UNDERSTANDING LINKS BETWEEN ADOLESCENT HEALTH AND EDUCATIONAL ATTAINMENT*

MARGOT I. JACKSON

The educational and economic consequences of poor health during childhood and adolescence have become increasingly clear, with a resurgence of evidence leading researchers to reconsider the potentially significant contribution of early-life health to population welfare both within and across generations. Meaningful relationships between early-life health and educational attainment raise important questions about how health may influence educational success in young adulthood and beyond, as well as for whom its influence is strongest. Using data from the National Longitudinal Survey of Youth 1997, I examine how adolescents' health and social status act together to create educational disparities in young adulthood, focusing on two questions in particular. First, does the link between adolescent health and educational attainment vary across socioeconomic and racial/ethnic groups? Second, what academic factors explain the connection between adolescent health and educational attainment? The findings suggest that poorer health in adolescence is strongly negatively related to educational attainment, net of both observed confounders and unobserved, time-invariant characteristics within households. The reduction in attainment is particularly large for non-Hispanic white adolescents, suggesting that the negative educational consequences of poor health are not limited to only the most socially disadvantaged adolescents. Finally, I find that the link between adolescent health and educational attainment is explained by academic factors related to educational participation and, most importantly, academic performance, rather than by reduced educational expectations. These findings add complexity to our understanding of how the educational consequences of poor health apply across the social hierarchy, as well as why poor health may lead adolescents to complete less schooling.

In a presidential address to the Population Association of America, Palloni (2006) emphasized the need for research on early-life health as a mechanism in the intergenerational transmission of socioeconomic status. Although poor health is well known as a consequence of childhood and family socioeconomic conditions, it is also clear that illness during childhood and adolescence has lasting educational and socioeconomic effects (Case, Fertig, and Paxson 2005; Conley and Bennett 2000; Smith 2005). What remains less clear is how health early in life influences educational success in young adulthood and beyond. Do those with a health disadvantage graduate from high school at lower rates, for example, because they perform poorly in school or because they and their families develop reduced expectations for the future? In addition, how do race/ethnicity and socioeconomic status complicate these relationships? Our understanding of how health's influence on educational attainment differs across groups is unclear.

This article considers these complexities by asking several questions. It confirms that health during adolescence is strongly negatively associated with educational attainment and then examines this relationship in greater depth than is typical. First, I examine variation in the link between health and educational attainment along socioeconomic and racial/ethnic lines. Are the families of adolescents in poorer health better able to mitigate the negative educational consequences of a condition if they are socially and/or economically

*Margot I. Jackson, Brown University, Department of Sociology, Box 1916, Providence, RI 02912; e-mail: margot_jackson@brown.edu. Earlier versions of this article were presented at the 2006 meeting of the Population Association of America and the 2007 meeting of the American Sociological Association. I am grateful for financial support during this research from the Center for Health and Wellbeing and the Office of Population Research (NICHD T32HD01763) at Princeton University. Many thanks are due to Robert Mare, Anne Pebley, Judith Seltzer, and several anonymous reviewers for their helpful suggestions along the way.

advantaged? Or do youths in these families suffer an equal or greater disadvantage? Second, I evaluate the role of academic factors—specifically, educational participation, performance, and expectations—that may explain the connection between adolescents' health and educational attainment. I examine these questions with data from the National Longitudinal Survey of Youth 1997 (NLSY97), with an overall goal of understanding the ways in which health and social status act together to create educational disparities in the early life course.

BACKGROUND

Reciprocal Connections Between Social Status and Health

Research on the relationship between social status and health is abundant, both in the United States and abroad. In the United States, individuals' social and economic environments are strongly related to health, whether health is self-reported or defined by particular acute, chronic, or disabling conditions (e.g., Kitigawa and Hauser 1973; Lynch 2003; Marmot 2001; Moore and Hayward 1990; Morenoff 2003). More recently, researchers and policymakers have revisited the bi-directionality of this fundamental relationship, often dubbing it the "health selection" debate. Just as aspects of youths' socioeconomic environments influence their health, health status during this period may influence socioeconomic success in adulthood (Smith 2005). Recognition of the reciprocal nature of this relationship is not new (e.g., Wadsworth 1986), but recent attention to it has generated a steady reemergence of studies examining the contribution of early-life health to future health and social status. One consequence of this work has been the realization that health early in life may meaningfully contribute to the intergenerational transmission of social status. A reciprocal relationship may exist between social 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).

The Lasting Educational Consequences of Early-Life Health

Conceptual and methodological innovations have led to evidence that the path between socioeconomic status and health in fact works in both directions. A health disadvantage in childhood, most often defined empirically by low birth weight, is adversely related to academic achievement in adolescence and attainment in adulthood (Boardman et al. 2002; Conley and Bennett 2000; Currie and Hyson 1999; Currie and Stabile 2006; Hack et al. 2002). This relationship is still debated (e.g., Gorman 2002; Kaestner and Corman 1995), but health status at this very early point is likely a determinant of individuals' educational, and in turn socioeconomic, trajectories. In contrast, the educational and socioeconomic consequences of poor health at points in childhood beyond infancy are poorly understood. Any effect of health among older, school-aged children and adolescents could reflect compounded illness from earlier health problems. Alternatively, the nature and timing of a health problem at this later point in childhood could translate into different associations with future success. For example, whereas the potential cognitive deficits of an unhealthy infancy could be remedied with proper family and school-level intervention, the onset of a condition closer to adolescence, in the midst of what is a consequential educational period, may prove to be more influential in shaping attainment. Attention to the implications of poor health at ages beyond infancy is therefore important from both developmental and intervention perspectives. This article focuses on adolescence to identify any lasting consequences of poor health at points beyond very early life. In addition, it seeks to clarify the current lack of understanding about *how* adolescents with a health problem end up educationally disadvantaged relative to their peers, and about how health and social status intersect to produce educational disparities.

Why Should Health Matter for Educational Attainment?

Clarifying how poor health in adolescence exerts its educational consequences is equally important to identifying the presence of an association. To date, "early-life" has translated empirically into environments in utero and during infancy (e.g., Barker 1994, 1995; Barker et al. 2001; Lucas 1991); research in this vein has revealed strong associations. Case et al. (2005), for example, found an influence of the uterine environment on health in middle age, independent of education, health, and income in earlier adulthood. Similarly, Bengtsson and Lindstrom (2000) found that "disease load" experienced during the first year of life influences mortality in old age. Tests of the long-run social and economic effects of health early in life also generally focus on conditions before or immediately following birth. But studying health during adolescence, a critical period in the educational process, is necessary for identifying pathways. If health during adolescence reflects a compounded prenatal influence, then it may be a channel through which health in utero and infancy influences educational attainment. Alternatively, adolescent health may independently shape eventual educational success through its influence on school participation, performance, and success, as well as individual and family expectations for future attainment.

Although social and biological processes likely interact to link health to social status, in this article, I investigate potential social mediators. Conceptually, the social pathways linking adolescents' health to educational attainment can be separated into three domains: educational participation, performance, and expectations. Although their educational consequences may be equal, these routes imply different processes from health to eventual attainment and should therefore be considered separately.

Educational participation and performance. Struggling with a health condition may cause adolescents to miss more days of school than their peers. Without the proper safety net to compensate for missed schoolwork and learning, adolescents may fall behind academically and perform more poorly on learning assessments both within and outside of school (see, e.g., Boardman et al. [2002] for evidence on birth weight, and Haas and Fosse [2008] for evidence on adolescents). Given the strong role of achievement and test performance in predicting subsequent tracking placement, college entrance, and attainment, a significant relationship between health and academic performance could translate into a meaningful role for health in explaining disparities in educational attainment.

