Preliminary. Comments welcome.

Economic status and health in childhood: the origins of the gradient

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1. Introduction

A strong inverse relationship between economic status and adult health has been well documented in both developed and developing countries. While several theories can potentially explain the relationship, there is little consensus. Some researchers have focused on the fact that less healthy adults work less and earn less, and that they may have accumulated less human capital, both as a result of being ill and in anticipation of working for fewer years. (Strauss and Thomas 1998, Smith, 1999.) Others have argued that poorer individuals may have worse health outcomes because they lack access to adequate medical care (World Health Report 2000), or because they find themselves under high levels of psychosocial stress (Sapolsky 1994, Marmot 1999, Wilkinson 1999, Adler et al. 1994). Still others have argued that the relationship is a spurious correlation, caused by unobserved characteristics (high rates of time discount, or biological or genetic characteristics) that result in both poorer health and lower economic status (Fuchs, 1982).

Hypotheses on the causes of the relationship between income and health are difficult to untangle in adulthood. Some researchers have attempted to separate the effects of wealth on health by using instrumental variables thought to influence health only through their effects on income (Pritchett and Summers 1996, Ettner 1996). It is difficult, however, to find valid instruments: most variables thought to influence income may also have a direct effect on health.

In this paper, we assess the mechanisms that run from income to health by focusing our attention on children. Generally in the United States children do not contribute to family income, and so the correlation between poor health in childhood and low family income cannot be explained by lower earnings of children (although it should be noted that ill children could reduce parental labor supply— a point we return to in what follows). By focusing on children, we can eliminate the channel that runs from health to resources.

We find, using a variety of cross-sectional and panel data sets for the U.S. from the mid-1980s through to 1997, that the gradient observed in adulthood is present for children aged 0 to 17. Moreover, the gradient of health with respect to income becomes steeper with age. Small but significant differences among 5-year-olds become more pronounced for 10-year-olds, and larger still for 15-year-olds. In addition, we find that one important mechanism through which income affects the health status of children is the response of health to chronic illnesses. Not only are poor children significantly more likely to suffer from asthma (for example) but, among children with asthma, health status is more seriously compromised for poor children than for rich ones. Our panel data estimates are consistent with a model in which the effects of low long-run average income are cumulative over a child's life.

We begin, in Section 2, by introducing our primary sources of data. Section 3 presents findings on the income-health gradient, and on the correlation between chronic conditions and income. Section 4 presents a model of health stock that is consistent with the findings in Section 3, and Section 5 examines the empirical support for implications of the model. Section 6 explores the extent to which the relationship between income and health can be explained by other characteristics of parents and the child's environment, such as parental health and labor supply. Section 7 offers some final thoughts.

2. Data

In our analysis we use data from four sources: the annual National Health Interview Survey (NHIS), the 1988 child health supplement to the NHIS (NHIS-CH), the Panel Study of Income Dynamics with its associated 1997 Child Development Supplement (PSID-CDS), and the National Longitudinal Survey of Youth (NLSY).

The NHIS is a cross-sectional survey that collects data on the health status and chronic and acute medical conditions of a large nationally representative sample of American adults and children annually. We pool NHIS data from 1986 to 1995, which yields roughly 62,000 observations for 1986, and 120,000 observations annually between 1987 and 1995. (The NHIS was substantially redesigned after 1995, which is why we do not use later data.) The NHIS contains basic demographics for each household member, and asks a knowledgeable household member to report on the health status and health conditions of children aged 0 to 17 (although 17-year-olds have the option of reporting for themselves.) In addition, each household was randomly assigned to answer questions from one of six "condition lists," and information was collected on whether each household member had experienced each of the medical conditions on the assigned condition list. Our interest is in understanding the relationship between family income and children's health, and for this reason we restrict our 'core' sample to all children aged 0 to 17 for whom household income is reported. The NHIS contains information on total household income, presented by income band. We assign incomes to these income categories using data from the 1986-1995 March Current Population Surveys. (Detailed information on the sample and on the income assignment procedure is provided in the Appendix.)

Summary statistics for our core NHIS sample of children are provided in column 1 of Table 1. The children are on average 8.3 years old (we have roughly equal numbers at each age), and are on average in very good or excellent health. Only 3 percent of them are reported to be in only fair or poor health. Less than 2 percent of the children are living apart from a mother; 20 percent are living apart from a father. The sample is roughly 78 percent white, and 15 percent black.

The sample for the 1988 NHIS-CH consists of one child per family drawn from the 1988 NHIS. The respondents for these children were asked a wide variety of questions regarding the child's health. We use the NHIS-CH to examine issues related to the child's health at birth and the child's health insurance coverage, for which there is no information in the core NHIS.

The bulk of our PSID data comes from a Child Development Supplement that was conducted in 1997, in which a battery of health-related questions was asked of (a maximum of) two children aged 12 or under in all PSID households. Information was gathered on whether a child had ever had specific chronic conditions; on the health status of children and their parents; and on the children's health status at birth. We supplement the 1997 data with information on family income and parental work histories from earlier years of the PSID.

Summary statistics for the PSID sample are given in column 2 of Table 1. The PSID children are on average younger than the NHIS children (they range in age from 0 to 12, instead of from 0 to 17). Their health is also generally very good or excellent. The PSID sample is less white (52 percent) and more black (42 percent) than the NHIS. Part of our sample comes from the PSID-SEO, which intentionally oversampled the poor.

Our final data source is the National Longitudinal Survey of Youth (NLSY), which tracks a sample of people who were aged 14 to 21 in 1979. Interviews were conducted annually between 1979 and 1994, and biennially after 1994. A separate biennial survey of the children of women from the original cohort (called the NLSY-Children) began in 1986. We use data on mothers' report of their child's health status asked in the 1992, 1994, 1996, and 1998 waves. Our interest here is in following changes in children's health status, and thus we select children aged 5 to 14 with at least two consecutive health reports, and non-missing income and demographic information at the time of the first report. (The age range for children whose mothers were asked about their health status was 10 to 21 in 1992, 10 to 14 in 1994, and 5 to 14 in 1996 and 1998.) This results in a sample of 3392 children. Since some children have three or four health reports, there are 3793 health transitions (changes in reported health status between two successive reports). An important caveat is that, because the sample is drawn from a small birth cohort of mothers, the oldest children in the survey are born to women who gave birth relatively earlier in their lives. Therefore it is difficult to separate aging effects from changes in the sample composition as we move from examining younger to older children.

Summary statistics for the NLSY data are given in the third column of Table 1. Health status is measured on a four-point scale (unlike the NHIS and PSID, which have five-point scales). Consistent with the NHIS and PSID, 70 percent of mothers report their children to be in excellent health, and only 3.2 percent report their children in fair or poor health. The NLSY also oversamples black, Hispanic, and poor whites, which results in the sample having more blacks than the nationally-representative NHIS sample (31 percent compared to 15 percent).

3. The income-gradient in children's health status

We first look at the relationship between family income and overall health status, where health status is a categorical variable with values 1=Excellent, 2=Very Good, 3=Good, 4=Fair, and 5=Poor. Finding appropriate measures of a child's health status is a challenge. In developing countries, infant mortality rates, anthropometric measures, and indicators for vaccination provide a guide to child health. Using U.S. data, Korenman and Miller (1997) examine how the timing of poverty is related to stunting, wasting, obesity, and several indicators of child development among a sample of 5 to 7 year olds from the NLSY. However, in the U.S., stunting and wasting are quite rare. For adults, a poor self-report of health is a powerful predictor of mortality, even when controlling for current health status and health-related behaviors. Poor self-reports of health are also a significant predictor of future changes in functioning among the elderly. (Idler and Kasl 1995 presents results on changes in functioning, and an extensive set of references on the studies of self reported health and mortality.) Much less is known about the predictive power of reported poor health in children. In the next section, we find that this measure correlates strongly with children's chronic conditions, bed days, and hospitalization episodes.

The upper half of Figure 3.1 shows the average of health status in the NHIS as a function of the log of family income, for children by age group, in the left-hand panel, and for younger and older adults by age group in the right-hand panel. The bottom half shows similar graphs for the PSID, although the samples of adult for the PSID consist of parents of the children in the PSID-CDS and so are not representative of all adults in the United States. The conditional expectations are calculated using a Fan (1992) locally weighted regression smoother, which allows the data to determine the shape of the function, rather than imposing (for example) a linear or quadratic form. The top left panel of Figure 3.1 presents results for children ages 0-3, 4-8, 9-12, and 13-17, and the right panel presents those same children 13-17, and compares them with adults aged 25-34, 35-44, 45-54, 55-64 and 65 and above.[1] We do not include adults aged 18-24 in this second panel, because we are concerned about the representativeness of this sample of college-aged individuals, and whether these respondents report their current incomes or the incomes of the families in which they were raised. The PSID uses the same age groupings for children (up to age 12), and for two groups of parents, aged 25-34 and 35-44.

Immediately apparent in the left panel of Figure 3.1 is the inverse relationship between family income and children's health status for children of all ages. The correlation becomes progressively more negative with age—a phenomenon that holds throughout childhood and adulthood (note the change in scale between the panels). This steepening of the gradient with age is observed until roughly age 65, a result consistent with the findings of other researchers. The results for the PSID are similar to those for the NHIS.

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[1]The Fan regressions are weighted using sampling weights provided in the NHIS, and are thus representative of the population as a whole. (Unweighted regression results are very similar.)

Our findings contrast with those found by West (1997). Using the 1991 British Census, West concludes that the gradient found among children disappears for youths (ages 11-19), only to reappear in early adulthood (ages 20 and higher). We find that the gradient in reported health status found in childhood becomes more pronounced as youths age, and no evidence that the gradient vanishes in adolescence.

There are many other parental, household and child-specific characteristics that may vary between households with 2 year olds (say) and households with 12 year olds. In order to control for a range of other characteristics, we run regressions of health status on income and on sets of household controls, and present the results in Table 2 for the NHIS. The first four columns of Table 2 present results for health status (values are integers from 1=excellent to 5=poor), and the last four columns for an indicator that health status is excellent or very good. These regressions are run by age group (0-3, 4-8, 9-12, 13-17).[2]

We present two sets of regression results for each age group. The first row shows results of a regression of health status on the log of family income, with age indicators, year indicators, and with controls for whether the child is male, black, or white; whether the child's mother is present in the household, whether the father is present in the household; interactions between mother's presence and mother's age, and between father's presence and father's age; and the log of family size. Each regression also includes controls for the identity of the child's health respondent (both mother and father, mother only, father only, or someone else). The last set of indicators are included to control for the fact that fathers on average report their children to be in better health (Case and Paxson 2001) and to use less medical care (Currie and Gruber 1996).

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[2]Table 2 presents OLS regressions of the 5-point health measure. Results are similar using ordered probits. (See Tables 8, 9, 11, and 13 for ordered probit results.)

The next set of rows presents results in which, in addition to the above controls, the following interactions are added: mother's presence and her education; father's presence and his education; mother is present and unemployed; and father is present and unemployed. Children are at greater risk for maltreatment when both parents are unemployed (Paxson and Waldfogel 1999), and we include parents' unemployment here, both to insure that the impact of income on health is not proxying for the impact of parental unemployment on children's health, and to see whether the unemployment result carries over to children's health more broadly.

The regression results in Table 2 show that, whether we focus on health status or on the indicator that health is very good or excellent, the negative relationship between income and health status becomes more pronounced and significant for each older age group. This is true with or without controls for parents' educations and unemployment status.

Coefficients on parents' educations, presented for the second regression for each age group, are large and significant. Children living with a mother with a high school degree are reported to be in better health than those whose mothers have not finished high school (the omitted category here). Children whose mothers have more than a high school degree are reported to be in even better health. A similar pattern is seen with respect to fathers' educations. This may be because education makes parents more adept at protecting their children's health. Alternatively, education itself may not be causal, but may signify that the parent is patient, and may be more nurturing. In either case, if parents' educations are omitted, their effects may load onto the income coefficient, with which they are highly correlated. Yet another explanation is that household income is measured with error, and the 'true' household income may be correlated with parents' educations, leading to large (or larger) coefficients on parents' educations, as the education coefficients pick up part of the effect of 'true' income.

We have explored whether measurement error in income is important in our analysis, by instrumenting the log of family income on 15 indicators that anyone in the household is employed in particular industries, and on 15 indicators that anyone in the household is employed in particular occupations, and on 9 indicators that anyone in the household falls into particular employment classes. For each age group and each specification, the instrumented coefficients show a stronger effect of income on health status, increasing the size of the coefficients in absolute value between twenty five and fifty percent. Other than its effect on the sizes of the coefficients, instrumentation does little to the pattern of coefficients observed here: the gradients for older children continue to be steeper than those for younger children. Instrumentation does reduce the estimated effects of mother's and father's educations, but their coefficients remain large and significant.

