1.50)	
Observations	6499	6499	2434	2434	675
Number of Households	5158	5158	2323	2323	303
Log Likelihood	-3188	-2708	-1193	-1083	-238
Type of Model[1]	L	L	L	L	FE

Standard errors in parentheses

* significant at 5%; ** significant at 1%

[1]L=binary logit model; FE=sibling fixed effects

[a]All models include main effects for race/ethnicity, age, sex, number of children under 18 in the household, 1997 parental education, 1997 parental marital status and 1997 household poverty ratio.

Table 4: Association between Health and Attendance of Some College, NLYS97[a]

Variable	(1)	(2)	(3)	(4)	(5)
Adolescent-Rated Good/Fair/Poor Health	-.742**	-.493**	-1.09**	-1.06**	-.519**
	(.197)	(.201)	(.308)	(.324)	(.175)
Parent-Rated Good/Fair/Poor Health	-.102	.0035	-.098	-.034	-.058
	(.212)	(.230)	(.332)	(.352)	(.240)
Pov. Ratio 1-2 * Health	-.285	-.369	-.322	-.236	
	(.231)	(.241)	(.379)	(.396)	
Pov. Ratio 2-3 * Health	.159	.177	-.0041	.0096	
	(.202)	(.211)	(.313)	(.331)	
Pov. Ratio >3 * Health	-.064	.0267	-.041	-.091	
	(.219)	(.231)	(.356)	(.369)	
Pov. Ratio 1-2 * Parent-Rated Health	.246	.377	.220	.166	
	(.236)	(.263)	(.390)	(.404)	
Pov. Ratio 2-3 * Parent-Rated Health	-.017	.112	.036	.035	
	(.215)	(.236)	(.335)	(.351)	
Pov. Ratio >3 * Parent-Rated Health	-.330	-.110	-.480	-.418	
	(.251)	(.279)	(.392)	(.412)	
Black*Health	.619**	.480**	.949**	.919**	
	(.164)	(.174)	(.265)	(.273)	
Black*Parent-Rated Health	-.245	-.357*	-.151	-.233	
	(.197)	(.203)	(.294)	(.303)	
Hispanic*Health	.506**	.414**	.945**	.919**	
	(.185)	(.208)	(.317)	(.331)	
Hispanic*Parent-Rated Health	.059	-.062	.086	.108	
	(.203)	(.235)	(.348)	(.367)	
Constant	-3.00**	-4.42**	.752	-4.16**	
	(.324)	(.370)	(1.05)	(1.27)	
Observations	6023	6023	2440	2440	809
Number of Households	4892	4892	2337	2337	376
Log Likelihood	-3685	-3272	-1473	-1436	-279
Type of Model[1]	L	L	L	L	FE

Standard errors in parentheses
* significant at 5%; ** significant at 1%
[1]L=binary logit model; FE=sibling fixed effects
[a]All models include main effects for race/ethnicity, age, sex, number of children under 18 in the household, 1997 parental education, 1997 parental marital status and 1997 household poverty ratio.

Table 5: Predicted Probabilities of Timely HS Graduation and College Attendance, NLSY97*

	Timely HS Graduation				College Attendance			
Variables	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Very Good or Excellent Health								
High Income, Black	.89	.91	.87	.87	.64	.68	.72	.71
High Income, NBNH	.91	.88	.91	.91	.69	.59	.76	.74
High Income, Hispanic	.91	.91	.89	.89	.65	.65	.69	.67
Low Income, Black	.65	.77	.63	.64	.46	.58	.53	.54
Low Income, NBNH	.70	.72	.73	.72	.51	.49	.58	.58
Low Income, Hispanic	.70	.78	.67	.68	.47	.55	.49	.49
Good, Fair or Poor Health								
High Income, Black	.78	.86	.77	.76	.44	.57	.45	.45
High Income, NBNH	.81	.82	.84	.82	.49	.47	.51	.49
High Income, Hispanic	.82	.86	.80	.79	.46	.54	.41	.40
Low Income, Black	.56	.77	.47	.53	.29	.46	.27	.30
Low Income, NBNH	.61	.72	.58	.63	.33	.37	.32	.33
Low Income, Hispanic	.61	.77	.52	.58	.30	.43	.24	.26

*All variables in each model other than the health indicators are held at the sample mean.