Those in poorer health may also struggle with impaired cognitive development, perhaps accumulated from an earlier age (e.g., Boardman et al. 2002). The cognitive pathways through which health leads to reduced educational success depend on the particular health problem: for example, there may be lasting motor and reactive handicaps associated with prenatal and infant health (Ruff et al. 1984; Scott and Spiker 1989) or debilitating fatigue among adolescents with anemia, both of which may reduce the capacity to learn effectively and perform well. In the absence of significant numbers of adolescents within any particular condition, however, a broad measure of health is useful in identifying patterns that can later be studied within specific conditions.

Educational expectations. There may also be subjective limitations associated with poor adolescent health that translate into reduced educational attainment. Mirowsky, Ross, and Reynolds (2000) argued that the link between social status and health may be explained in part by differential beliefs in the extent to which people can shape their success by making particular choices. Those who lack high social and economic status may believe more strongly that their outcomes are out of their control. Although this argument has typically been applied to explaining socioeconomic disparities in health, it also informs examination of the converse relationship: health-generated disparities in educational attainment.

One way in which this belief may manifest is through reduced educational expectations. Adolescents and parents who experience discrimination or limited opportunity for employment may come to expect fewer benefits from formal education

(Goldenberg et al. 2001; Suarez-Orozco and Suarez-Orozco 1996). In a similar vein, adolescents who struggle with illness may reduce their educational expectations, believing that they are in large part limited by their poor health. The same may be true on the part of parents, who may decide that keeping their child healthy is more important than pushing him to excel academically. The role of this pathway should also depend on the illness: those with severe asthma or depression, for example, may think differently about their educational futures than those who have mobility impairments but are otherwise healthy. In a study that is suggestive of health's influence on behaviors and outlooks, Adda and Lechene (2001) argued that social class differences in life expectancy explain higher smoking rates among adults with low socioeconomic status (SES) because higher-SES adults view the longevity cost of smoking to be higher.

The Role of Social Status

Although health and social status are often considered to act in isolation of each other in influencing educational success, they more likely intersect to create and maintain disparities. Health, at least when observed very early in life, is known to be a determinant of educational success. Health is also strongly predicted by race/ethnicity and socioeconomic status (Landale et al. 1999; National Center for Health Statistics 2004), and these factors predict educational success (Currie 2005; Duncan and Magnuson 2005; Jencks and Phillips 1998). The links in all directions among health, social status, and educational success suggest the need to consider them in combination with one another.

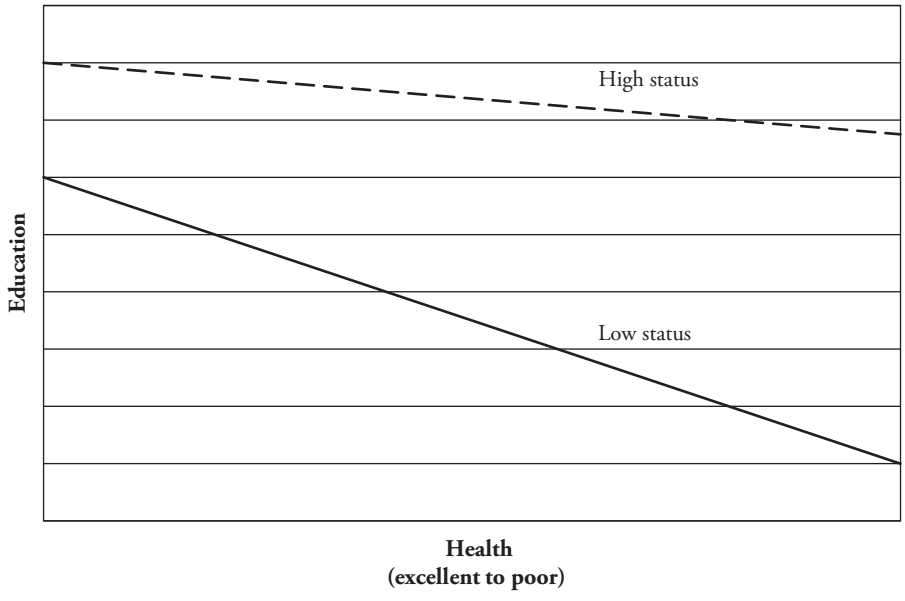
Although income is the most common marker of individuals' socioeconomic attainment, nonfinancial indicators deserve equal attention. Income, education, and occupation form the core of definitions of social status (e.g., Blau and Duncan 1967), with each marker conferring different benefits in the form of physical resources, knowledge and information, access, and social networks. Race/ethnicity is another important component of status, one that is not only strongly related to socioeconomic origin but is also an independent determinant of social and cultural resources and of eventual educational, occupational, and financial attainment. Although age variation in the relationship between health and education has been documented (Boardman et al. 2002), evidence on how this relationship varies along socioeconomic and racial/ethnic lines is unclear, especially for periods in the life course beyond infancy. Socioeconomic and racial/ethnic variation in the relationship between adolescent health and education, if it exists, could appear in one of two forms, as shown in Figures 1 and 2.

Double jeopardy. First, as shown in Figure 1, high social status may diminish any potentially negative educational consequences of poor health, so that the relationship is stronger and more negative for disadvantaged populations. There may be a "double jeopardy" associated with having multiple marginalized statuses, such as facing both a health and a racial/ethnic or socioeconomic disadvantage. Although first proposed as a hypothesis about the combined disadvantage of being older and a racial/ethnic minority (e.g., Dowd and Bengtson 1978; Ferraro and Farmer 1996), the term *double jeopardy* can be applied generally to denote the presence of multiple marginalized statuses.

Adolescents who experience socioeconomic or racial/ethnic advantage are less likely to be exposed to the routine stressors associated with financial hardship, discrimination, and crime and may be better able to thrive educationally from an early age, even with a health problem (e.g., Escalona 1982). Parents of adolescents with a health condition may also be better able to compensate for what would otherwise be adverse educational consequences by investing greater financial, social, and cultural resources toward the child (Becker and Tomes 1976). This may also depend on parents' own health, making parental health another important characteristic of adolescents' social environment.

Examinations of the potential double jeopardy of poor health and low social status have focused on adults or infants and have centered on families' economic status, as opposed

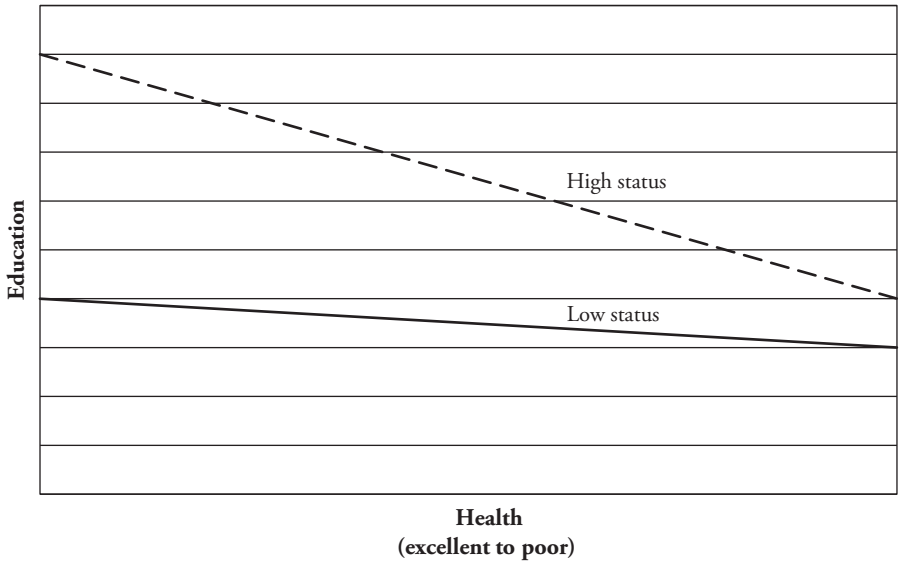
Figure 1. Hypothetical Double Jeopardy of Poor Health and Low Social Status in the Relationship Between Adolescent Health and Educational Attainment