Distinct from the pattern we observed for income, we see little change in the impact of parents' educations on children's health status at older ages. Both mothers' and fathers' educations have a slightly stronger impact for children above age 3; the coefficient on the indicator that mother has more than a high school degree, for example, jumps from –.193 to –.246 between age groups 0 to 3 and 4 to 8. However, a comparison of the education coefficients for children aged 4 to 8, 9 to 12 and 13 to 17 show that the relationship between parents educations and childrens' health remain constant above age 3. That there is a steepening gradient of health with respect to income with age, but no steepening with respect to parents' educations, is noteworthy. It appears that income (and what it buys a child) has a different effect on a child's health from the skills that accompany parental education.

The addition of parents' educational attainment to the gradient regressions has a large effect on the estimated income coefficients, reducing them by roughly a third for all ages relative to results in row 1. However, the gradients remain large and highly significant. Results in row 2 show that, even with controls for parents' educations, a doubling of household income is associated with an increase in the probability that a child is in excellent or very good health of 4.0 percent (for ages 0-3), 4.9 percent (ages 4-8), 5.9 percent (ages 9-12) and 7.2 percent (ages 13-17).

One potential objection to the use of parents' reports of their children's health status is that they are not objective, and may be colored by the parent's own health status. Dadds *et al* (1995) present evidence that this is *not* the case. This study concludes that maternal mental health does not influence mothers' reports of child health. We provide additional evidence on this issue by looking at 17-year-olds in the NHIS. Children of this age were given the option of reporting on their own health, and the survey indicates whether the child was a respondent. In Figure 3.2, we compare the gradients in health status for 17-year-olds who did and did not report for themselves. Conditional on income, children of this age report their health status to be only slightly better than parents report for children of this age. Using this sample of 17-year-olds, we reproduced the regressions shown in the top panel of Table 2, with the addition of an indicator for whether the child was the respondent, and logarithm of income interacted with whether the child was the respondent. In no case was the effect of either of the added variables significantly different from zero.

The NHIS also contains information on specific chronic medical conditions, and we examine whether there are gradients in these conditions for children. The 16 measures of chronic conditions we work with are listed in the Appendix, along with the NHIS code numbers and (for conditions that are aggregates) the more detailed conditions that went into their construction. Figure 3.3 parallels Figure 3.1, and shows non-parametric regressions of an indicator of having a medical condition on the log of family income for children in different age groups. We have graphed 9 of the 16 conditions to illustrate the diversity of relationships between specific medical conditions and income. The vertical lines in the figures are placed at the 25th, 50th and 75th percentiles of income.

Many of the conditions are more prevalent at lower incomes for all age groups. These include digestive disorders, hearing problems, speech problems, heart conditions, epilepsy, and mental retardation. Others display a negative relationship between prevalence and income for some but not all ages. For example, there is a negative association between asthma and income for children aged 8 and under, but not for older children. This result is consistent with Halfon and Newacheck (1993), who find that the difference in the prevalence of asthma across children above and below the poverty line is largest for young children. However, our results indicate that the negative association between asthma and income for younger children is not driven solely by a higher prevalence of asthma among children in poverty: the negatively sloped gradient is apparent up through the 50th percentile of income, well above the poverty line.

Although many of the conditions we examine are negatively related to income, some are not. One of the conditions shown — hay fever — is positively related to income at all ages, possibly a consequence of wealthier children living in areas where the exposure to pollen is greater, or of being more likely to be taken to a doctor for the diagnosis of hay fever. Some of the conditions we analyze are not chronic, in that their presence diminishes with age. Speech impairments, for example, are most common during the period when children are first learning to speak; many of these appear to be corrected by late childhood.

Table 3 shows results from the NHIS of regressions of an indicator that a child has a medical condition on the logarithm of income, the logarithm of family size, a complete set of age and year dummies, and indicators of the child’s race and gender. Although these regressions do not allow the relationship between income and health to vary with age, they do provide a useful summary measure of the gradient for each condition. The results indicate that, for the majority of adverse health conditions, conditions are more likely among lower-income children. The coefficients on the logarithm of income are often large. For example, a one-standard-deviation reduction in the logarithm of income (0.964) would increase the probability of having a heart condition by .002, a number equal to 10 percent of the fraction of children with heart conditions. However, there is a positive relationship between several of the chronic conditions most prevalent among children — hay fever, sinusitis, and bronchitis — and income. Newacheck (1994) finds similar results using the 1988 NHIS-CH, and argues that although the overall probability of having *any* medical condition is actually higher for children above the poverty line than below it, children below the poverty line are more likely to have severe medical conditions. The last four rows in column 2 of Table 3 provide some evidence that poorer children are more seriously affected by illness. Lower incomes are associated with more restricted activity days, more days in bed, more days missed from school (for those aged 5 and over), and more hospital episodes.[3]

The next section will present a model of children's health status that is consistent with the preliminary findings of this section: that, on average, children's health becomes poorer with age; that, on average, the differences in the health of wealthier and poorer children become more pronounced with age; and that, on average, the probability of developing a severe chronic condition is inversely related to income.

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[3]Results in Table 3 do not control for mother's and father's education or unemployment, because to add these controls we lose roughly 15 percent of our sample, those for whom information on these parental characteristics is missing. When we run the regressions in Table 3 on the subsample for whom we have these parental characteristics, and add the same controls in 'controls 2' in Table 2, we find the effects of income on the probability of a condition become larger (more negative) and more significant for bronchitis, asthma, tonsilitis, and diabetes. Adding controls for parents' education reduces the (positive) income coefficient for hay fever by 50 percent, and that for sinusitis by 75 percent. Coefficients on digestive disorders, vision problems, hearing problems, speech problems, mental retardation, restricted activity days, bed days, hospitalization episodes and missed school days all remain significant, although in some cases the coefficients are somewhat smaller. The coefficients on kidney disease, frequent headaches, epilepsy and heart conditions become insignificant.

4. A model of cumulative health status

The results shown in the last section are consistent with a variety of views about how income affects health in childhood. One possibility is that the effects of income on health are cumulative over a child's life (and possibly on into adulthood.) In this view, the steepening of the gradient with age reflects the fact that poorer children experience a greater erosion in their health capital at each age. Another possibility is that the effects of income are not cumulative, but that income is more useful in preventing and treating the types of illnesses that are more prevalent among older children. The results presented in Section 3 do not speak to the mechanisms underlying the gradient.

In this section, we sketch a model of how a child's health stock might evolve over time. The model builds on the idea that incomes have cumulative effects on health, and that a health stock depends on both the accumulation of medical conditions and the effort and money parents spend to prevent the deterioration in their children's health when they become ill. The model has implications that are consistent with our previous results — both that older children on average are reported to have poorer health, and that the gradient in health steepens with age—and also has a variety of other testable implications that we examine below.

We assume, to begin, that all children are born into excellent health status, h^*, and that children's health erodes only as they receive health shocks, which arrive in the form of chronic conditions. If a child never contracts a chronic condition, then the child's health will remain at the highest level. (Below we relax the assumption that all children have identical, excellent health status at birth. We can also allow for non-chronic health shocks that do not persist over time, such as common colds or stomach viruses, that might temporarily reduce reported health status.)

Chronic conditions accumulate over time. We define c_t to be an index of the number and severity of chronic conditions a child has. Each period, c can increase, either because the child receives a new chronic condition or an existing chronic condition worsens. A simple (discrete) process for the accumulation of chronic conditions is:

$$c_t = c_{t-1} + d_t$$

where d_t is an integer that ranges from 0 to D, such that each value has a probability of occurring of p_d, where $\sum_{d=0}^{D} p_d = 1$. In this specification, chronic conditions can increase but not decrease over time. It is sensible but not necessary to assume that p_d decreases in *d*. Consistent with the evidence presented in Figure 3.3, we assume that the probabilities p_d are a decreasing function of income.

A child's stock of health h evolves through time. Chronic conditions c erode the child's health stock by an amount $\delta(c)h$, where the fraction of health stock lost to illness each period $\delta(c)$ depends upon the number and/or severity of conditions. Without proper treatment, a child with asthma, for example, is at greater risk of developing respiratory viral infections, which may in turn lead to lower health status.

To a greater or lesser extent, the depreciation in the child's health stock may be offset by household (parental) investments in the child's health. Here we assume that investments can be characterized as investments per unit of the child's current health $e(y,h)h$, where the investment is a function of the child's current health status and the family's income y. For the moment we leave open the question of what income measure is most relevant to a child's health investments — current income or long-run average income are both plausible candidates. Such investments may take many forms. For example, the parents of a child with asthma may invest time and effort in helping to develop and monitor a medical protocol that works for their child; they may keep the child's medications up to date, and his or her inhaler in working order. Parents may also change their own behaviors, perhaps refraining from smoking near the child, or ensuring that dust mites aren't aggravating the child's condition. As written here, the investment function includes both medical services purchased and health-related behaviors (nutrition, smoking, exercise).

The two critical assumptions we make about the investment function are that, at any given level of health stock, wealthier parents are willing (able) to invest more, so that $\partial e(y,h)/\partial y > 0$, and that all parents are willing to invest more when a child's health becomes poorer, so that $\partial e(y,h)/\partial h < 0$. We also assume that as long as children are observed in excellent health, no investment is made in their health: $e(y,h^*) = 0$. Figure 4.1 displays a configuration of the relationship between a child's health and the health investment for the wealthiest household in the survey, $\bar{y}$, and the poorest household in the survey, $\underline{y}$. We have drawn health investments to be linear in the child's health stock, but the exact shape of the investment profile is not essential.

In this model, a child's health stock evolves as a function of the child's chronic conditions, his or her current health stock, depreciation of the current stock, and investments made by parents:

$$h_t = h_{t-1} - \delta(c_{t-1})h_{t-1} + e(y,h_{t-1})h_{t-1}$$

Conditional on the child's conditions, health transitions toward a steady state are determined by parents' investments and the severity of the conditions faced. Assuming the arrival of no additional conditions, steady state would be reached when:

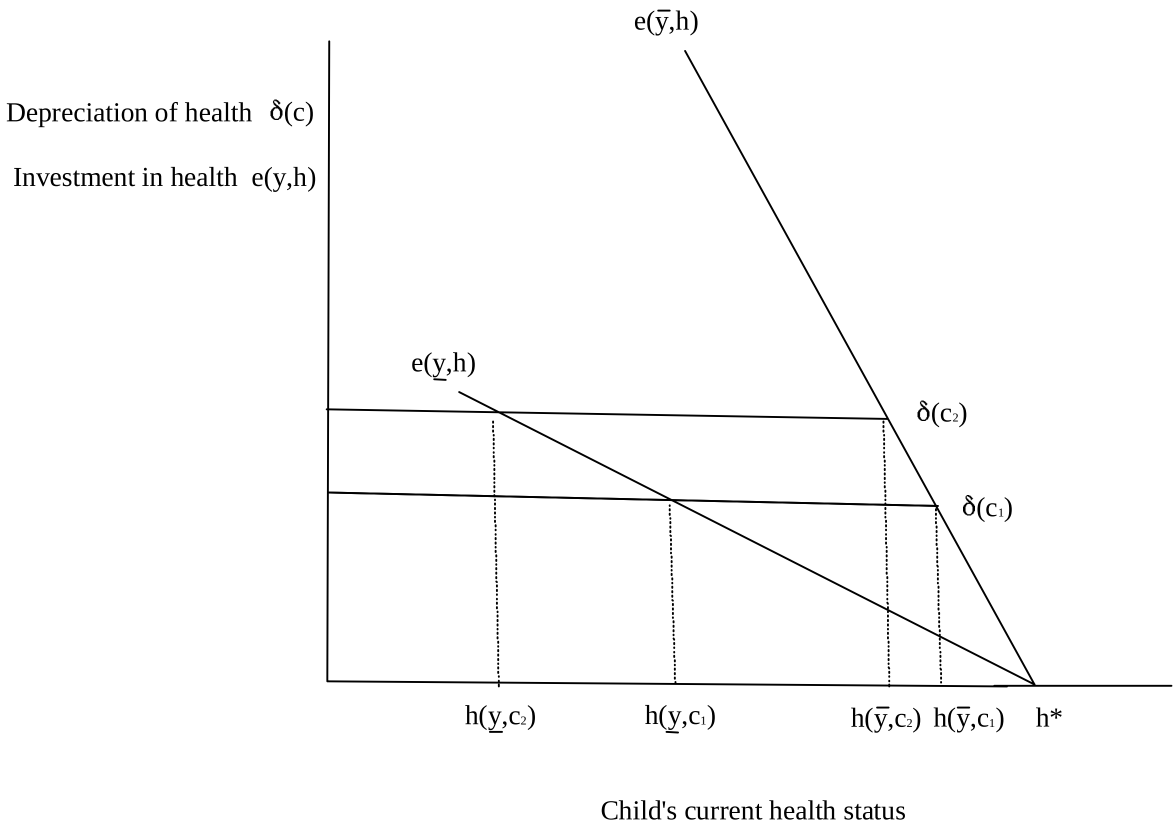
$$e(y,h) = \delta(c).$$

For a set of conditions $\tilde{c}$ and an income level $\tilde{y}$, children will not survive if the chronic conditions faced are such that $e(\tilde{y}, h_{min}) < \delta(\tilde{c})$, where h_{min} is a level of health so low that, below this level, children die.