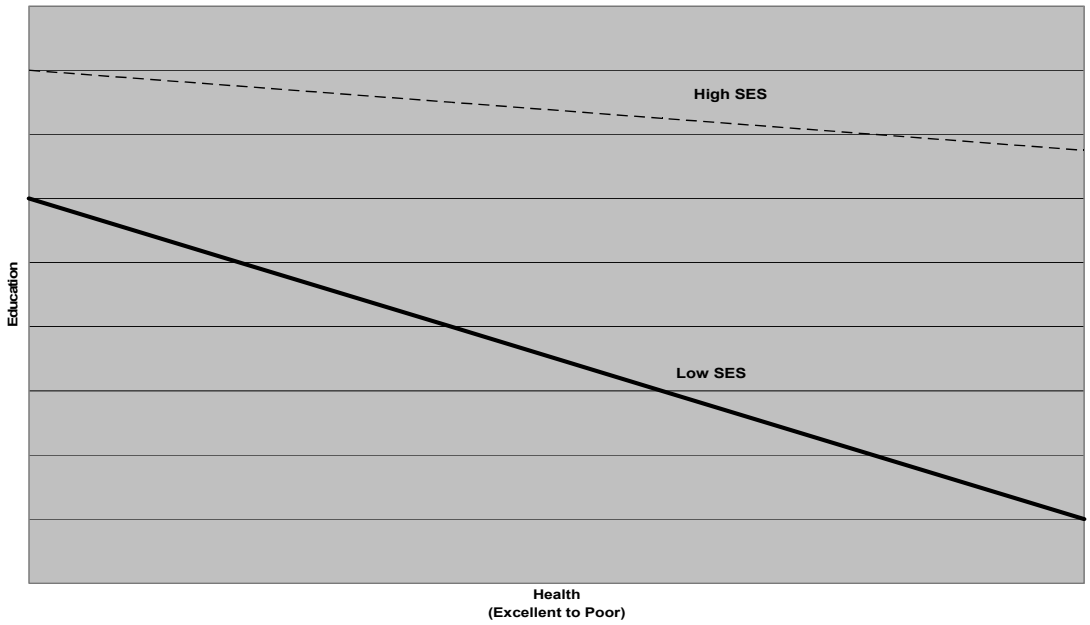
Table 6: Contribution of Health to Racial Differences in Predicted Achievement Test Score, NLSY97 and NLSY79-CYA*

Variables	ASVAB Percentile			
	(1)[1]	(2)[2]		
NLSY97				
Black	29.7	30.3		
Hispanic	38.5	39.0		
Non-Hispanic White	54.0	53.7		
	PIAT-Math		PIAT-Reading	
	(1)[3]	(2)[4]	(1)[3]	(2)[4]
NLSY79-CYA				
Black	94.5	94.9	97.2	97.7
Hispanic	95.8	96.0	99.5	99.7
Non-Hispanic White	101.4	101.2	102.7	102.4

*1986-2002 NLSY-Child and Young Adult Files. Individual years are pooled. N=8,090 person years.
[1]Controls for sex, age, household poverty ratio, responding parent's highest grade completed, number of children in household (all held at the mean).
[2]Controls for sex, age, household poverty ratio, responding parent's highest grade completed, number of children in household, self-rated health and whether or not adolescent has a chronic illness (all held at the mean).
[3] Controls for sex, age, parent's marital status, logged family income, mother's education, age of mother at birth.
[4] Controls for sex, age, parent's marital status, logged family income, mother's education, age of mother at birth, birth weight (in pounds), whether or not child was breastfed, whether or not mother smoked during pregnancy, if child went to doctor for illness in first year, and if child went to doctor for illness in past year.

Figure 1: Socioeconomic Variation in the Relationship between Health and Education

A)



B)