to human capital or race/ethnicity. In this vein, Pampel and Rogers (2004) found some support for the consequences of a double jeopardy among adults in their study of smoking and health, showing that smoking is most strongly related to future morbidity among those with the lowest incomes. In their study of birth weight and educational attainment, Conley and Bennett (2001) found that low-birth-weight infants in high-income families face fewer educational penalties than their lower-income, low-birth-weight peers within an ordinary least squares framework, but not within a stricter framework controlling for unobserved, family-specific characteristics. Whether this result is due to unobserved heterogeneity or to the different composition of the two analytic samples is unclear; if not driven by sample composition, their two estimates may provide upper and lower bounds of the interactive effect of low birth weight and income on educational attainment.

Blaxter hypothesis. An alternative possibility is that the educational attainment of adolescents with a socioeconomic or racial/ethnic advantage is equally or more adversely hindered by poor health than is that of their peers, as shown in Figure 2. This possibility is sometimes referred to as the *Blaxter hypothesis*, stemming from Blaxter's (1990) finding that the adverse health consequences of smoking among adults are most pronounced among those with high socioeconomic status. Blaxter's hypothesis, represented hypothetically in Figure 2, characterizes differences between groups within a hierarchical perspective, wherein those closer to the top of the hierarchy have further to fall than those who begin lower. In the case of educational attainment, a health problem may lead to the loss of the advantages that these adolescents hold over their peers both in and out of the classroom: poor health will certainly not help the educational progress of less advantaged adolescents and may exacerbate the difficulty of progression, but it may do the same for those who are more privileged, with ultimately greater consequence. Along these lines, Currie and Hyson

Figure 2. Hypothetical Blaxter Hypothesis of the Relationship Between Adolescent Health and Educational Attainment



(1999) found that low-SES infants in Britain are not always harmed more by low birth weight than are their wealthier peers—high-SES boys, for example, are more adversely affected by low birth weight than are low-SES boys.

Studies examining the variation that exists by social status, or "contingencies" (Palloni 2006:61) in the relationship between health and education, have reached inconsistent conclusions. In addition, existing work has relied almost entirely on interactions between health and financial markers of social status. Although income is a vital marker of adolescents' social environment, it is not the only meaningful indicator of advantage. Equally important resources accrue from adolescents' and parents' race/ethnicity and from the resources that accompany high levels of parental education. Finally, it is unclear how disparities in educational attainment are produced by interactions between health and social status at points beyond infancy, and particularly during the critical educational period of adolescence. This article incorporates these perspectives, along with appropriate measures and data.

The Current Study

The analyses below extend the predominant focus on the uterine and infant environment to consider health during the educational process, and adolescence in particular. Using nationally representative data from adolescents in the National Longitudinal Survey of Youth 1997 (NLSY97), I consider variation in the link between health and educational attainment by race/ethnicity and socioeconomic status, moving beyond the typically singular focus on financial markers of social status. I also evaluate the role of several academic factors—related to participation, performance, and expectations—that may explain the link between adolescent health and educational attainment. As a preview, the findings

suggest a strong association between poor health and educational attainment, and a particularly strong detriment for non-Hispanic white adolescents. I also find that educational participation and performance play a strong explanatory role in the health-attainment link, relative to educational expectations. In the next section, I present the data, variables, and statistical methods used in the analyses. I then discuss the findings, ending with conclusions and implications.

METHODS

Data

The NLSY97 is a nationally representative panel survey of almost 9,000 U.S. children and adolescents aged 12–17 in 1997 and has continued annually since then. I consider the period between 1997 and 2003. In line with the survey's goal of understanding the transition into adulthood, information is collected from adolescents about their health, relationships, expectations, and experiences in educational systems and the labor force. In 1997, information about adolescents' health and parental background was also collected from parents.

Dependent Variable

Educational attainment is the dependent variable. A commonly used marker of attainment is the receipt of a high school diploma. I construct an indicator of timely high school graduation that distinguishes those who received a regular high school diploma by the age of 19 from those who did not, conditional on reaching that age by 2003. I limit the definition of high school completion to regular diplomas, in contrast to including GEDs, given evidence that GEDs confer fewer socioeconomic benefits than do traditional diplomas (e.g., Cameron and Heckman 1993). All seven waves of data (1997–2003) are used in the construction of this measure, but its value does not vary within adolescents.

Because high school graduation is no longer the best indicator of educational success in the United States, given high rates of high school completion (Mare 1995), I also include a measure of college-going, conditional on high school completion. This categorical measure distinguishes among those who did not enroll in any postsecondary college or university during the observed period, those who attended a two-year college or university, and those who attended a four-year program. Although it would be instructive to separate attendance from completion within each school type, too few respondents had reached college completion age by 2003 to categorize this group separately.[1] The distinctions among no college, two-year programs, and four-year programs are meaningful independent of completion, however, and are known to be important determinants of labor market returns (e.g., Kane and Rouse 1995).

Independent Variables

Health. Health is measured with adolescents' self-reports. The NLSY97 provides substantial detail about physical and mental health conditions, as well as the date of their onset. For any given health problem, however, there is little variation across adolescents, making it difficult to examine the effects of a given condition. Instead, I use an adolescent-reported health measure and dichotomize it, with a value of 1 indicating good/fair/poor health and 0 indicating excellent/very good health.[2] Self-reported health is predicted by

1. The findings I present here omit those who completed (vs. attended) a two- or four-year college/university, although including completers in the sample does not change the results at all, given the small number of respondents who completed college by 2003. I omit these respondents to avoid confounding college enrollment with college graduation.

2. 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.

clinical factors such as body mass index, type 2 diabetes, and cardiovascular health, and is a strong predictor of future survival, morbidity, and health care need (Idler and Benyamini 1997; Moller, Kristensen, and Hallnagel 1996). Self-reports of health may also measure health more holistically;[3] unlike clinical measures, self-ratings capture people's own perceptions of their health and may reflect both physical and psychological dimensions of health (Boardman 2006).[4]

In analyses of both high school completion and college enrollment, health is lagged and measured in 1997 to minimize the endogeneity of health and education. Measuring health concurrently with education may introduce simultaneity bias, whereby experiences in the educational system influence adolescents' ratings of their health, making educational factors determinants of health instead of the converse. Lagging health does not eliminate the possibility that 1997 health is partially a result of educational experiences earlier in childhood. Although it is unlikely that the effects of adolescents' health on educational attainment are confounded by their own earlier educational performance, rather than by the attainment of their parents, unobserved heterogeneity remains a concern. Nonetheless, lagging health addresses concerns about simultaneity within the context of these data.[5]

Social, parental, and demographic characteristics. I measure several social and demographic variables that are correlated with both adolescents' health and their educational attainment. I include adolescents' age (in years) and sex, as well as the responding parent's 1997 marital status and the number of children under age 18 in the household in 1997. The responding parent's education in 1997 distinguishes among those who completed less than high school, high school, some college, and college or more. The poverty ratio of the 1997 household categorizes adolescents as living below poverty, near poverty, between 2 and 3 times above the poverty threshold, or 3 or more times above.