Figure 4.1 shows the steady state values for children with the same number of conditions from the wealthiest and poorest households. Holding income constant, children with more chronic conditions are less healthy. Holding the number of conditions constant, children with less income are less healthy. The model predicts that, for any non-zero level of chronic conditions, say c_1, the steady state health level for poor children will be below that for rich children, $h(\underline{y},c_1) < h(\bar{y},c_1)$, as in Figure 4.1.

We illustrate the health dynamics implied by this model with the following example. Suppose a rich child and a poor child of the same age both developed a chronic condition, c_1, at time t. The model predicts that at $t+1$ the health of both children will have deteriorated somewhat, because the families do not spend resources on the children's health when the children are in excellent health, and it takes time for the condition to erode health status. But once the erosion is observed, the wealthy family is able to bring more resources to bear to shore up the health of their child. The wealthy family may be able to stem the deterioration in the child's health status at time $t+1$, while the poor family may observe additional deterioration until $t+2$ (or perhaps beyond), until the child reaches a health level h such that $e(\underline{y},h) = \delta(c)$. The rich and

Figure 4.1 Children's health status, conditions and family income



poor child, when observed in cross section, would be presented with identical health status at time t and $t+1$. It is only at time $t+2$ and beyond that the gradient in these children's health appears.

This is shown in Figure 4.2, where the health status of a rich child and a poor child are graphed against age. The status of both children are shown after a health shock at age 0 (time t). The gradient in these children's health status appears only after age 1 (time $t+1$), when the differences in the treatment they receive for their chronic conditions begins to be reflected in their health. If at age 3 these children were both to develop a second chronic condition, erosion of their health from their current levels brings more resources to bear, and again the wealthy family stems the erosion with less loss of health than does the poor family. If the slope of the expenditure function with respect to health is steeper for the wealthy family than for the poor family at these levels of health, then the difference in the children's health will widen after the onset of this new condition. This is shown both in Figure 4.1 and 4.2 as the difference between $h(\underline{y},c_2)$ and $h(\bar{y},c_2)$.

The model has a variety of implications for the relationship between health, chronic conditions, and income, many of which are testable. We list these, and return in the next section to present evidence on each.

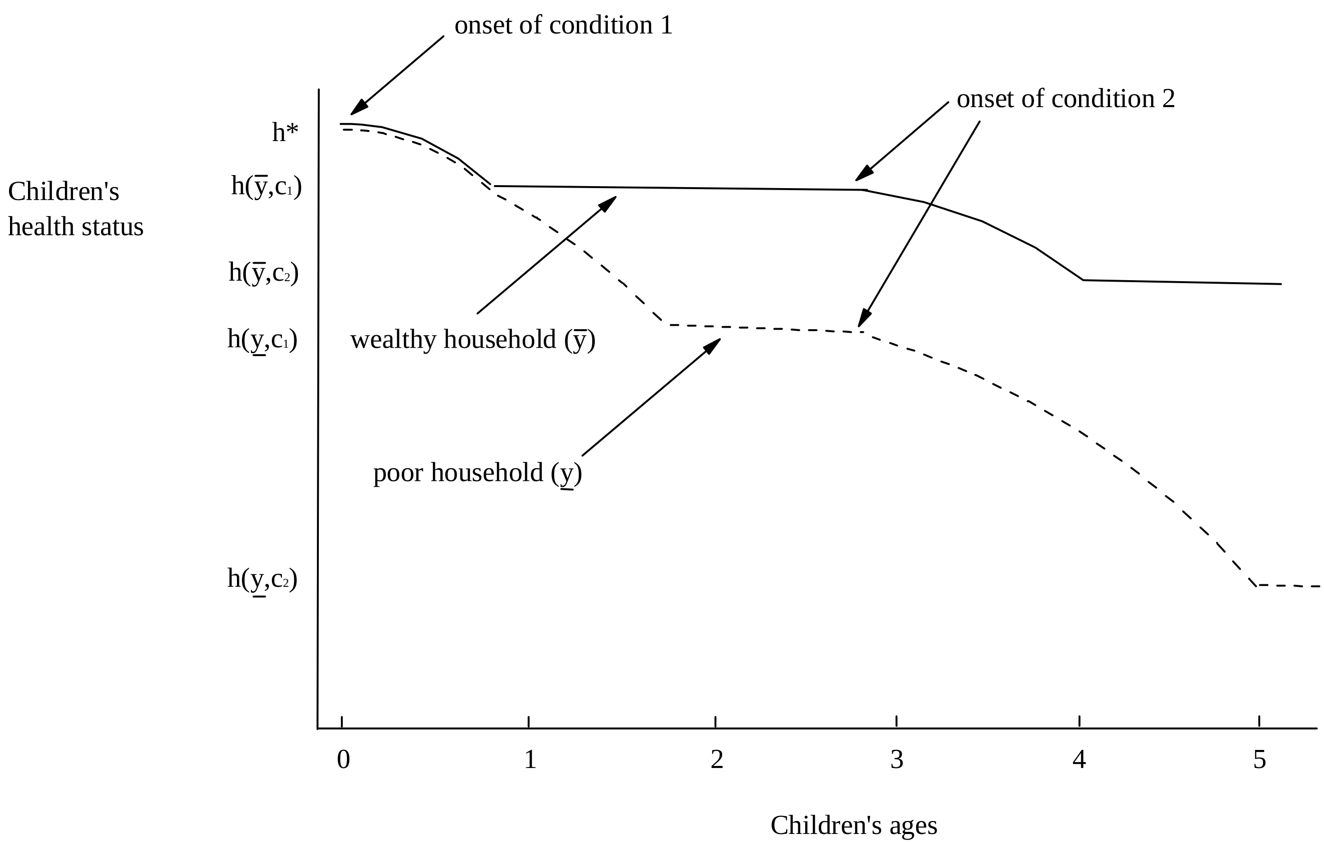
(i) Children who suffer from no conditions remain in excellent health but, given the stochastic arrival of chronic conditions, on average the health of children will deteriorate with age.

As conditions accumulate over time, $\delta(c)$ shifts up, and health worsens on average with age for children at any income level. This implication hinges on the assumption that chronic conditions can only accumulate over time. It could be reversed if children were able to recover from some serious adverse health conditions.

(ii) Observed in the cross section, the gradient in the health-income relationship is steeper for older children than for younger children.

Shallower gradients for younger children appear for two related reasons. First, the probability of receiving a chronic condition is higher for poorer children, and the accumulation of these conditions over time will manifest itself in a steeper gradient. In addition, the erosion of poor

Figure 4.2 The evolution of children's health status



children’s health stock, after the arrival of a chronic condition, takes time. As shown in Figure 4.2, a poor child at age 1 with chronic condition c_1 is in better health than he will be at age 2 (the point in time when the erosion in his health elicits a large enough resource response to maintain his health at a particular level).

(iii) The impact of a health shock on children's health stock should depend upon the severity of the chronic condition contracted. For any given chronic condition, the children from wealthier families have a higher health stock and, if $\partial^2 e(y,h)/\partial h \partial y < 0$ *at all h and y, so that the slope of the investment function with respect to health is always steeper for wealthier families, then difference in the health of rich and poor children will increase with the severity of the condition.* As in Figure 4.1, at any value of *c*, children from wealthier families will have better health outcomes than will children from poorer families. Increases in *c*, which shift $\delta(c)$ up, will have a larger adverse effect on poor children than rich children.

In Section 5, we test these implications of the model using data on children's health from the NHIS, the PSID, and the NLSY. We also return to the question of whether current or long run income is more relevant for children's health status.

5. Evidence on chronic conditions, income and cumulative health status

For the purposes of testing the model laid out in Section 4, the NHIS, PSID and NLSY have strengths in different dimensions. The NHIS has the advantage of being large, which is crucial for analyzing chronic conditions that are relatively rare. However, the NHIS is not a panel, and thus we cannot track parents, children or income through time. The PSID is a panel, and we can use household incomes from all periods of a child's life to assess whether income has a persistent effect on health. The PSID tracks income through time, but does not track children's health (we have only one child health assessment from the PSID). The NLSY has multiple health assessments for a subset of children of the NLSY, but the children of the NLSY who are old enough to be observed multiple times tend to come from households that are significantly younger and poorer than the average household. We use all of these data sets to test aspects of the model presented in Section 4.

The model predicts that the effect of a chronic condition on children's health stock should depend upon the severity of the chronic condition and, for any given chronic condition, children from wealthier families should have higher health stocks. In addition, if the slope of the investment function with respect to health is everywhere steeper for wealthier families, then the difference in the health of rich and poor children should increase with the severity of the condition.

We test these implications of the model by running regressions, one for each chronic condition, in which we regress an indicator of poor health (health status=4 or 5) on an indicator for the presence of a chronic condition, the log of family income, and the log of family income interacted with the indicator for the presence of that condition. All regressions include a complete set of age and year indicators, and indicators that the child is male, white, or black. Results of these regressions are presented in Table 4, where each row of the table presents results from a different regression.

Column 4 of the table provides estimates of the change in the probability of reporting poor health with each condition, evaluated at the median household income. The results show that conditions we would *a priori* label as more severe have the largest effect on children's health status: at median household income, the probability of poor health increases by 9 percent with asthma; 15 percent with diabetes; 21 percent with epilepsy; 19 percent with kidney disease; and 10 percent with mental retardation. Conditions we would *a priori* label as less severe have the smallest effect on children's health: at median household income the probability of poor health increases by 1 percent with hay fever; 2 percent with sinusitis; and 3 percent with tonsilitis.

For any given chronic condition, children from wealthier families have higher health stocks. This can be seen by inspection of columns 1 and 3 of Table 4. For every condition, the interaction term between income and the chronic condition is negative and significant, with the exception of kidney disease, tonsilitis and speech problems (the latter two perhaps not representing chronic conditions). When added to the own-effect of income in column 1, the sum of the own-effect of income and the interaction effects are negative and significant for all conditions. Children from wealthier families are healthier, when observed with each of these chronic conditions.[4]

The gradient in health is largest for the most severe chronic conditions. That is, the protective effect of income is largest for the conditions that cause the greatest erosion to children's health status. The interaction term of income with asthma (–.048), diabetes (–.139), epilepsy (–.077) — three of the chronic conditions that lead to the largest average deterioration of health status — are the largest interaction terms observed. (The only exception here is kidney disease, where the condition has a large and significant effect on health status, but income appears not to be protective.)

The model presented in Section 4 would also predict that the effect of income on health upon the arrival of a chronic condition should be larger, the longer the child had suffered from the chronic condition. In the NHIS we do not have information about the onset date of chronic conditions. However, we can examine the impact of the condition, and its interaction, at different ages observed in cross-section, and we do so in the last four columns of Table 4. Columns 5 and

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[4]One drawback of using the data on chronic conditions from the NHIS interviews is that each child is asked only about a subset of chronic conditions. Because the prevalence of observed chronic conditions may co-vary with chronic conditions for which no information is obtained, the estimates of the "effects" of any given condition on health may be biased. The 1988 NHIS-CH does not share this drawback (although it is limited by a much smaller sample size). Information on a variety of health conditions was collected for all of the children in the survey. When we use these data and run a regression of health status on the full set of condition indicators, plus interactions of the condition indicators with income, the coefficients are much less precisely estimated than in Table 4, which is to be expected given the smaller sample size and the rarity of many of the conditions. However, the general pattern — that chronic conditions worsen health, and that they do so more for poorer children — is also observed in this data set.

6 present the impact of conditions, and the interaction of conditions with log income, on the probability that a child is observed in poor health, for children is aged 0-8, and columns 7 and 8 present the impact of conditions, and interactions with log income, on the probability of poor health, for children aged 9 to 17.

If we assume that the deterioration of health status is cumulative, we would expect, even without information about the date of onset of particular conditions, that older children should experience more detrimental health outcomes due to chronic conditions, the lower is household income. Consistent with the model, we find that income is more protective of children's health status at older ages for almost every condition presented.