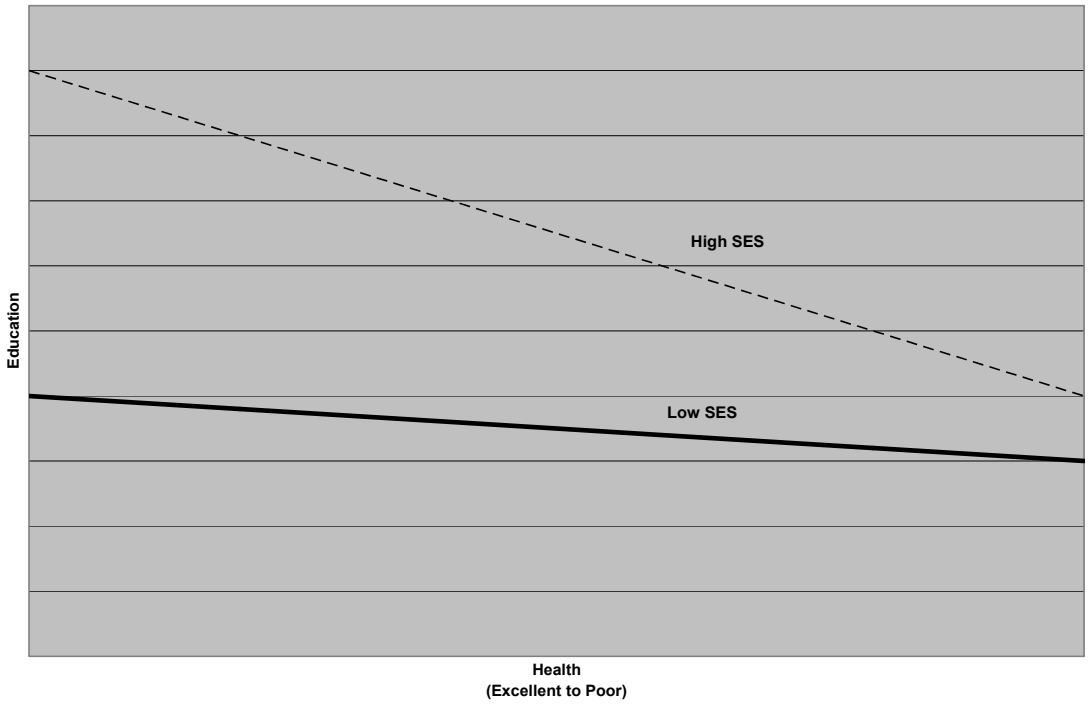


Figure 2: Predicted Probability of Timely High School Graduation, NLSY97

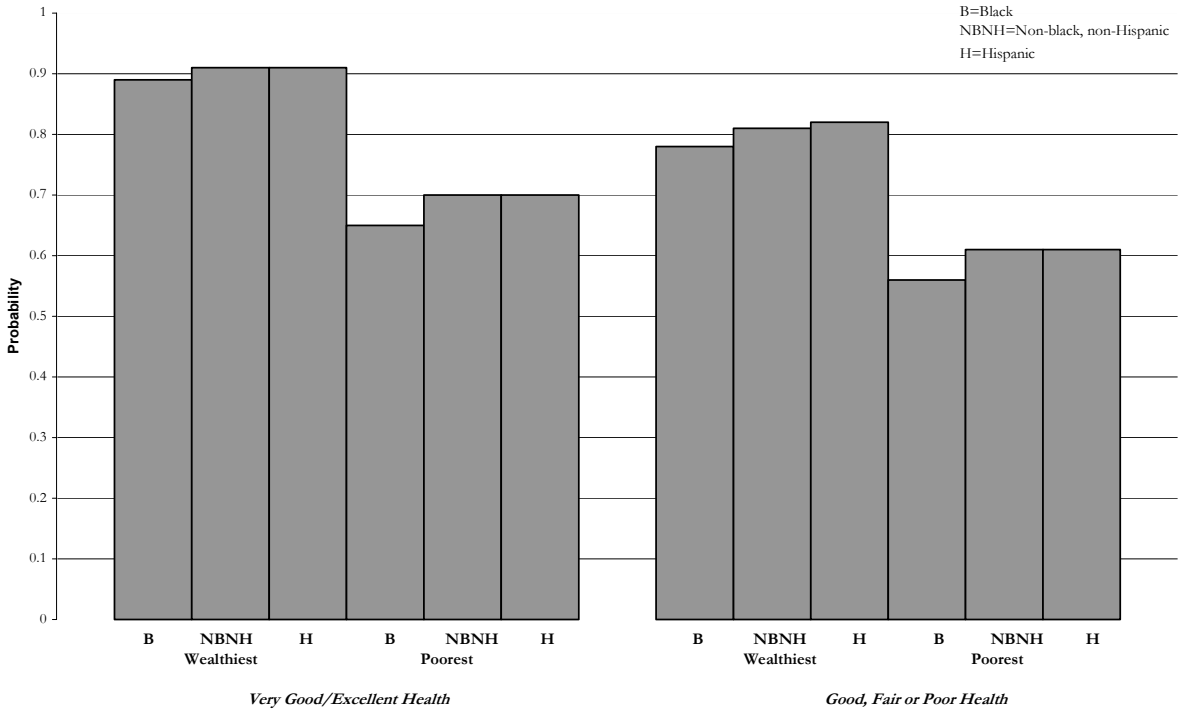


Figure 3: Predicted Probability of College Attendance, NLSY97