Academic mediators. In addition to the health, social, and demographic variables described above, I measure academic factors related to educational participation, performance, and expectations as mediators of the relationship between health and educational attainment. Measures of educational participation include a dichotomous 1997 parental report of whether an adolescent has experienced limitations in the time spent on, and performance in, school and/or work due to health; and the number of days absent from school in the last term. Educational performance measures include, first, adolescents' performance on the Armed Services Vocational Aptitude Battery (ASVAB). The ASVAB is an assessment of math (knowledge and arithmetic reasoning) and verbal (word recognition and passage comprehension) skills. I use the age-adjusted math-verbal percentile score, with scores

3. As a supplementary analysis of whether self-reported health assessments are informed primarily by physical or mental health, I tested two additional measures: asthma and the presence of a mental health condition (broad, but excluding learning disabilities). Both measures are strong and significant predictors of educational attainment. Because of small numbers of black and Hispanic adolescents in these categories, it is hard to estimate interactions. The significance and large magnitude of the main effects, however, suggest that both physical and mental conditions are significantly related to educational success.

4. Previous work has also shown that Hispanics tend to report poorer health, even after clinical measures of physical and mental health are controlled for (Franzini and Eugenia Fernandez-Esquer 2004). To eliminate any bias introduced by this possibility, I conducted analyses both including and excluding Hispanics (where the sample is limited to non-Hispanic black and white adolescents). The results did not differ in substantive and statistical significance, so the results I present here include Hispanics.

5. The data also contain two parent-rated health measures. Parents' rating of their adolescents' health does not significantly predict education after adolescent-rated health is accounted for, so I do not include it in my final models. There is also a parent-reported indicator of whether the adolescent has ever had a chronic illness (not necessarily at the time of the interview or in the recent past). This measure is problematic and vague, however, because it does not necessarily measure present health status 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. Nonetheless, I tested the relationship between the chronic illness measure and education. In contrast to the other health measures, it is not a significant predictor of college attendance. I do not report the results of the chronic illness measure analysis here.

ranging from 0 to 99. Other performance measures include whether the adolescent has ever repeated a grade, as well as performance in the most 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, and so on).

Finally, to measure educational expectations, I consider adolescents' estimates of the likelihood that they will graduate from high school in a timely way, responding parents' expectations about whether their youth will finish high school, and adolescents' estimates of the likelihood that they will be enrolled in regular school in the next year. The expectations variables range from 0%–100%, with higher numbers indicating a greater expectation of completion. Because the three expectations questions were asked only to adolescents born in 1980 and 1981 and not to those born in later years, analyses with these measures are based on a smaller subset of the sample. They therefore consider an older age group than analyses with measures of educational participation and performance, which include all ages.

Missing data. Missing data on all variables are replaced using multiple imputation from relevant predictor variables. Values are not replaced if respondents were not asked a particular question. Findings are robust to sensitivity analyses that do not use imputation and to analyses that impute missing data at the mean and model the missing data with a dichotomous variable.

ANALYSIS

The first part of the analysis (1) examines the association between adolescent health and educational attainment in young adulthood, net of observed and unobserved socioeconomic and family characteristics, and (2) considers variation in this relationship by socioeconomic status and race/ethnicity by testing interactions between health and parental education, health and household income, and health and race/ethnicity.[6] In analyses of timely high school graduation, I estimate binary logistic regression models with random effects. These models explicitly incorporate the clustering of multiple adolescents within the same household into the model estimation, rather than adjusting variances after estimation. 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

$$\log[p_{ih} / (1 - p_{ih})] = \eta_0 + \eta_1 \mathbf{G}_h + \eta_2 \mathbf{X}_{ih} \times S_h + \alpha_{0h}, \quad (1)$$

where $\log[p_{ih} / (1 - p_{ih})]$ equals the log odds of p, the probability that each adolescent, i, within a household, h, graduates from high school by the age of 19. $\mathbf{G}_h$ is a vector of household-level characteristics, $\mathbf{X}_{ih}$ is a vector of adolescent-level characteristics (including health), S_h includes measures of social status (maternal education, household poverty ratio, and adolescent race/ethnicity), and α_{0h} is a random error component. In analyses of college attendance, I extend Eq. (1) to model no enrollment, two-year college enrollment, and four-year college enrollment as a multinomial outcome. Because both the double jeopardy and Blaxter hypotheses predict that economic and social status should moderate the influence of health on education, I begin by allowing health's effect to vary according to both socioeconomic status and race/ethnicity and then proceed with the model that fits the data most closely.

Although models with random effects account for bias generated by household-level clustering, they assume that the errors are uncorrelated with the regressors; that is, they

6. Although other interactions are plausible—race/ethnicity may interact with socioeconomic status in addition to interacting with health, for example—I focus the analysis on health's influence and how that influence may vary across groups.

assume that no unmeasured factors exist that are correlated with both health and educational attainment. Failing to account for these characteristics, if they exist, may bias coefficients. As a supplementary analysis, I exploit the presence of multiple children within the same household by estimating models with household fixed effects, which can be represented as

$$\log[p_{ih} / (1 - p_{ih})] = \beta_0 + \beta_1 \mathbf{X}_{ih} + \beta_2 \mathbf{X}_{iVh} \times S_h + \mu_h, \quad (2)$$

where $\mathbf{X}_{iVh}$ 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 children in the same household, even if they are not observed in the data. Although it is not possible within this framework to estimate the main effects of variables that do not vary within households (S_h), it is possible to interact these variables with $\mathbf{X}_{iVh}$ to examine interactions between health and socioeconomic status and between health and race/ethnicity. Unobserved characteristics that do vary within households are not accounted for, however. To be more specific, any influence of parents' tendency to treat a healthy adolescent differently from a sibling with an illness will not be eliminated within the fixed-effects framework.

In the final part of the analysis, I successively add the academic mediators to the models specified in Eq. (1) to test the role of educational participation, performance, and expectations in explaining the relationship between adolescent health and educational attainment. I compare changes in the relationship with the addition of the mediating variables by computing predicted probabilities.

RESULTS

Sample Characteristics

Table 1 presents unweighted descriptive characteristics of the NLSY97 sample, by race.[7] Non-Hispanic whites make up more than half of the sample, with blacks and Hispanics composing about 25% and 18%, respectively. Mean age is about 14 years. Non-Hispanic white adolescents live in the wealthiest and most educated households. This group of adolescents and their parents also rate their health more favorably than black and Hispanic adolescents. The majority of the adolescent sample graduated from high school by age 19 (87%). About 20% of those who completed high school attended or finished a two-year college only, and about 40% attended or completed a four-year college only. These patterns predictably vary somewhat by race, with blacks and Hispanics less likely than whites to receive a high school diploma by age 19 or to attend college. One striking racial difference is in the likelihood of repeating a grade: 22% of blacks have ever repeated a grade, compared with only 12% of non-Hispanic whites and 18% of Hispanics.

Is Health Associated With Educational Attainment, and Is Poor Health Equally Detrimental for All Adolescents?

Additive associations. Tables 2 and 3 present the associations among adolescent-reported health, timely high school completion, and college enrollment (conditional on high school completion). Models 1 and 3 in each table present the additive relationship between health and education for the entire sample and for the older sample who answered the psychosocial questions, respectively. Both tables demonstrate a strong association between adolescent-rated health and educational attainment in young adulthood, net of correlated observed adolescent and family-level factors. Model 1, for example, shows that

7. Estimates are obtained without weights because the strategy for calculating weights differs substantially across the years I consider. Multivariate results do not meaningfully differ when weights are applied, however.