We take the results in Table 4 as evidence in support of the model's implication that chronic conditions interact with income and, in doing so, create a gradient in children's health. A second set of results consistent with this implication is provided in Table 5, where the number of bed days lost to illness and the number of hospitalization stays are used as alternative measures of poor health. The left panel of Table 5 presents results of regressions where number of bed days is regressed against an indicator that the child has particular conditions, the log of family income, the log of family income interacted with these conditions, the log of family size, and a complete set of age and year indicator variables and indicators that the child was male, white and black. The last column in the panel presents the marginal effect of the condition on bed days, evaluated at median household income. The right panel provides an analogous set of results for hospitalization episodes.

Both panels provide evidence that income protects children with chronic conditions. Asthma provides a useful example. We find that the association between asthma and bed days and hospitalization at the 25th percentile of income is much greater than that at the 75th percentile of the income: at the 25th percentile (a log income level of 9.5) children with asthma spend 5.6 more days in bed than do children without asthma, and have 0.12 more hospital episodes, relative to 3.8 more bed days and 0.05 more hospital episodes for a child at the 75th percentile of income.

The model in Section 4 left open the question of whether the timing of income over a child's life affects a child's health. One possibility is that investment decisions are made based on long run average income, in which case the timing is not important. Another possibility, which has been discussed in the child development literature, is that the effect of income depends on the age of the child when the income was received (Duncan et al. 1997). We use data from the PSID to examine whether the timing of income matters, exploiting the fact that we have information on the family's income throughout the child's lifetime (and indeed from the period before the child was born). The first panel of Table 6 presents the results of regressions of health status on the log of average income in different periods of life (ages 0 to 3, 4 to 8, 9 to 12), and on the log of average income in the household in the six years before the child was born. Each column of Panel A presents the results of a different regression. All regressions include a complete set of age dummies, and indicators for whether the child is male, white or black, the log of family size, an indicator that mother is present, mother's age interacted with her presence, mother's education interacted with her presence, an indicator that father is present, father's age interacted with his presence, and father's education interacted with his presence.

We see in Table 6 that family income in the years before the child is born and those at different ages of life are all equally correlated with a child's current health status. Family income *prior* to the child's birth is significantly correlated with the child's current health, for children of all ages (columns 1, 3 and 7 of Panel A). Moreover, the coefficient on income prior to birth for children aged 0 to 3 (–.096) is not significantly different from that on income during the years when the child is aged 0 to 3 (–.106). The same pattern is seen for older children: the coefficient on income prior to birth for children aged 9 to 12 (–.132) is not significantly different from that on income during ages 0 to 3 (–.144), ages 4 to 8 (–.142), or ages 9 to 12 (–.167).

These results are consistent with the hypothesis that long run average income determines health investments and health status at different ages. If this is true, the coefficients on income when the child was aged 0 to 3, for children now aged 4 or above, cannot be interpreted as the impact of income arriving during ages 0 to 3. For these older children, the coefficient on income from earlier ages (and indeed that before birth) just provides us with an estimate of the impact of permanent income on children's health at their current age.

We cannot reject that income at different ages have equal effects on a child's health status, and in the last three panels we impose their equality. We regress health status on the log of average income for all years the child has been alive (ages 0 to the current year) in Panel B; on the log of average income from the six years prior to birth through the current year, in Panel C; and on the log of average income from the nine years prior to birth through the current year, in Panel D. Using income since birth, we find a significant relationship between income and health status that becomes more pronounced at older ages (the coefficient increases from –0.106 for the youngest children to –0.187 for children aged 4 to 8, to –.213 for children aged 9 to 12). When we use income from six years prior to birth through to current age, these coefficients become larger in absolute value (–.124, –.187, –.247); our measure of permanent income becomes less noisy when we use these additional years of data. The coefficient estimates change very little with additional lags beyond that point (see the results when we add lags of income for seven to nine years before birth in Panel D). We take the evidence in Table 6 to suggest that children's health status is correlated with the household's permanent income, and that the impact of permanent income on a child's health status becomes larger, the older is the child.

Neither the cross-sectional results from the NHIS nor the panel results from the PSID provide us with evidence on the relationship between income and health transitions for the same children. For this, we turn to evidence on children's transitions between different health states, using data from the NLSY. Table 7 presents data for children who were aged 5 to 7, 8 to 11, and 12 to 14 at the time their health status was first measured and who have had their health status recorded in at least two points in time. Note that the sample of older children is larger than that for the youngest children, and that the older children have been born to younger mothers, on average, and that their mothers have fewer years of completed schooling. (We discourage comparison between the age groups, for this reason.) Within each age group and initial health status, we have divided children according to whether their household's income in the initial period was above or below the median income for children in this age group-health status cell. We then tabulate the numbers of children whose health status worsened during the period between their health readings; the numbers whose health status stayed the same; and the numbers whose health status improved. There is a lot of randomness in the movement between health states—perhaps short term (non-chronic) illnesses influence a mother's report of her child's health. However, one pattern does emerge: among children aged 8 to 11 and 12 to 14 who were initially observed in excellent health, children in households below the median income were significantly more likely to have their health worsen between readings than were children in households above median income. For example, among children aged 8 to 11 initially observed in excellent health (857 children), 85 children below the median income experienced a decline in their health status between readings, while only 38 children above the median did. For children aged 12 to 14 initially observed in excellent health (1732 children), 187 children below median income experienced a decline, while only 126 children above the median did. For both of these age groups, the difference between the above-median and below-median children's health transitions is significant. The same pattern in observed for the youngest children in the NLSY (10 from below the median and only 4 from above the median were observed with lower health status in the second reading), but the sample size is very small.

Overall, we take the evidence in Tables 4 through 7 as consistent with the model put forward in Section 4. Children from families with lower incomes are at risk for worse health outcomes. The differences manifest themselves over time in childhood, and appear to work, at least in part, through chronic conditions.

6. Extensions and alternative explanations

The results presented in Section 5 are consistent with a model in which permanent income affects children's health status through its effect on parental management of children's chronic conditions. The results presented in Section 5 do not rule out many third factor explanations, such as a lasting effect of poor health at birth, or a spurious correlation between children's health and household income that derives from poor parental health. We evaluate these potential explanations in this section.

a. <u>Health at birth</u>

The model sketched in section 4 includes the assumption that all children are born in excellent health. In fact, health at birth varies across children. Some children are born with health problems, such as prematurity, low birth weight for gestational age, or congenital birth defects.

There are several reasons to think that heterogeneity in health at birth could account for at least some of our earlier findings. First, it may be that children born to poorer women are at greater risk of being born with health problems, possibly due to poorer prenatal care, higher rates of maternal smoking that accompany lower income levels, or other maternal or environmental characteristics associated with low income. Poor birth health could therefore produce a gradient in health among very young children. Second, if poorer children are born with the most severe health problems, ones that require a longer recovery period or that result in chronic conditions, then the gap in health between rich and poor children might increase with age, as wealthier children who are born in poor health recover whereas poorer children who are born in poor health do not. Finally, holding constant the severity of health problems at birth, wealthier children may recover faster because their parents spend more on their care.

For policy purposes, it is important to examine whether health at birth accounts for a large part of the gradient between health and income in childhood. If so, it implies that equalizing the quality of prenatal health care and working to improve maternal health behaviors in the prenatal period may go a long way toward eliminating the gradients we observe throughout childhood.

Adding heterogeneity in health at birth does not fundamentally alter the model developed above. Health at birth can be broken into a component that is chronic, so that children can be born with different values of c, and a component that is transitory, so that given c children can be born with non-steady state health levels below h^*. In this case, the model works as described above, with the only addition that children with transitory health problems at birth move, after the birth, to the steady state-level that coincides with their family income level and value of c.

We use data from the NHIS to examine whether health at birth accounts for the relationship between current health and current income. The core NHIS collects no information on health at birth. However, the 1988 NHIS Child Health supplement collects information for one child per family on the child's birth weight and the number of nights the child spent in the hospital after the birth. We use the number of hospital nights and an indicator of low birth weight (defined as 5.5 pounds or less) as our measures of poor health at birth.

The top panel of Table 8 presents results of order probits of health status on income, with the birth health measures excluded. These results correspond to (and are almost identical to) those in the bottom panel of Table 2, but use the smaller 1988 sample.[5] The bottom panel adds the indicator of low birth weight and the number of hospital nights. Several findings emerge from these results. First, the addition of controls for low birth weight and hospital nights has very little effect on the health-income gradient, even for the youngest children. Second, adding the birth health measures does not alter the finding that the slope of the gradient increases with age. Third, the adverse effects of poor health at birth on current health dissipate with age.[6] Low birth weight is a significant determinant of children's health status for children in age groups 0 to 3 and 4 to 8. Above age 8, however, we find no significant effect of low birth weight on children's health status. The number of nights spent in the hospital after the birth has a substantial and significant effect on the health of children aged 0-3, but this effect diminishes markedly with age, with the coefficient falling from 0.016 (ages 0-3) to 0.011 (4-8), to 0.008 (9-12) to 0.006 (13-17). For the 13-17 year olds, the effects of low birth weight and hospital nights are no longer jointly significant.

The finding that children generally "recover" from poor birth health does not necessarily mean that all children recover at the same rate. To the extent that wealthy parents bring more

[5]Results are similar if we use an indicator that the child's health was excellent or very good. Note that the results in Table 8 include all the controls in the bottom panel of Table 2, with the exception of indicators for parental unemployment (which has an insignificant effect on the results in all specifications).

[6]This is consistent with the findings of McCormick et al. (1993) but somewhat at odds with those of Currie and Hyson (1998).Currie and Hyson, using data from the British National Child Development Survery (1958 birth cohort) find a significant effect of low birth weight on the probability a woman reports fair or poor health at age 23, but not at age 33, and a significant effect of low birth weight on the probability that men report fair or poor health at age 33, but not at age 23.

resources to bear, their children may recover more quickly from poor birth health. In addition, if health at birth results in chronic health problems, our model predicts that it should have larger long-run effects on poorer children. In Table 9, we show results of order probits of current health status on poor health at birth, including interactions of poor birth health with age and income. These are similar in structure to those shown in Tables 4 and 5, for the effects of chronic conditions on health, in that we pool children of all ages. We use, as an indicator of poor health at birth, that a child spent one week or longer in the hospital after birth and/or that the child was born at very low birth weight (less than 3.5 pounds). This assigns poor birth health to ten percent of our sample. (Results are similar using different cutoffs for poor birth health.)

The results indicate that poor birth health has larger adverse effects on children at low income levels, and that improvements with age are slower for poorer children. Column 2 confirms the findings in Table 8: poor health at birth is positively related to poor health later in life, and the effects of poor health at birth diminish with age. The third column includes an interaction of health at birth and income, and indicates that poor birth health has a larger adverse effect on poorer children. In the fourth column, we examine the hypothesis that higher income children recover from poor health at birth more quickly than do poorer children, by including an interaction of age, poor health at birth, and income. (The birth health/income interaction is omitted, which imposes the implicit restriction that poor health at birth has identical effects on health status for poor and rich children at age 0.) The parameter estimate for this interaction term is negative and marginally significant, indicating that the adverse effects of health at birth on current health decline more quickly with age for wealthier children. The final column shows results of an ordered probit that include a complete set of interactions of poor health at birth with age, income, and income times age. The parameter estimates are consistent with the hypothesis that wealthier children are less affected by poor health at birth, and recover more quickly. However, although the “health at birth” variables are jointly significant, with this number of interactions the individual parameters are not estimated precisely.

b. Parental health as a determinant of children’s health

Children’ health may also be affected by the health status of their parents, possibly through an inherited susceptibility to different diseases, a “less healthy” uterine environment, or lower quality care by sick parents. In addition, the health of parents and children might be affected by common but unmeasured environmental factors, resulting in a correlation between their health levels. It is also possible that parental health is a “third factor” that accounts for the income gradient in children’s health. Specifically, an income gradient in children’s health might be observed if parents in poor health have lower earnings, and poor health is transmitted from parents to children — producing a spurious correlation between income and children’s health.

This line of reasoning might suggest equations of the form shown in Table 2 should include controls for parental health. However, doing so has several potential pitfalls. If the health of parents is affected by their income levels (as is argued in much of the literature on socioeconomic status and health), and income is measured with error, then the “effects” of parental health may simply reflect the effects of income. In addition, if the health of both parents and children are affected by current and lagged values of income, the parental health may serve as a proxy for the income levels experienced by children at earlier ages. For both of these reasons, we cannot cleanly separate the effects of parent’s health and family income on children’s health.