Table 1. Descriptive Characteristics of the NLSY97 Sample, by Race/Ethnicity: 1997–2003[a]

Variables	White	Black	Hispanic	All
Race/Ethnicity	57	25	18	100
Male	52	50	53	51
Mean Age	14.3	14.3	14.3	14.3
Parental Education				
Less than high school	10	21	44	19
High school	32	37	25	32
Some college or more	58	42	31	48
Household Poverty Ratio				
Below poverty	8	30	30	18
Near poverty	15	21	22	18
2–3 times above poverty	34	34	31	33
3 or more times above poverty	44	15	17	31
Parents Are Married	79	46	72	70
Excellent/Very Good Health (adolescent-rated)	77	69	66	73
Timely High School Graduation	83	69	70	87
Attended Two-Year College Only	20	22	28	22
Attended Four-Year College Only	48	34	28	41
Educational Participation				
Health has limited school attendance	7.8	5.2	4.3	6.5
Mean number of absent days	4.7	4.7	5.2	4.9
Educational Performance				
Mean grade performance (1 = As, 8 = Fs)	3.3	3.8	3.8	3.5
Mean ASVAB percentile score	57.1	30.0	36.8	46.3
Ever repeated grade	12	22	18	13
Educational Expectations				
Mean expectation for timely high school graduation	97.1	95.7	94.5	96.3
Mean parental expectation for timely high school 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
N	3,583	1,717	1,279	6,579

[a]Numbers are percentages unless mean is indicated.

those in good, fair, or poor health are almost 40% less likely than their healthier peers to graduate from high school on time (Table 2: $e^{-.463}$) and about 50% less likely to attend a four-year college after high school (Table 3: $e^{-.691}$). Not surprisingly, the relationship between health and college attendance is stronger for attendance of a four-year college than for a two-year college, although the two-year relationship is also significant. The pattern of these findings does not change when the older subset of the sample, for which the educational expectations questions are asked, is analyzed (Model 3). In fact, the magnitude of the health coefficients is consistently larger, suggesting that there is an age gradient in the relationship between health and educational attainment, with stronger associations observed at older ages.

Table 2. Variation in the Association Between Adolescent Health and Timely High School Completion: NLSY97, 1997–2003[a]

Variable	Total Sample, Additive (1)	Total Sample, Interactions (2)	Older Sample, Additive (3)	Older Sample, Interactions (4)	Sibling Sample (5)
Good/Fair/Poor Health	–0.463**	–0.664**	–0.546**	–0.850**	0.258
	(0.066)	(0.10)	(0.11)	(0.16)	(0.30)
Black	–0.132†	–0.292**	–0.242†	–0.456**	
	(0.077)	(0.091)	(0.13)	(0.15)	
Hispanic	0.113	0.054	–0.04	–0.176	
	(0.087)	(0.10)	(0.15)	(0.18)	
Black × Health		0.496**		0.649**	–0.512
		(0.15)		(0.25)	(0.41)
Hispanic × Health		0.187		0.417	–0.654
		(0.17)		(0.29)	(0.45)
Constant	0.916**	1.01**	–1.22	–1.12	
	(0.33)	(0.34)	(1.21)	(1.21)	
N	6,579	6,579	2,434	2,434	687
Number of Households	5,209	5,209	2,323	2,323	310
Log Likelihood	–3,243	–3,239	–1,202	–1,200	–240
Type of Model[b]	L	L	L	L	FE
Test of Joint Significance					
Race Dummy Variables × Health					
χ^2 (2)		10.45		7.21	
$p > \chi^2$		.0054		.027	

[a]Standard errors are in parentheses. The omitted category is no high school graduation by age 19. All models include main effects for age, sex, number of children under age 18 in the household, 1997 parental education, 1997 household poverty ratio, and 1997 parental marital status. Models 1 and 2 show the additive and interactive associations, respectively, for all adolescents. Models 3 and 4 include only the older adolescents, who answered the educational expectations questions. Model 5 includes household fixed effects.

[b]L = binary logistic regression model; FE = binary logistic regression with household fixed effects.

†$p < .10$; **$p < .01$

Interactive associations. Tables 2 and 3 also demonstrate that the relationship between health and educational attainment varies significantly by race/ethnicity. I compare an unrestricted model that allows health's influence to vary with parental education, household poverty ratio, and race/ethnicity to a series of more restricted models. The best-fitting model for both high school graduation and college attendance allows health's association to vary by only race/ethnicity.[8] Interactions between health and household poverty and between health and parental education are similar in direction and magnitude to that for race/ethnicity and exhibit a similar gradient to each other—the negative relationship between health and educational attainment is stronger among adolescents with wealthier and better-educated parents. These coefficients are not consistently statistically significant, however, regardless of how household poverty and parental education are categorized. I therefore do not present these findings.

Models 2 and 4 in Tables 2 and 3 show the interactive association among health, race/ethnicity, and educational attainment for the total and older samples, respectively.

8. Results of likelihood ratio tests are not shown but are available from the author by request.

Table 3. Variation in the Association Between Adolescent Health and College Attendance: NLSY97, 1997–2003[a]

	Total Sample, Additive (1)		Total Sample, Interactions (2)		Older Sample, Additive (3)		Older Sample, Interactions (4)		Sibling Sample (5)	
Variable	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year
Good/Fair/Poor Health	–0.255**	–0.691**	–0.417**	–0.990**	–0.417**	–1.008**	–0.634**	–1.467**	–0.343†	–0.843**
	(0.078)	(0.077)	(0.11)	(0.10)	(0.12)	(0.13)	(0.18)	(0.17)	(0.21)	(0.18)
Black	0.05	–0.022	–0.048	–0.195*	0.223	0.110	0.126	–0.158		
	(0.090)	(0.083)	(0.11)	(0.095)	(0.14)	(0.13)	(0.16)	(0.15)		
Hispanic	0.304**	–0.119	0.211†	–0.266*	0.302*	–0.257	0.122	–0.452*		
	(0.096)	(0.094)	(0.11)	(0.11)	(0.15)	(0.16)	(0.18)	(0.18)		
Black × Health			0.318†	0.678**			0.291	1.09**	0.158	0.173
			(0.18)	(0.18)			(0.29)	(0.28)	(0.39)	(0.38)
Hispanic × Health			0.306	0.621**			0.580†	0.835*	–0.525	–0.428
			(0.19)	(0.21)			(0.31)	(0.34)	(0.37)	(0.35)
Constant	–0.925*	–1.418**	–0.883*	–1.369**	1.125	1.337	1.102	1.333		
	(0.38)	(0.36)	(0.38)	(0.36)	(1.32)	(1.22)	(1.32)	(1.22)		
N	6,120		6,120		2,409		2,409		809	
Number of Households	4,944		4,944		2.306		2,306		376	
Log Likelihood	–5,846		–5,837		–2,298		–2,289		–3,083	
Type of Model[b]	ML		ML		ML		ML		FE	
Test of Joint Significance										
Race Dummy Variables × Health										
χ^2 (2)			18.36				18.31			
$p > \chi^2$			.00				.00			

[a]Standard errors are in parentheses. The omitted category is no college attendance. College attendance is conditional on high school completion. All models include main effects for age, sex, number of children under age 18 in the household, 1997 parental education, 1997 household poverty ratio, and 1997 parental marital status. Models 1 and 2 show the additive and interactive associations, respectively, for all adolescents. Models 3 and 4 include only the older adolescents, who answered the educational expectations questions. Model 5 includes household fixed effects.

[b]ML = multinomial logistic regression model; FE = multinomial logistic regression with household fixed effects.