Despite these problems, we estimate models identical to those in the lower panel of Table 2 but with additional controls for mothers’ and fathers’ health status, with the aim of seeing whether this eliminates the income gradient in health or the steepening of the gradient with age. The results are shown in Table 10. In the top panel, we include indicator variables for whether the child's mother and father are in excellent or very good health. The bottom panel includes a complete set of dummy variables for the health of both parents. There are several key findings. First, there are large "effects" of parent's health on children's health. For example, if a child aged 0-3 has a mother in very good or excellent health, his or her chance of also being in very good or excellent health rises by 27.4%. The corresponding increase associated with having a father in very good or excellent health is 16.3%. Second, mother's health is more strongly associated with children's health than is father's health, which is consistent with the idea that women in worse health bear less healthy children, or that poor health in women makes them less able care givers.[7]

Third, the inclusion of controls for parents' health reduces the coefficients on family income. For children in the oldest age group, the coefficient on family income in a regression on health status declines from –.169 when no health variables are included (lower panel of Table 2), to –.088 when indicators of whether parent's health is excellent or very good are included, to –.070 when the full set of parental health indicators are included. However, these estimates are still highly significant and large. For example, the results in the bottom panel of Table 10 indicate that a doubling of household income increases the chance that a child aged 13-17 is in excellent or very good health by 3%. In addition, the gradients in income still increase substantially with the age of the child, whereas the gradients in parental health do not. Controlling for parental health status does not eliminate the rotation of the gradient with age.

c. Genetic ties

[7]There is a non-monotonic relationship between mother's health status and that of children aged 0 to 3: as one moves from "fair" to "poor" health of the mother, the child's health status improves. Perhaps when mother's health is especially poor fathers play a bigger role in children's health provision.

The powerful connection between parents' health status and children's health status leads us to ask whether permanent income is simply proxying for the genetic tie between parents and children. Healthy parents earn more money and, by passing along "good genes," also have healthy children. We can test this hypothesis using the data from the NHIS-CH 1988, where we have information on whether parent figures in the household are birth parents or other types (step, adoptive, foster parents). In the ordered probits presented in Table 11, we allow household income to have different effects on children's health status, based on the relationships between parents and their child. The regressions in Panel B includes a complete set of indicators for family type: birth mother and father, birth mother and other father, birth mother only, other mother only, other mother and birth father, birth father only, other father only, or two non-birth parent, and each of these controls interacted with the log of family income. We present in the table the two polar cases: the income effect for a child living with both birth parents, and the income effect for a child living with two non-birth parents. For no age group is there a significant difference in the impact of income based on parental type and, for three of the four age groups, the impact of income is larger for child living with non-birth parents. We cannot reject equality of the eight income*parental type coefficients for any age group.

d. Health and health insurance

The model sketched in section 4 indicates that parental investments, together with accumulated chronic conditions, are key determinants of childhood health status. If investment is comprised mainly of medical expenditure, then access to health insurance might be an important determinant of health status. Our finding that poorer children have worse health given specific chronic conditions could be due to poorer children having no insurance coverage, or insurance coverage that pays for lower quality care.

The 1988 NHIS child health supplement contains information on whether the child was covered by Medicaid or other health insurance, and we use these data to examine whether the relationships between income, chronic conditions, and health status are altered when we include controls for insurance. This exercise has several potential pitfalls. First, insurance may be endogenous, so that parents of less-healthy children may seek out jobs with insurance coverage. This could make it appear as if insurance harms health. Second, because private insurance is positively correlated with income, and income is measured with error, a positive relationship between insurance and health may simply reflect the effects of income on health. A similar problem may arise because Medicaid is negatively correlated with income. Finally, access to insurance, either private insurance or Medicaid, does not guarantee utilization of medical care. Currie and Thomas (1995) find significant differences in doctors visits for illness between white and black children covered by Medicaid.

Table 12 shows regressions of health status on income, whether the child has had one of a number of medical conditions included in the 1988 NHIS child health supplement (listed in the footnote to the table), interactions of income and the condition measure, plus controls for insurance. The second column indicates that children with insurance—either private insurance or Medicaid—are in significantly better health. The point estimate indicates that in the absence of any medical conditions, being insured has the same effect on health status as a 54% increase in income. However, adding the insurance measure does not alter the estimated effects of income on health. The third column adds an interaction of the indicators for whether the child is insured and whether he or she has an adverse medical condition. This coefficient should be negative if families with insurance are better equipped to deal with medical problems. Instead, it is positive and imprecisely estimated, indicating if anything that insurance exacerbates the adverse effects of medical problems on health status.

This anomalous result could be due to the fact that the insurance measure includes Medicaid, and a child on Medicaid may have worse health for a variety of other reasons. (The parents of poor children may learn that their children are eligible for Medicaid only when the children are sick and presented for treatment.) In the fourth column we add an indicator for whether the child receives Medicaid, and an interaction of Medicaid with the condition indicator. We find that adding these controls for Medicaid does not alter the previous finding that insurance does nothing to improve the health of children with adverse medical conditions. In addition, the results indicate that children who are insured and receive Medicaid have worse health status than those who have private insurance, and the hypothesis that the net effect of medicaid on health is zero (given no adverse medical conditions) cannot be rejected.[8] Children who receive Medicaid and have a medical condition have significantly worse health status than those with no insurance and a medical condition (*F*-statistic=4.41, *p*-value=.04). It seems implausible that Medicaid actually damages children's health (see Currie and Gruber 1996 on the beneficial impact of Medicaid expansions on infant mortality rates) and we think the more likely explanation for this result is that Medicaid is correlated with unmeasured family characteristics that are related to poor health outcomes. For our purposes, the important finding is that controlling for insurance does not substantially alter the estimated effects of income on health.

The first four columns of Table 12 present the results of interacting insurance with the presence of any chronic condition. These conditions vary in severity, and may vary as well in their responsiveness to treatment. Grouping heterogeneous conditions may be responsible for the insignificance of the condition-insurance interaction term in columns 3 and 4. To shed light on this, we focus in the last columns of Table 12 on the impact of insurance on one particular chronic

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[8]The net effect of having Medicaid when there are no adverse health conditions is –.1171 + .0754 = –.0417. The F-statistic for the test that this effect equals zero is .79 (p-value=.38).

condition (asthma). Asthma is one of the more prevalent chronic conditions children face, and one that responds to treatment. We find evidence that household income protects children with asthma (consistent with the results of Table 4 above). However, we find no evidence that insurance is protective: the coefficient on the asthma-insurance interaction term is positive (less protective) and not significantly different from zero.

e. Children's health and maternal labor supply

Another possible explanation for the income gradient in children's health is that the parents of less-healthy children reduce their labor supply, producing a positive correlation between low income and poor health. Our earlier results suggest that this is unlikely to provide a complete explanation of our findings: incomes from before the child was born were seen to have as strong an effect on children's health status in the PSID as income in any period of a child's life. In the NLSY, children observed in low income families in the initial period were significantly more likely to experience a decline in health status between interviews. We provide additional evidence here, using data from the PSID to examine the impact of a child's poor health at birth on subsequent maternal labor supply. We look at maternal labor supply during the first three years of a child's life, since our earlier results indicate that poor health at birth carries over into poor health in this time period. The PSID has information on whether the child was born at low weight (5.5 pounds or less) or spent time in a neonatal intensive care unit, which we use to construct an indicator of poor health at birth.

Table 13 shows regressions of an indicator of mothers' employment status (top panel) and hours worked (bottom panel) on the indicator of the child's health at birth. These results provide strong evidence that poor health at birth does not affect maternal labor supply. Mothers of infants with health problems are not significantly less likely to work in the first three years of the child's life, and do not have significantly fewer work hours. In the first regression on each panel, the coefficient on the indicator of poor health at birth is typically *positive*, although not significantly different from zero. The second column of each panel indicates that whether a woman worked in the year prior to the birth is an important determinant of whether and how much a mother works in the first three years after the birth. However, as indicated in the third column of each panel, of mothers who worked prior to the child's birth, there is no significant difference in work status and work hours of those who did and did not have a child with poor health at birth. Our conclusion is that the positive relationship between income and health in childhood is not due to the poor health of children reducing family income.

7. Conclusion

We have shown that the relationship between income and health status observed for adults has antecedents in childhood. A family's long-run average income is a powerful determinant of children's health status, one that works in part to protect children's health upon the arrival of chronic conditions. The health of children from families with lower incomes erodes faster with age, and these children enter adulthood with both lower socioeconomic status and poorer health.

Our paper does not identify the mechanisms through which wealthier parents protect the health of their children, although we have ruled out several possible mechanisms. Our results indicate that insurance does not play a crucial role in protecting health upon the arrival of a chronic condition, nor is health in childhood a persistent reflection of health at birth.

One avenue for future work is to examine over time the relationship between family income, parental health behaviors, and children's health. Table 14 presents preliminary results of ordered probits in which a child's health status is modeled as a function of the log of family income and a number of health behaviors, including whether the child has a regular bedtime, whether someone in the household smokes, whether the child wears a seatbelt all or most of the time, whether the child has a place for routine medical care and a place for sick care, and whether the child has had a routine doctor's visit in the past year. Jointly, these variables are highly correlated with children's health status. However, they do not affect the coefficient on log income, perhaps because the gradient shows the cumulative effect of such behaviors over a lifetime, and not just at a point in time. Some of these behaviors — particularly regular bedtimes and wearing seatbelts — are highly correlated with children's health status. It seems unlikely that seatbelt use directly affects the child's health (short of having an accident), but that both seatbelt use and regular bedtimes are correlated with stability in household life. Future work will focus on factors that we can not examine in the data sets here, but which may be related — including such parental behaviors as staying home with children when the children are sick, getting them to a doctor in a timely fashion when they fall ill, and overseeing the children's meals on a daily basis.

Poorer children arrive at the doorstep of adulthood with lower health status. It is an open question whether this poorer health status results in lower earnings as adults — contributing to the gradients observed in adulthood.

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Appendix

National Health Interview Survey 1986-1995

We start with 314455 children aged 0 to 17, and drop 43707 cases (14 percent) for whom household income is not reported. We deliberately exclude children when there is doubt about whether reported household income adequately reflects the income over which the child may have a claim. Thus we remove from our analysis children who, at the time of the interview, were not living with at least one of their parents (5483 cases).[9] We also remove children who were not the sons or daughters of the reference person or spouse (18608 children). Our concern with including children residing with a grandparent head of household (the largest alternative to residing with a parental head— 13741 cases) is that we do not know how long the child has lived with the grandparent, and we may be falsely assigning to the child income that does not reflect the income in which the child has a share, or has had a share for an unknown period of time. We also remove children in households containing more than one family (899 children), and children who are not members of the "primary family" within the household (2382 children). We remove 5095 children from households where children in the households are reported to be of different races.[10] We are also interested in whether our results are robust to the inclusion (exclusion) of controls for parental and household characteristics that might have independent effects of children's health (family size; race; mothers' age, education and an unemployment indicator if she is present; fathers' age, education and an unemployment indicator if he is present), and we restrict our core sample to children for whom this information is available. Our core sample of children from the NHIS is 229,330 observations. When we turn to the analysis of (sometimes rare) medical conditions, we use the full sample of all children with non-missing information on income, family size, race, age and gender.

Assignment of household income

The NHIS contains information on total household income for 27 income categories, in $1000 intervals between an income of $0 and $20,000, and in $5000 intervals between $20,000 and $50,000. All household incomes above $50000 are top coded. We assign incomes to these income categories using data from the 1986-1995 March Current Population Surveys. Specifically, we calculate, for each income category in each year, the mean total household income in the CPS for households whose head's education matches that of the reference person in the household and whose income falls into that income category.[11]

Definitions of chronic conditions:

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[9]All reports on cases removed are for the sample of children with non-missing household income. A child may be included in more than one removal count.

[10] Difference in race within a sibship may reflect children having fathers of different races, and we would not choose to remove such children just for this reason. However, difference in reported race may also be due to measurement error, or to children being fostered. The latter two are cause for concern in our analysis, especially for our within household analysis below.

[11]For households containing both a reference person and spouse, we used the education of the male (whether he was the reference person or not) to match income information across the data sets.