†p <.10; *p <.05; **p <.01

Model 2 in Table 2 shows that adolescents who rated their health as "good" or worse (relative to those in very good/excellent health) are expected to suffer the most significant educational disadvantage if they identified as non-Hispanic white. Among non-Hispanic white adolescents, being in "good" or worse health, relative to very good or excellent health, is associated with a 49% ($e^{-.664}$) decrease in the odds of timely high school graduation, versus a 15% ($e^{-.664 + .496}$) decrease for their black peers. The association between health and education is not significant for Hispanic adolescents, although the coefficient is positive. College enrollment follows a similar, more pronounced pattern. The interaction between health and race/ethnicity persists and, in the case of four-year college attendance, is significant for Hispanic adolescents as well as blacks.

These patterns are most easily understood by examining predicted probabilities, shown in Table 4. Model 1 in Table 4 presents the probability of timely high school graduation (top panel) and two- or four-year college attendance (bottom panel), by health. The difference in the probability of timely high school graduation between the healthiest and least healthy adolescents is largest among non-Hispanic whites. Whereas those in the best health have a .81 likelihood of timely high school graduation, the likelihood for their peers in poorer health is .69: a difference of about 15%. In contrast, the gap among blacks is 4% (.76 vs. .73), and among Hispanics about 10% (.82 vs. .74). College attendance follows a similar pattern for attendance of four-year institutions, but not two-year institutions. Non-Hispanic white adolescents are 42% (.45 vs. .26) more likely to attend a four-year college if they are in the best health, compared with 15% and 19% higher likelihoods among blacks and Hispanics, respectively.

These findings contrast the predictions of the "double jeopardy" hypothesis. Rather than observing greater educational consequence from both a health and a socioeconomic or racial/ethnic disadvantage, these data suggest that poor health has particularly negative consequences for the educational attainment of non-Hispanic whites, the most socially advantaged racial/ethnic group. Non-Hispanic white families may be able to exploit any advantage when their adolescents' health is good, but not when it is compromised.[9] These results are in line with the predictions of the Blaxter hypothesis, which posits that the greatest socioeconomic disadvantage should be incurred by those who begin at the highest point in a hierarchy and therefore have the furthest to fall.

Fixed-effects associations. As a supplement to the random-effects estimates, I estimate models with household-level fixed effects to control for unobserved and invariant characteristics of adolescents' households that may be correlated with both health and educational attainment. Model 5 in Tables 2 and 3 includes household fixed effects. When the confounding influence of unobserved household factors that do not differ among siblings within the same household is eliminated, a significant association between health and attainment persists for college attendance among non-Hispanic white adolescents. Adolescents in this group who are in the poorest health remain significantly less likely to attend two- or four-year colleges than their healthier peers. Neither the coefficients for black and Hispanic adolescents' college attendance nor the coefficients for timely high school graduation remain significant.

Attention to sample composition is important in interpreting coefficients from fixed-effects models. For high school graduation, for example, fixed-effects models limit the sample to households in which one adolescent graduates from high school by the age of 19 and one does not: a limited and likely unrepresentative subset of today's U.S. households with children. The fixed-effects sample is also much smaller than the

9. An alternative explanation is that the health problems of more advantaged children are more severe than those of less advantaged children, such that parents' resources cannot compensate for the severity of the condition. Although the data contain only small numbers of children within each specific condition, there is no evidence that more advantaged children suffer from more serious health problems, or that the bottom end of the health distribution is worse for these children.

Table 4. Predicted Probability of Timely High School Graduation and College Attendance, by Race and Health: NLSY97, 1997–2003[a]

Variable	Timely High School Graduation				
	Total Sample, No Mediators (1)	Add Educational Participation (2)	Add Educational Performance (3)	Older Sample, No Mediators (4)	Add Educational Expectations (5)
Very Good/Excellent Health					
Non-Hispanic white	.81	.81	.81	.82	.82
Black	.76	.75	.84	.75	.74
Hispanic	.82	.82	.85	.80	.79
Good/Fair/Poor Health					
Non-Hispanic white	.69	.73	.77	.67	.70
Black	.73	.74	.84	.71	.73
Hispanic	.74	.76	.80	.72	.76
N	6,579	6,579	6,579	2,434	2,434

Variable	College Attendance									
	Total Sample, No Mediators (1)		Add Educational Participation (2)		Add Educational Performance (3)		Older Sample, No Mediators (4)		Add Educational Expectations (5)	
	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year
Very Good/Excellent Health										
Non-Hispanic white	.22	.45	.23	.44	.27	.34	.22	.48	.23	.45
Black	.23	.40	.24	.38	.24	.48	.26	.42	.27	.41
Hispanic	.29	.36	.29	.35	.32	.34	.29	.36	.29	.34
Good/Fair/Poor Health										
Non-Hispanic white	.23	.26	.23	.28	.25	.26	.22	.21	.21	.02
Black	.24	.34	.24	.33	.25	.45	.23	.37	.24	.36
Hispanic	.30	.29	.30	.30	.32	.33	.33	.23	.34	.23
N	6,120		6,120		6,120		2,409		2,409	

[a]All variables in each model other than the health indicators are held at the sample mean. Models 1–3 include adolescents of all ages, and Models 4–5 include only the older adolescents who answered the educational expectations questions. Probabilities in Models 1–3 come from estimates that are adjusted for individual and family characteristics but not educational participation or performance. Model 2 adjusts for educational participation, Model 3 adjusts for educational performance, and Model 5 adjusts for educational expectations.

random-effects sample, making statistical power a potential contributor to the differences in the coefficients and to the insignificance of the interaction coefficients. Random-effects models estimated on the fixed-effects samples produce results that are virtually identical to those from models with fixed effects.[10] This suggests that the statistical insignificance for high school graduation and for blacks' and Hispanics' college attendance is due in part to sample composition rather than solely to unobserved household characteristics. Although unmeasured family-level factors may certainly play a role in explaining the change in the coefficients across models, changes in sample composition and statistical power between the random-effects and fixed-effects models should also be considered when interpreting the results.

Do Academic Factors Explain the Link Between Health and Educational Attainment?

Tables 4 and 5 and Appendix Tables A1 and A2 show whether the preceding associations are generated by differences in adolescents' educational participation, performance, and expectations. Table 5 presents the relationship between adolescent health and the academic factors. Adolescents in poorer health, particularly non-Hispanic whites, are more likely to miss school because of illness, to perform worse in school, and to have lower expectations about their educational prospects. The relationship between health and measures of educational performance is not as strong for black and Hispanic adolescents, suggesting that the previously discussed racial/ethnic differences in the health/attainment relationship are being driven by achievement differences earlier in the educational process.

The role of these factors in explaining the association between health and educational attainment is summarized concisely in Table 4, which presents changes in the predicted probabilities of timely high school graduation and college attendance with successive adjustment for participation, performance, and expectations. The predicted probability of each educational outcome from the interactive model without mediators is shown in Model 1 for the total sample. Models 2 and 3 display the predicted probabilities adjusted for educational participation and performance, respectively. Model 2 shows that educational participation plays a role in explaining differences in attainment by health. The 15% lower likelihood of timely high school completion among less healthy non-Hispanic white adolescents (.81 vs. .69) shown in Model 1, for example, is reduced to a 10% gap (.81 vs. .73) after educational participation is adjusted for. After adjusting for both participation and performance, the gap is reduced to 5% (Model 3). A similar reduction after adjusting for educational performance is observed among all three racial/ethnic groups, although the size of initial gaps among blacks and Hispanics is lower.

The findings follow a similar pattern for college attendance, although they are less pronounced. Among non-Hispanic white adolescents, for example, adjusting for educational participation reduces the 42% gap in the likelihood of four-year college attendance to 36%, while additionally adjusting for performance reduces it to 24%. Educational participation and performance therefore collectively account for almost 50% of the gap in college attendance by health, with this reduction driven most strongly by differences in performance. A meaningful disparity still remains, however. As was the case with high school graduation, there are smaller initial attainment gaps by health among blacks and Hispanics, but the proportional reduction in those gaps due to educational participation and performance is similar. For all racial/ethnic groups, there are initially very small differences in the likelihood of two-year college attendance by health, and the academic mediators do little to change those probabilities. Finally, it is worth noting that for both high school completion and college attendance, adjusting for educational performance also explains racial/ethnic differences in attainment (Model 3). Blacks and Hispanics

10. These results are not shown but are available from the author upon request.

Table 5. Associations Between Adolescent Health and Academic Mediators: NLSY97, 1997–2003[a]

	Educational Participation		Educational Performance			Educational Expectations		
Variable	School/ Work Limitations	Days Absent	ASVAB	Repeat	Average Grade	Will Stay in School	Graduation Expectations	Parents' Graduation Expectations
Good/Fair/Poor Health	1.099**	2.48**	–8.208**	0.520**	0.905**	–1.358	–0.805	–1.200
	(0.13)	(0.42)	(1.13)	(0.12)	(0.085)	(1.29)	(1.21)	(1.27)
Black	–0.449	–0.742**	–20.951**	0.778**	0.420**	–1.792	–1.813	–1.989
	(0.17)	(0.26)	(1.04)	(0.11)	(0.076)	(1.20)	(1.17)	(1.23)
Hispanic	–0.984	–0.00174	–10.151**	0.130	0.278**	–1.773	–1.493	–2.143
	(0.24)	(0.32)	(1.23)	(0.13)	(0.090)	(1.34)	(1.25)	(1.34)
Black × Health	–0.348	–1.408*	5.269**	–0.329†	–0.729**	3.260	3.129	2.375
	(0.23)	(0.58)	(1.66)	(0.17)	(0.14)	(2.15)	(2.03)	(2.19)
Hispanic × Health	0.0123	–0.885	2.868	–0.409*	–0.415*	2.069	1.751	1.652
	(0.31)	(0.64)	(1.96)	(0.21)	(0.16)	(2.46)	(2.33)	(2.46)
Constant	–2.001**	–2.279*	39.473**	–4.431**	1.998**	–348.499**	–358.760**	–342.118**
	(0.56)	(0.92)	(3.57)	(0.39)	(0.28)	(3.67)	(3.25)	(3.78)
N	6,505	6,467	5,486	6,407	5,341	6,106	6,102	6,105
Type of Model[b]	L	OLS	OLS	L	OLS	OLS	OLS	OLS

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

[b]L = binary logit model; OLS = ordinary least squares.

†p <.10; *p <.05; **p <.01

are predicted to have higher educational attainment after performance is adjusted for, reflecting a long-standing finding regarding racial/ethnic differences in educational attainment (e.g., Kerckoff and Campbell 1977).

In contrast to the sizeable explanatory role of educational performance, educational expectations do little to account for gaps in attainment by health. In both panels of Table 4 (and in Appendix Tables A1 and A2), Model 4 shows the probability of each educational outcome, unadjusted for academic mediators (for the older sample who answered the expectations questions), and Model 5 shows the probabilities after educational expectations are adjusted for. Model 5 reveals that the initial 18% lower predicted probability (Model 4, .82 vs. .67) of timely high school graduation among non-Hispanic white adolescents in poorer health decreases to only 15% with the adjustment of expectations. A similar pattern is observed for college attendance.

DISCUSSION

It has become increasingly clear that individuals' social status and health are generated reciprocally, where each affects the other over the course of a lifetime and across generations. This article focuses on one half of the relationship, within a generation, by examining the association between adolescent health and educational attainment in greater depth than is typical. I consider health as a contributor to disparities in educational attainment by (a) extending the early-life temporal window beyond infancy to consider health during adolescence, a critical period of educational progress and transition; (b) examining linkages among health, social status, and educational attainment in the form of interactions between health and socioeconomic status and race/ethnicity; and (c) exploring how health during adolescence may translate into lower educational attainment in young adulthood through academic factors related to educational participation, performance, and expectations.

A recent study (Haas and Fosse 2008) using the same data considered this latter issue of mediation, focusing on the respective contributions of "academic" (school performance and absence) and "psychosocial" (peer and school relationships) factors. My approach to identifying mechanisms that explain the relationship between health and educational attainment differs in that I consider academic performance and participation independently and examine the impact of educational expectations. In addition, I investigate the explanatory role of academic factors separately across socioeconomic and racial/ethnic groups in order to address an entirely different question: whether the relationship between health and educational attainment varies according to adolescents' social status. The analyses in the current study are not without limitations. Most importantly, caution is warranted in the interpretation of the results, since the methods used here cannot address all possible sources of bias from omitted variables. The results presented here demonstrate strong associations but cannot be taken as evidence of a causal relationship. Parents' health, for example, may be correlated with children's socioeconomic status, health, and education. Children learn behaviors in part from their parents, and they also inherit biological predispositions to particular conditions. I partially address this by estimating household-level fixed effects, but I cannot fully remove this source of bias. In a similar vein, the observed relationships may be driven in part by health even earlier in the life course, but the unavailability of a measure of health during infancy, or of markers of the prenatal environment, hinder investigation of this possibility. Finally, these analyses are limited by the need to use broad and self-rated markers of health. Although these measures are strongly correlated with objective health and are useful in identifying patterns and variation, the analyses would benefit from more detailed health measures. Differences in the predictive ability of adolescent- and parent-rated health also raise questions for future research about whether parents' and adolescents' ratings of their health influence each other or if they are capturing the same thing.

These limitations notwithstanding, several findings emerge from the analysis. First, the results add to the mounting evidence showing that the relationship between health and educational attainment is not unidirectional, and that the association does not merely reflect unobserved household factors. Adolescents in poorer health are both less likely to graduate from high school in a timely manner and less likely to attend both two- and four-year colleges, but especially four-year colleges, after high school graduation. Second, I find that rather than avoiding the adverse educational consequences of poor health, non-Hispanic white adolescents face greater detriment than their peers in other racial/ethnic groups. These results contradict the predictions of the double jeopardy hypothesis and suggest that non-Hispanic white adolescents who experience a health problem lose their initial educational advantages. Because black and Hispanic adolescents are more likely to perform poorly independent of health status, they may face a smaller decline overall, given their initially lower level on the educational hierarchy.

This finding highlights the reality that the adverse educational consequences of poor health are not limited to one subgroup of the population and that they span the spectrum of social status, at least when defined by race/ethnicity. It is not clear why the relationship between adolescent health and educational attainment does not vary as systematically along socioeconomic lines as by race/ethnicity. The similarity in the magnitude and direction of health's interaction with household poverty and parental education to that for race/ethnicity, and the occasional significance of these interactions depending on how the socioeconomic markers are categorized, are suggestive of a similar pattern. It remains unclear, however, whether the insignificance of those interactions relative to race/ethnicity is unique to these data and measures or characteristic of a general pattern. Whether or not socioeconomic variation exists, it would be useful for future research to examine the ways in which parents try to compensate for adolescents' health problems as they progress through the educational system, and whether they are effective.

Finally, the findings suggest that educational participation and performance—particularly performance—play meaningful roles in explaining why adolescents in poorer health attain lower levels of education. In contrast, educational expectations on the part of both adolescents and their parents do not offer any explanatory power. It is possible that the factors considered in this analysis work together in some way, rather than operating independently of one another. Adolescents may perform worse in school, for example, in part because they are more likely to be absent. Similarly, both adolescents and their parents may develop low educational expectations because they are discouraged by poor school performance. Although the data do not allow me to fully untangle these possibilities, the findings begin to clarify why poor health may lead adolescents to complete less schooling.