The chronic conditions we use are drawn from 5 of the 6 "condition lists" in the National Health Interview Survey. The following table maps the NHIS condition codes and definitions into the definitions of chronic conditions we use:

Chronic condition	Code	Definition
Vision problem	201	blind – both eyes
	202	other visual impairments
	240	tinnitus
	241	cataracts
	242	glaucoma
	243	diseases of the retina
Hearing problem	203	deaf – both ears
	204	other hearing impairments
Speech problem	205	stammering and stuttering
	206	other speech impediments
Retardation	208	mental retardation
Deformity	209	absence – both arms/hands
	210	absence – one arm/hand
	211	absence – fingers, one or both hands
	212	absence – one or both legs
	213	absence – feet/toes, one or both limbs
	214	absence – lung
	215	absence – kidney
	216	absence – breast
	217	absence – bone, joint, muscle of extremity
	218	absence – tips of fingers, toes
	219	paralysis of entire body
	220	paralysis of one side of body – hemiplagia
	221	paralysis of both legs – paraplegia
	222	other total paralysis
	223	partial paralysis — cerebral palsy
	224	partial paralysis — one side of body only – hemiparesis
	225	partial paralysis — legs — both or paraparesis
	226	other partial paralysis
	227	paralysis - complete or partial - other site
	228	curvature/deformity of back or spine
	229	orthopedic impairment of back
	230	spina bifida
	231	orthopedic impairment of hands, fingers only
	232	orthopedic impairment ofshoulders
	233	other orthopedic impairment of upper extremities
	234	flatfeet
	235	clubfeet

Chronic condition	Code	Definition
	236 237 238	other orthopedic impairment of lower extremities other deformities/orthopedic impairments cleft palate
Digestive problem	301 302 303 304 305 306 307 308 309 310 311 312 313 314 315	gallbladder stones liver diseases including cirrhosis gastric ulcer duodenal ulcer peptic ulcer hernia of abdominal cavity disease of the esophagus gastritis and duodenitis indigestion other functional disorders of stomach and digestive system enteritis and colitis spastic colon diverticula of intestines constipation other stomach and intestinal disorders
Diabetes	403	diabetes
Epilepsy	405	epilepsy
Frequent headaches	406 407	migraine headache other headache
Kidney disease	409 410 411	kidney stone kidney infections other kidney trouble
Heart disease	501 502 503 504 505 506 507	rheumatic fever with or w/o heart disease ischemic heart disease tachycardia or rapid heart heart murmurs other unspecified heart rhythm disorders congenital heart disease other selected types of heart disease
Bronchitis	601	bronchitis
Asthma	602	asthma
Hayfever	603	hayfever
Sinusitis	605	sinusitis
Tonsilitis	607	tonsilitis

Table 1. Summary Statistics

	NHIS	PSID	NLSY
Age	8.31	6.29	11.72
Income ($1997)	48,343	47,525	49,862
Health Status*	1.687	1.701	1.335
Health Status Very Good or Excellent*	0.807	0.824	0.700
Health Status Fair or Poor	0.026	0.023	0.032
Mother Present	0.987	0.932	0.989
Father Present	0.810	0.643	0.537
Male	0.513	0.516	0.496
White	0.779	0.524	0.477
Black	0.149	0.424	0.308
Mother's age (if present)	34.77	33.31	35.76
Father's age (if present)	37.57	36.27	37.54
Mother's education (if present)	12.69	13.14	12.73
Father's education (if present)	13.15	13.33	12.82
Number of observations	229330	2950	3793

***** For the NHIS and PSID, health status is on a five-point scale: 1=Excellent, 2=Very Good, 3=Good, 4=Fair, 5=Poor. For the NLSY, health status is on a four-point scale: 1=Excellent, 2=Good, 3=Fair, 4=Poor. The row marked "Health Status Very Good-Exc" is the fraction of children in the PSID and NHIS with health status of 1 or 2**,** and the fraction of children in the NLSY with health status of 1. The number of observations listed for the NLSY is the total number of health transitions observed for the 3392 children in the NLSY-Children data set.

Table 2: Health status and ln(family income). 1986-1995 NHIS.

	Health status (1=excellent, 2=very good, 3=good, 4=fair, 5=poor)				Indicator: Health status is excellent or very good			
ages	0-3	4-8	9-12	13-17	0-3	4-8	9-12	13-17
obs	51,448	54,067	64,746	59,069	51,448	54,067	64,746	59,069
controls 1								
ln(family income)	–.138 (.006)	–.182 (.006)	–.212 (.006)	–.249 (.006)	.062 (.003)	.077 (.003)	.091 (.003)	.107 (.003)
controls 2								
ln(family income)	–.086 (.006)	–.116 (.006)	–.138 (.006)	–.169 (.007)	.040 (.003)	.049 (.003)	.059 (.003)	.072 (.003)
mother’s ed=12 yrs	–.123 (.015)	–.146 (.014)	–.148 (.013)	–.151 (.014)	.067 (.007)	.075 (.007)	.078 (.007)	.079 (.007)
mother’s ed>12 yrs	–.193 (.016)	–.246 (.016)	–.255 (.014)	–.248 (.015)	.093 (.008)	.109 (.007)	.116 (.007)	.112 (.007)
father’s ed=12 yrs	–.116 (.016)	–.131 (.016)	–.133 (.015)	–.135 (.015)	.050 (.008)	.062 (.008)	.062 (.007)	.064 (.007)
father’s ed>12 yrs	–.199 (.017)	–.214 (.017)	–.217 (.015)	–.217 (.015)	.073 (.008)	.090 (.008)	.090 (.007)	.092 (.007)
mother unemployed	–.038 (.020)	.002 (.021)	–.025 (.020)	–.019 (.024)	.017 (.009)	.006 (.010)	.007 (.010)	.003 (.011)
father unemployed	.018 (.026)	–.003 (.026)	–.031 (.025)	–.032 (.028)	–.013 (.012)	–.013 (.013)	–.001 (.013)	.014 (.013)

Notes: The numbers in parentheses are robust standard errors, where correlation is allowed between unobservables for observations from the same household. For rows labeled “controls 1,” each regression included complete sets of age and year dummies, the logarithm of family size, indicators variables for whether the child has a mother in the household, a father in the household, whether the child is male, black, or white, interactions of the indicator for whether a mother is in the household with mother’s age, and interactions of the indicator for whether a father is in the household with father’s age. Each regression also contains dummy variables for whether both the mother and father were respondents to the health survey, whether the father and not the mother was a respondent to the health survey, and whether neither the mother nor father were respondents to the health survey (the excluded category is that the mother but not the father was the respondent.) For rows labeled “controls 2,” all variables in “controls 1” are included, plus the measures of father’s and mother’s schooling shown in the table (each of which is interacted with an indicator of whether the father/mother is in the household), and an indicators of mother’s and father’s unemployment that equal 1 if mother (father) in the household is unemployed. The sample is restricted to children age 17 or younger, who come from single-family households, who are members of the “primary family” in the household, who are children of either the reference person or spouse of reference person, who are of the same race as other children in the household, and who have non-missing values for all of the variables included in the regression. All children in a household are removed if any children in the household are removed. Total sample size is 229,330.

Table 3. Gradients in health conditions and in alternative measures of poor health. NHIS 1986-1995.

Dependent variable [mean]	coefficient on ln(y)	Dependent variable [mean]	coefficient on ln(y)
hayfever (obs=43255) [.065]	.0154 (.0015)	digestive disorder (obs=44479) [.023]	–.0037 (.0009)
bronchitis (obs=43255) [.056]	–.0009 (.0014)	vision problem (obs=44449) [.012]	–.0017 (.0006)
asthma (obs=43255) [.063]	–.0030 (.0015)	hearing problem (obs=44449) [.018]	–.0041 (.0007)
sinusitis (obs=43255) [.065]	.0049 (.0015)	speech problem (obs=44449) [.019]	–.0057 (.0008)
tonsilitis (obs=43255) [.027]	–.0014 (.0010)	mental retardation (obs=44449) [.013]	–.0059 (.0007)
heart condition (obs=44250) [.020]	–.0022 (.0008)	deformity (obs=44449) [.035]	–.0003 (.0010)
diabetes (obs=43953) [.002]	–.0002 (.0002)	restricted activity days in last 14 days (obs=264693) [.362]	–.0396 (.0037)
epilepsy (obs=43953) [.004]	–.0009 (.0004)	bed days in last year (obs=264693) [2.88]	–.1736 (.0240)
frequent headaches (obs=43953) [.026]	–.0023 (.0009)	hospitalization episodes in last year (obs=254693) [.042]	–.0093 (.0006)
kidney disease (obs=43953) [.003]	–.0009 (.0003)	missed school days last 14 days, over age 5 (obs=188119) [.189]	–.0319 (.0027)

Note: Robust standard errors in parentheses. Each coefficient reported is from a different regression of the health condition listed on log of family income, ln(y), and controls, which included a complete set of age dummies, year dummies, indicator variables for whether the child was male, white or black, and the logarithm of family size. The numbers in parentheses are robust standard errors, where correlation is allowed between unobservables for observations from the same household

Table 4: Regressions of poor health indicator (health status=4 or 5) on ln(y), a specific health condition, and the interaction of income and the health condition. 1986-1995 NHIS.

	Ages 0-17				Ages 0-8		Ages 9-17	
	Coefficients (standard errors)			$\frac{\partial(\text{health})}{\partial(\text{cond.})}$ at median ln(y)	Coefficients (standard errors)		Coefficients (standard errors)	
Condition	ln(y)	has cond'n	cond'n x ln(y)		has cond'n	cond'n x ln(y)	has cond'n	cond'n x ln(y)
hay fever	–.018	.128	–.012	.013	.157	–.013	.077	–.007
(obs=43,493)	(.001)	(.063)	(.006)	(.004)	(.106)	(.010)	(.078)	(.007)
bronchitis	–.016	.351	–.030	.050	.324	–.027	.436	–.038
(obs=43,493)	(.001)	(.080)	(.008)	(.005)	(.100)	(.010)	(.127)	(.012)
asthma	–.014	.572	–.048	.092	.510	–.042	.637	–.054
(obs=43,493)	(.001)	(.074)	(.007)	(.006)	(.103)	(.010)	(.106)	(.010)
sinusitis	–.017	.223	–.020	.024	.189	–.016	.222	–.020
(obs=43,493)	(.001)	(.067)	(.006)	(.004)	(.114)	(.011)	(.080)	(.008)
tonsilitis	–.018	.148	–.011	.036	.057	–.002	.263	–.023
(obs=43,493)	(.001)	(.089)	(.009)	(.007)	(.108)	(.011)	(.140)	(.014)
heart condition	–.017	.371	–.030	.071	.325	–.026	.424	–.035
(obs=44,499)	(.001)	(.118)	(.012)	(.009)	(.149)	(.015)	(.179)	(.018)
diabetes	–.019	1.538	–.139	.152	–1.74	.203	1.88	–.174
(obs=44,197)	(.001)	(.538)	(.052)	(.042)	(1.57)	(.163)	(.521)	(.049)
epilepsy	–.019	.984	–.077	.214	.504	–.025	1.17	–.098
(obs=44,197)	(.001)	(.347)	(.034)	(.032)	(.608)	(.062)	(.422)	(.041)
freq. headaches	–.018	.416	–.037	.049	.191	–.142	.398	–.035
(obs=44,197)	(.001)	(.117)	(.011)	(.008)	(.302)	(.030)	(.126)	(.012)
kidney disease	–.019	.245	–.006	.186	.692	–.055	–.089	.030
(obs=44,197)	(.001)	(.373)	(.038)	(.035)	(.630)	(.063)	(.465)	(.047)
digestive disorder	–.019	.410	–.033	.076	.222	–.015	.701	–.061
(obs=44,731)	(.001)	(.101)	(.010)	(.009)	(.115)	(.011)	(.186)	(.018)
vision problem	–.018	.452	–.040	.056	.728	–.062	.368	–.033
(obs=44,680)	(.001)	(.135)	(.015)	(.011)	(.369)	(.036)	(.162)	(.106)
hearing disorder	–.018	.450	–.037	.075	.382	–.029	.479	–.041
(obs=44,680)	(.001)	(.136)	(.013)	(.011)	(.231)	(.023)	(.162)	(.016)
speech problem	–.018	.177	–.012	.059	.125	–.007	.287	–.023
(obs=44,680)	(.001)	(.094)	(.009)	(.009)	(.114)	(.011)	(.163)	(.016)
mental retardation	–.018	.514	–.041	.107	.254	–.008	.579	–.049
(obs=44,680)	(.001)	(.172)	(.017)	(.015)	(.345)	(.036)	(.190)	(.019)
deformity	–.017	.493	–.044	.055	.335	–.026	.533	–.049
(obs=44,680)	(.001)	(.102)	(.010)	(.007)	(.185)	(.018)	(.122)	(.012)

Note: Robust standard errors in parentheses. Each row contains the results of three identical regressions estimated for different ages groups (0-17, 0-8, and 9-17). For each regression, an indicator of poor health is regressed on the logarithm of family income, denoted as ln(y), an indicator of whether the child has the health condition listed for that row, and an interaction of ln(y) and the condition indicator. In addition, each regression includes a complete set of age dummies, year dummies, the logarithm of family size, and indicator variables for whether the child was male, white or black. Although ln(y) is included in the regressions for the younger and older age groups, we do not show its coefficient.

Table 5: Bed days and hospitalization episodes per year. Selected chronic conditions.
Each row is a single regression. 1986-1995 NHIS.

	Dep var: bed days in last year.			Dep var: hospitalization episodes.		
	condition	condition x ln(y)	∂bed days / ∂condition	condition	condition x ln(y)	∂hosp.eps / ∂condition
hay fever	7.30	–.576	1.53	.101	–.008	.017
	(2.77)	(.261)	(.232)	(.076)	(.007)	(.006)
bronchitis	17.41	–1.34	4.04	.475	–.041	.067
	(22.60)	(.379)	(.289)	(.132)	(.013)	(.010)
asthma	22.60	–1.79	4.70	.724	–.064	.087
	(3.89)	(.375)	(.374)	(.162)	(.016)	(.011)
sinusitis	10.46	–.782	2.63	.155	–.013	.020
	(3.61)	(.353)	(.291)	(.112)	(.011)	(.007)
tonsilitis	12.85	–.796	4.89	.077	.003	.104
	(3.82)	(.371)	(.353)	(.120)	(.012)	(.014)
heart condition	10.54	–.588	4.66	.196	–.006	.132
	(5.89)	(.603)	(.791)	(.193)	(.019)	(.022)
diabetes	153.69	–14.68	6.87	2.09	.004	.247
	(124.96)	(12.20)	(3.22)	(.764)	(.076)	(.072)
epilepsy	29.45	–1.20	17.44	.638	–.022	.420
	(43.43)	(4.38)	(4.11)	(.759)	(.076)	(.070)
frequent headaches	24.30	–1.93	5.02	.171	–.013	.037
	(7.79)	(.763)	(.537)	(.135)	(.013)	(.009)
kidney disease	–13.47	2.78	14.30	1.37	–.107	.295
	(40.05)	(4.35)	(4.11)	(.823)	(.082)	(.055)
digestive disorder	24.36	–2.05	3.88	–.021	.016	.139
	(14.98)	(1.50)	(.447)	(.118)	(.012)	(.025)
vision problem	15.02	–1.12	3.78	.373	–.032	.053
	(14.47)	(1.44)	(1.27)	(.199)	(.019)	(.018)
hearing disorder	9.90	–.555	4.35	.324	–.028	.040
	(10.59)	(1.08)	(.975)	(.157)	(.015)	(.012)
speech problem	8.82	–.570	3.12	.224	–.019	.038
	(6.28)	(.614)	(.850)	(.104)	(.010)	(.011)
mental retardation	3.39	.071	4.10	–.155	.022	.064
	(9.50)	(.957)	(1.20)	(.141)	(.015)	(.018)
deformity	11.78	–.703	4.74	–.007	.143	.100
	(7.58)	(.758)	(.696)	(.002)	(.130)	(.013)

Note: Robust standard errors in parentheses. Controls include a complete set of age dummies, and indicator variables for whether the child was male, white or black, and the logarithm of family size. ln(y) is the logarithm of family income. The marginal effect of the conditions (columns 3 and 6) are evaluated at median income.

Table 6: Health status and family income at different ages, PSID   Dependent variable: Health status (1=excellent, 5=poor)

	ages 0-3			ages 4-8				ages 9-12					
Panel A: Regressions of health status on log of average income in different periods of life													
log(mean income 6 yrs to 1 yr before birth)	–.096		–.061	–.115			–.047	–.132					–.050
	(.045)		(.050)	(.042)			(.050)	(.048)					(.050)
log(mean income ages 0 to 3)		–.106	–.080		–.135		–.031		–.144			–.090	–.061
		(.045)	(.050)		(.039)		(.056)		(.043)			(.054)	(.052)
log(mean income ages 4 to 8)						–.159	–.124			–.142		.027	.023
						(.038)	(.049)			(.046)		(.070)	(.070)
log(mean income ages 9 to 12)											–.167	–.145	–.142
											(.040)	(.055)	(.055)
F-test: joint significance of income coefficients			3.59				6.45					6.68	5.24
			(.0282)				(.0003)					(.0002)	(.0004)
F-test: equality of coefficients			0.05				0.79					1.20	0.80
			(.8205)				(.4557)					(.3008)	(.4930)
Panel B: Regressions of health status on the log of average income during the child's entire life													
log (mean income ages 0 to current year)			–.106				–.187						–.213
			(.045)				(.044)						(.051)
Panel C: Regressions of health status on the log of average income from 6 years prior to birth through the current year													
log (mean income 6 years prior to birth - current yr)			–.124				–.187						–.247
			(.053)				(.049)						(.057)
Panel D: Regressions of health status on the log of average income from 9 years prior to birth through the current year													
log(mean income 9 years prior to birth - current yr)			–.124				–.190						–.258
			(.053)				(.050)						(.060)
Number of obs	809	809	809	1078	1078	1078	1078	883	883	883	883	883	883

Notes: Standard errors in parentheses. All regressions include a complete set of age dummies, and indicators that child is male, white, or black; an indicator that mother is present; mother's age interacted with her presence; mother's education interacted with her presence; an indicator that father is present; father's age interacted with his presence; father's education interacted with his presence; and the log of family size. If a parent's education is missing, the mean education for that sex is assigned, and an indicator variable is included that education is missing. Log(mean income 0 to 3) is the log of the mean income for the household when the child was between the ages of 0 and 3. Other income variables analogously defined.

Table 7: Transitions in health status. NLSY. Health status is (1=Excellent...4=Poor)

	Mother Age	Mother Educ	Total	Health worsens		Health the same		Health improves		KSM test
			N	N	Pct	N	Pct	N	Pct	p-value
Children aged 5-7 in initial period										
Initial health=Excellent	13.4	29.5								
Below median income			58	10	17.2	48	82.8	—	—	.892
Above median income			57	4	7.0	53	93.0			
Initial health=Good	13.3	29.5								
Below median income			18	1	5.6	10	55.6	7	38.9	.990
Above median income			17	1	5.9	7	41.2	9	52.9	
Initial health=Fair	13.3	28.6								
Below median income			2	0	0.0	0	0.0	2	100.0	—
Above median income			1	0	0.0	0	0.0	1	100.0	
Total			153	16		118		19		
Children aged 8-11 in initial period										
Initial health=Excellent	13.3	27.2								
Below median income			430	85	19.8	345	80.2	—	—	0.010
Above median income			427	38	8.9	389	91.1			
Initial health=Good	12.7	27.0								
Below median income			134	5	3.7	74	55.2	55	41.0	0.999
Above median income			132	3	2.3	71	53.8	58	43.9	
Initial health=Fair	12.9	26.6								
Below median income			15	1	6.7	5	33.3	9	60.0	0.935
Above median income			14	0	0.0	3	21.4	11	78.6	
Total			1152	132		887		133		
Children aged 12-14 in initial period										
Initial health=Excellent	12.6	22.3								
Below median income			866	187	21.6	679	78.4	—	—	0.024
Above median income			866	126	14.6	740	85.5			
Initial health=Good	12.3	22.3								
Below median income			329	26	7.9	178	54.1	125	38.0	0.806
Above median income			329	10	3.0	195	59.3	124	37.7	
Initial health=Fair	11.8	22.2								
Below median income			44	2	4.6	11	25.0	31	70.5	0.999
Above median income			43	0	0.0	16	37.2	27	62.8	
Total			2477	499		1819		307		

Notes: The last column provides p-values from a Kolmogorov-Smirnoff test of the equality of the distributions between each pair of rows. Within each initial health-age group cell, children are divided into two groups, based on whether their household income in the initial period was above or below the median observed for that health-age group cell.

Table 8: Health at birth and current health. 1988 NHIS.
Ordered Probits. Dependent variable is health status (1=Excellent to 5=Poor)

	ages 0-3			ages 4-8			ages 9-12			ages 13-17		
observations:	3553			3713			2628			3848		
No measures of health at birth included												
log (family income)	–.111 (.026)			–.134 (.026)			–.117 (.034)			–.192 (.027)		
Measures of health at birth included												
log (family income)	–.111 (.026)	–.106 (.026)	–.106 (.026)	–.130 (.026)	–.132 (.026)	–.130 (.026)	–.117 (.034)	–.116 (.034)	–.116 (.034)	–.192 (.027)	–.189 (.027)	–.189 (.027)
Indicator: weight at birth was less than 5.5 lbs	.213 (.081)		.019 (.090)	.287 (.072)		.178 (.081)	.038 (.090)		–.059 (.097)	.003 (.073)		–.056 (.079)
Nights child spent in hospital after birth		.016 (.003)	.016 (.003)		.011 (.002)	.008 (.003)		.008 (.003)	.008 (.003)		.006 (.003)	.006 (.003)
Chi-square test: low birth weight and hospital nights jointly insignificant (p-value)			33.47 (.000)			25.01 (.000)			7.40 (.025)			4.37 (.113)

Note: Standard errors in parentheses. Each ordered probit includes a complete set of age dummies, the logarithm of family size, indicators variables for whether the child has a mother in the household, a father in the household, whether the child is male, black, or white, interactions of the indicator for whether a mother is in the household with mother's age and mother's education, and interactions of the indicator for whether a father is in the household with father's age and father's education. Each ordered probit also contains dummy variables for whether both the mother and father were respondents to the health survey, whether the father and not the mother was a respondent to the health survey, and whether neither the mother nor father were respondents to the health survey (the excluded category is that the mother but not the father was the respondent.) The fraction of children in the whole sample with low birth weight is 0.068. The average number of nights in the hospital after the birth is 4.32 (the median is 3, standard deviation 7.06).

Table 9: Birth health and income, 1988 NHIS.
Ordered Probits. Dependent variable is health status (1=Excellent to 5=Poor)

ln(y)	–.091 (.020)	–.086 (.020)	–.082 (.021)	–.087 (.020)	–.087 (.021)
age	.067 (.020)	.074 (.020)	.072 (.020)	.065 (.020)	.065 (.021)
ln(y) x age	–.006 (.002)	–.007 (.002)	–.007 (.002)	–.006 (.002)	–.006 (.002)
Indicator: poor birth health		.400 (.062)	.847 (.315)	.397 (.062)	.354 (.595)
(Poor birth health) x age		–.026 (.006)	–.025 (.006)	.029 (.032)	.033 (.060)
(Poor birth health) x ln(y)			–.047 (.032)		.004 (.061)
(Poor birth health) x ln(y) x age				–.006 (.003)	–.006 (.006)
Chi-square test: joint sig of birth health and all birth health interactions.		48.41 (.0000)	50.46 (.0000)	51.43 (.0000)	51.44 (.0000)
Chi-square test: joint sig of birth health interactions			20.06 (.0000)	20.96 (.0000)	20.97 (.0000)

Notes: Standard errors in parentheses."Poor birth health" is an indicator variable equal to 1 if birth weight is less than 3.5 lbs. or the child is in the hospital for one week or longer after the birth. Sample size=13,841. See notes to Table 8 for controls included in each ordered probit

Table 10: Health status, income, and parental health. 1986-1995 NHIS.

	Health status (1=excellent, 2=very good, 3=good, 4=fair, 5=poor)				Indicator: Health status is excellent or very good			
ages	0-3	4-8	9-12	13-17	0-3	4-8	9-12	13-17
obs	51,448	54,067	64,746	59,069	51,448	54,067	64,746	59,069
ln(family income)	–.032	–.051	–.065	–.088	.014	.017	.022	.032
	(.006)	(.006)	(.005)	(.006)	(.003)	(.003)	(.003)	(.003)
mother's health is excellent or very good	–.562	–.572	–.552	–.545	.274	.286	.275	.276
	(.011)	(.010)	(.009)	(.009)	(.005)	(.005)	(.004)	(.004)
father's health is excellent or very good	–.336	–.352	–.371	–.351	.163	.172	.179	.170
	(.012)	(.001)	(.010)	(.010)	(.006)	(.006)	(.005)	(.005)
ln(family income)	–.019	–.037	–.052	–.070	.013	.016	.022	.030
	(.006)	(.005)	(.005)	(.006)	(.003)	(.003)	(.003)	(.003)
mother's health=2 (Very Good)	.360	.365	.362	.339	–.027	–.023	–.018	–.012
	(.009)	(.008)	(.008)	(.009)	(.004)	(.004)	(.003)	(.004)
mother's health=3 (Good)	.701	.713	.688	.658	–.280	–.287	–.272	–.263
	(.012)	(.011)	(.010)	(.011)	(.006)	(.006)	(.005)	(.005)
mother's health=4 (Fair)	.901	.879	.874	.869	–.332	–.339	–.326	–.339
	(.025)	(.022)	(.019)	(.019)	(.012)	(.010)	(.009)	(.009)
mother's health=5 (Poor)	.778	.897	.851	.907	–.255	–.328	–.312	–.339
	(.063)	(.053)	(.039)	(.034)	(.026)	(.023)	(.017)	(.015)
father's health=2 (Very good)	.211	.213	.210	.222	–.002	.001	.002	–.001
	(.010)	(.009)	(.009)	(.009)	(.004)	(.004)	(.004)	(.004)
father's health=3 (Good)	.402	.426	.456	.445	–.166	–.175	–.186	–.176
	(.140)	(.013)	(.012)	(.012)	(.007)	(.007)	(.011)	(.006)
father's health=4 (Fair)	.401	.443	.439	.441	–.150	–.155	–.158	–.162
	(.030)	(.026)	(.022)	(.021)	(.014)	(.013)	(.011)	(.010)
father's health=5 (Poor)	.395	.440	.385	.441	–.188	–.135	–.138	–.153
	(.065)	(.050)	(.038)	(.033)	(.029)	(.023)	(.019)	(.016)

Notes: Robust standard errors in parentheses. The sample and set of controls is identical to that used in the lower panel of Table 2, the only different being the addition of the parental health measures. In the bottom panel, the omitted category for mothers' and fathers' health is "Excellent." Indicators for whether mother's and father's health were unknown were included in the regressions in both panels.