Demographic researchers are again recognizing the potentially significant contribution of health early in the life course to broader population welfare, both within and across generations. The sizeable relationship between adolescent health and educational attainment within the generation observed here raises the potential for health to contribute in a nontrivial way to intergenerational inequality. Health's relationship to educational attainment in particular is suggestive of a large indirect role of health in the stratification process through education, a known contributor to social mobility and reproduction. Although a formal consideration of the magnitude of health's role in reproducing social inequalities across generations is beyond the scope of this article, it will be useful in future research to tackle this question; doing so will allow for a fuller understanding of health's influence at both the individual and population levels.

Appendix Table A1. Academic Mediators of the Association Between Adolescent Health and Timely High School Graduation: NLSY97, 1997–2003[a]

Variable	Total Sample, No Mediators (1)	Add Educational Participation (2)	Add Educational Performance (3)	Older Sample, No Mediators (4)	Add Educational Expectations (5)
Good/Fair/Poor Health	–0.664**	–0.473**	–0.204†	–0.850**	–0.661**
	(0.10)	(0.10)	(0.12)	(0.16)	(0.17)
Black	–0.292**	–0.367**	0.194†	–0.456**	–0.450**
	(0.091)	(0.097)	(0.11)	(0.15)	(0.16)
Hispanic	0.054	0.014	0.262*	–0.176	–0.166
	(0.10)	(0.11)	(0.19)	(0.18)	(0.18)
Black × Health	0.496**	0.399**	0.212	0.649**	0.589*
	(0.15)	(0.15)	(0.17)	(0.25)	(0.26)
Hispanic × Health	0.187	0.122	–0.087	0.417	0.494
	(0.17)	(0.18)	(0.19)	(0.29)	(0.31)
Health-Related School Limitations		–0.718**	–0.473**		
		(0.12)	(0.13)		
Days Absent in Last Term		–0.056**	–0.052**		
		(0.0058)	(0.0059)		
ASVAB Percentile			0.021**		
			(0.0017)		
Ever Repeated Grade			–1.34**		
			(0.084)		
Average Grades in 1997			–0.203**		
			(0.021)		
% Chance in School Next Year					0.013**
					(0.0027)
% Chance High School Diploma					0.022**
					(0.0044)
Parent: % Chance High School Diploma					0.026**
					(0.0045)
Constant	1.01**	0.932**	0.147	–1.12	–9.04**
	(0.34)	(0.33)	(0.37)	(1.21)	(1.48)
N	6,579	6,579	6,579	2,434	2,434
Number of Households	5,209	5,209	5,209	2,323	2,323
Log Likelihood	–3,239	–3,135	–2,715	–1,200	–1,090
Test of Joint Significance					
Educational participation					
χ^2 (2)		131.5			
$p > \chi^2$		0.00			
Educational performance					
χ^2 (3)			664.3		
$p > \chi^2$			0.00		
Educational expectations					
χ^2 (3)					122.3
$p > \chi^2$					0.00

[a]Standard errors are in parentheses. The reference category for college enrollment is no attendance. College enrollment is conditional on high school completion. All models also include main effects for age, sex, number of children under age 18 in the household, 1997 parental education, 1997 household poverty ratio, and 1997 parental marital status. Models 1–3 include adolescents of all ages, and Models 4–5 include only the older adolescents who answered the educational expectations questions. Probabilities in Models 1–3 come from estimates that are adjusted for individual and family characteristics but not educational participation or performance. Model 2 adjusts for educational participation, Model 3 adjusts for educational performance, and Model 5 adjusts for educational expectations. In all columns, the model is a binary logistic regression model.

†$p < .10$; *$p < .05$; **$p < .01$

Appendix Table A2. Academic Mediators of the Association Between Adolescent Health and College Attendance: NLSY97, 1997–2003[a]

	Total Sample, No Mediators		Add Educational Participation		Add Educational Performance		Other Sample, No Mediators		Add Educational Expectations	
Variable	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year	Two-Year	Four-Year
Good/Fair/Poor Health	–0.417** (0.11)	–0.990** (0.10)	–0.381** (0.11)	–0.821** (0.11)	–0.291* (0.12)	–0.531** (0.12)	–0.634** (0.18)	–1.467** (0.17)	–0.596** (0.18)	–1.389** (0.18)
Black	–0.048 (0.11)	–0.195* (0.95)	–0.066 (0.11)	–0.243* (0.97)	0.243* (0.11)	0.664** (0.11)	0.126 (0.16)	–0.158 (0.15)	0.146 (0.17)	–0.122 (0.01)
Hispanic	0.211† (0.11)	–0.266* (0.11)	0.199† (0.11)	–0.274* (0.11)	0.338** (0.11)	0.141 (0.12)	0.122 (0.18)	–0.452* (0.18)	0.133 (0.18)	–0.414* (0.18)
Black × Health	0.318† (0.18)	0.678** (0.18)	0.294 (0.19)	–0.552** (0.18)	0.246 (0.19)	0.412* (0.20)	0.291 (0.29)	1.09** (0.28)	0.259 (0.29)	1.040** (0.29)
Hispanic × Health	0.306 (0.19)	0.621** (0.21)	0.296 (0.19)	0.566** (0.21)	0.241 (0.20)	0.445* (0.23)	0.580† (0.31)	0.835* (0.34)	0.577† (0.31)	0.833* (0.36)
Health-Related School Limitations			–0.242† (0.14)	–0.753** (0.15)	–0.135 (0.14)	–0.477** (0.16)				
Days Absent in Last Term			–0.011* (0.01)	–0.067** (0.01)	–0.011† (0.01)	–0.059** (0.01)				
ASVAB Percentile					0.014** (0.00)	0.038** (0.00)				
Ever Repeated Grade					–0.358** (0.10)	–0.982** (0.13)				
Average Grades in 1997					–0.096** (0.02)	–0.323** (0.02)				
% Chance in School Next Year									0.007* (0.00)	0.020** (0.00)
% Chance High School Diploma									0.002 (0.00)	0.021** (0.01)
Parent: % Chance High School Diploma									0.007 (0.00)	0.019** (0.01)
Constant	–0.883* (0.38)	–1.375** (0.36)	–0.893* (0.38)	–1.376** (0.36)	–1.471** (0.40)	–3.198** (0.42)	1.102 (1.32)	1.333 (1.22)	–0.902 (1.45)	–5.391** (1.62)
N	6,120		6,120		6,120		2,409		2,409	
Number of Households	4,944		4,944		4,944		2,306		2,306	
Log Likelihood	–5,837		–5,771		–5,201		–2,289		–2,247	
Test of Joint Significance										
Educational participation: χ^2 (2)			2,656.2							
$p > \chi^2$			.00							
Educational performance: χ^2 (3)					866.2					
$p > \chi^2$					.00					
Educational expectations: χ^2 (3)									51.5	
$p > \chi^2$									.00	

[a]Standard errors are in parentheses. The reference category for college enrollment is no attendance. College enrollment is conditional on high school completion. All models also include main effects for age, sex, number of children under age 18 in the household, 1997 parental education, 1997 household poverty ratio, and 1997 parental marital status. Models 1–3 include adolescents of all ages, and Models 4–5 include only the older adolescents who answered the educational expectations questions. Probabilities in Models 1–3 come from estimates that are adjusted for individual and family characteristics but not educational participation or performance. Model 2 adjusts for educational participation, Model 3 adjusts for educational performance, and Model 5 adjusts for educational expectations. In all columns, the model is a multinomial logistic regression model.

†$p < .10$; *$p < .05$; **$p < .01$

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