Table 11: Birth parents, other types of parents, and family income. NHIS Child Health Supplement 1988 Ordered Probits.

	Health status (1=excellent, 2=very good, 3=good, 4=fair, 5=poor)			
ages	0-3	4-8	9-12	13-17
obs	3686	3910	2842	4263
	Panel A:			
ln(family income)	–.104 (.025)	–.130 (.025)	–.120 (.032)	–.202 (.025)
	Panel B:			
(birth mother and birth father)*ln(family income)	–.094 (.034)	–.124 (.036)	–.104 (.049)	–.147 (.041)
(non-birth mother and non-birth father)*ln(family income)	–.109 (.527)	–.155 (.104)	–.027 (.111)	–.242 (.089)
Chi-square test: birth mother, birth father = non-birth mother, non-birth father	0.10 (.7516)	0.08 (.7728)	0.44 (.5069)	0.99 (.3202)

Notes: Standard errors in parentheses, except for Chi-square test, which present p-values. All probits include a complete set of age indicators, and indicators that the child is male, white, or black, the log of family size, indicators for whether the mother or father or another adult was the child's health respondent, an indicator that a mother figure is present, and her age and education if present, an indicator that a father figure is present, and his age and education if present. Panel B also includes a complete set of indicators for family type: birth mother and father, birth mother and other father, birth mother only, other mother only, other mother and birth father, birth father only, other father only, or two non-birth parent, and each of these controls interacted with the log of family income. The Chi-square test is for equality of the coefficients for log of family income when child is living with a birth mother and birth father and the log of family income when the child is living with two non-birth parents.

Table 12: Health insurance and the effects of chronic conditions on health. 1988 NHIS.

dependent variable: health status(1=Excellent to 5=Poor)							
ln(y)	–.1529 (.0132)	–.1450 (.0134)	–.1427 (.0136)	–.1349 (.0149)	ln(y)	–.1481 (.0135)	–.1460 (.7168)
has condition	.8336 (.1799)	.8438 (.1796)	.8398 (.1796)	.5782 (.2082)	has asthma	1.486 (.3816)	1.459 (.3843)
ln(y) x has condition	–.0564 (.0177)	–.0572 (.0177)	–.0613 (.0180)	–.0340 (.0210)	has other condition	.7189 (.1860)	.7168 (.1860)
insured		–.0758 (.0242)	–.1016 (.0320)	–.1171 (.0328)	ln(y) x has asthma	–.0874 (.0379)	–.0919 (.0382)
insured x has condition			.0513 (.0481)	.0217 (.0493)	ln(y) x has other condition	–.0493 (.0183)	–.0528 (.0187)
medicaid				.0754 (.0450)	insured	–.0768 (.0242)	–.1005 (.0320)
medicaid x has condition				.1388 (.0660)	insured x has asthma		.0809 (.1075)
					insured x has other condition		.0423 (.0497)
F: insurance variables jointly insignificant			5.97 (.0026)	9.70 (.0001)			4.04 (.007)
F: medicaid variables jointly insignificant				10.10 (.0000)			

Notes: Robust standard errors in parentheses. Sample size=12,708. “Insured” equals 1 if the child had private insurance of had medicaid coverage. 85.8% of the children are insured; 12.4% are on medicaid. “Has condition” equals 1 if the child has had at least of the following types of conditions: vision problem, hearing problem, speech problem, deformity, digestive problem, epilepsy, frequent headaches, heart condition, respiratory problem, tonsilitis, anemia (including sickle cell anemia), a set of infectious diseases (e.g. mononucleosis, hepatitis, pneumonia), a skin or bone condition, frequent ear infections, diabetes or asthma. “Has other condition” is the same as “has condition” except asthma is excluded from the list. All variables in “controls 1” (listed in Table 2) are included in each regression.

Table 13: Mothers' Labor Force Participation Following the Birth of a Child. PSID.

	Indicator: Mother works in birth year			Indicator: Mother works in 1st year after birth			Indicator: Mother works in 2nd year after birth		
Indicator: low birth weight or ICU stay	0.015 (0.032)	0.009 (0.031)	0.014 (0.048)	0.023 (0.031)	–0.012 (0.031)	–0.009 (0.052)	0.021 (0.034)	0.008 (0.035)	0.001 (0.058)
Indicator: Mother worked year before		0.461 (0.022)			0.422 (0.023)			0.384 (0.025)	
ICU/LBW × Mother worked year before birth			0.455 (0.060)			0.416 (0.061)			0.394 (0.065)
Not ICU/LBW × Mother worked year before			0.462 (0.024)			0.423 (0.024)			0.382 (0.027)
F-test: ICU=Not ICU (p-value)			0.01 (.9101)			0.01 (.9237)			0.03 (.8696)
Number of obs	1996	1799	1799	2083	1782	1782	1722	1508	1508
	Mother's hours in birth year			Mother's hours 1st year			Mother's hours 2nd year		
Indicator: low birth weight or ICU stay	68.30 (52.07)	32.14 (40.14)	46.22 (71.06)	86.23 (59.40)	23.39 (53.47)	17.01 (81.12)	20.76 (60.16)	9.25 (53.33)	–60.71 (78.49)
Mother's hours worked in the year before birth		0.631 (0.019)			0.556 (0.021)			0.524 (0.024)	
ICU/LBW × Mother worked year before birth			0.622 (0.047)			0.557 (0.056)			0.571 (0.055)
Not ICU/LBW × Mother worked year before birth			0.633 (0.020)			0.555 (0.022)			0.515 (0.026)
F-test: ICU/LBW =Not ICU/LBW p-value)			0.05 (.8271)			0.00 (.9661)			0.91 (.3410)
Number of obs	1996	1802	1802	2083	1784	1784	1723	1509	1509

Notes: Robust standard errors in parentheses. Also included in all regressions are mother's age and education (if she is present in the household); father's education (if he is present in the household); indicators that mother and father are present in the birth year (columns 1, 4 and 7); in the 1st year after birth (columns 2, 5 and 8); and in the 2nd year after birth (columns 3, 6 and 9); and indicators that the mother is white and that the mother is black. The variable ICU/LBW is an indicator that the child had a low birth weight (less than 2500 grams, 5.5 lbs) or that the child was moved to a neo-natal intensive care unit (ICU) after birth. Standard errors are presented in parentheses, and were estimated allowing correlation between unobservables for children in the same household.

Table 14: Health status and health related behaviors. 1988 NHIS Child Health Supplement Ordered Probits. (Standard errors in parentheses.)

	Health status (1=excellent, 2=very good, 3=good, 4=fair, 5=poor)			
ages	0-3	4-8	9-12	13-17
obs	3686	3910	2842	4263
ln(family income)	–.093 (.026)	–.126 (.026)	–.114 (.033)	–.193 (.025)
Indicator: =1 if child has a regular bedtime	–.048 (.051)	–.101 (.054)	–.048 (.065)	–.133 (.042)
Indicator: =1 if someone in household smokes	.108 (.040)	.068 (.039)	.063 (.045)	.037 (.037)
Indicator: =1 if child wears a seatbelt	–.137 (.059)	–.176 (.043)	–.117 (.046)	–.152 (.038)
Indicator: =1 if child has a place for regular medical care	–.100 (.093)	.023 (.082)	.097 (.081)	.117 (.065)
Indicator: =1 if child has a place for sick care	.071 (.092)	.139 (.094)	–.055 (.092)	–.078 (.074)
Indicator: =1 if routine doctor's visit in past year	–.049 (.067)	.097 (.042)	.116 (.045)	.094 (.037)
Chi-square test: joint significance (6 health variables)	17.00 (.0093)	33.12 (.0000)	17.59 (.0074)	40.94 (.0000)

Notes: See notes to Table 8 for the list of controls included in each ordered probit.

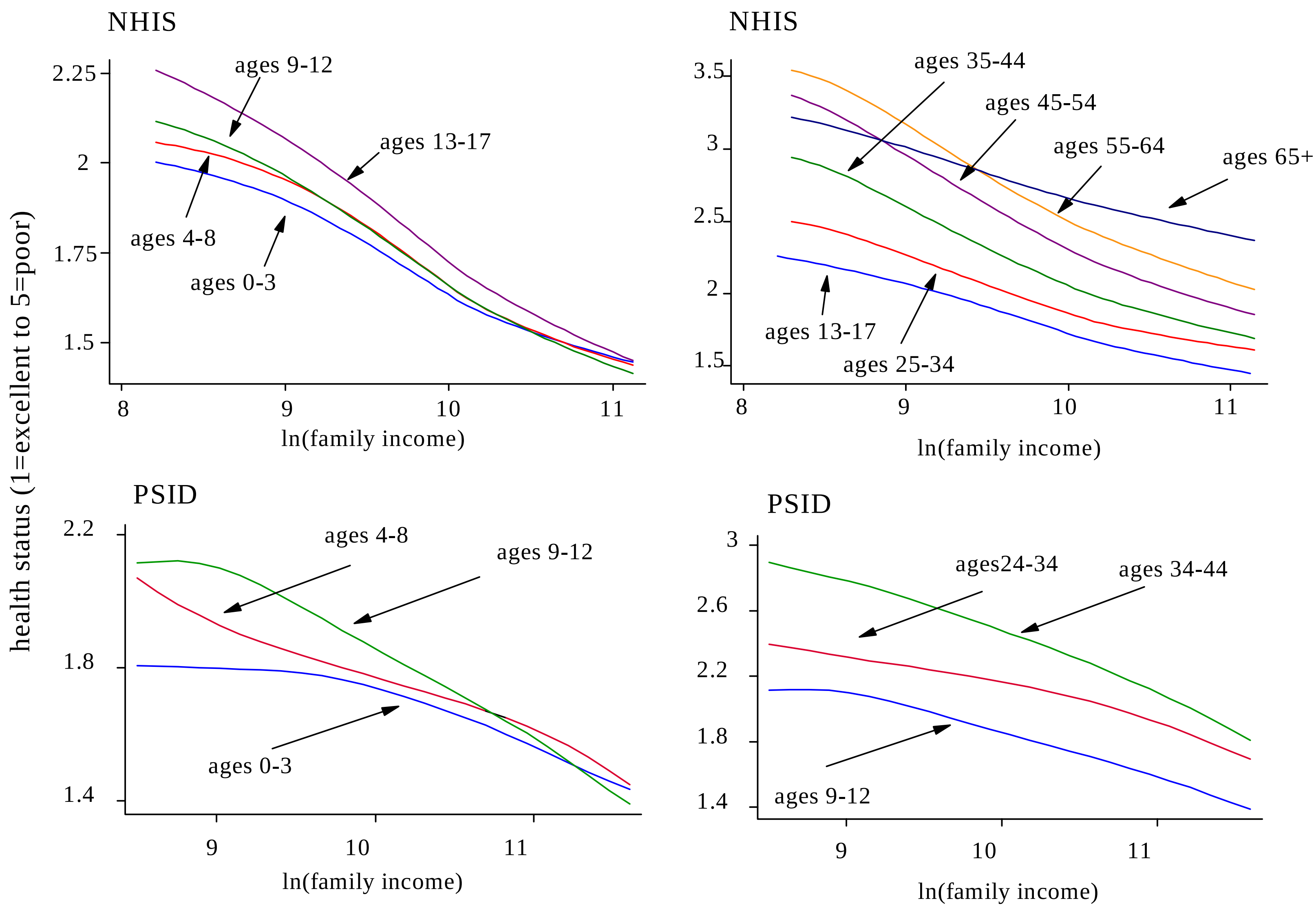

Figure 3.1: Health and income for children and adults. NHIS 1986-1995 and PSID.

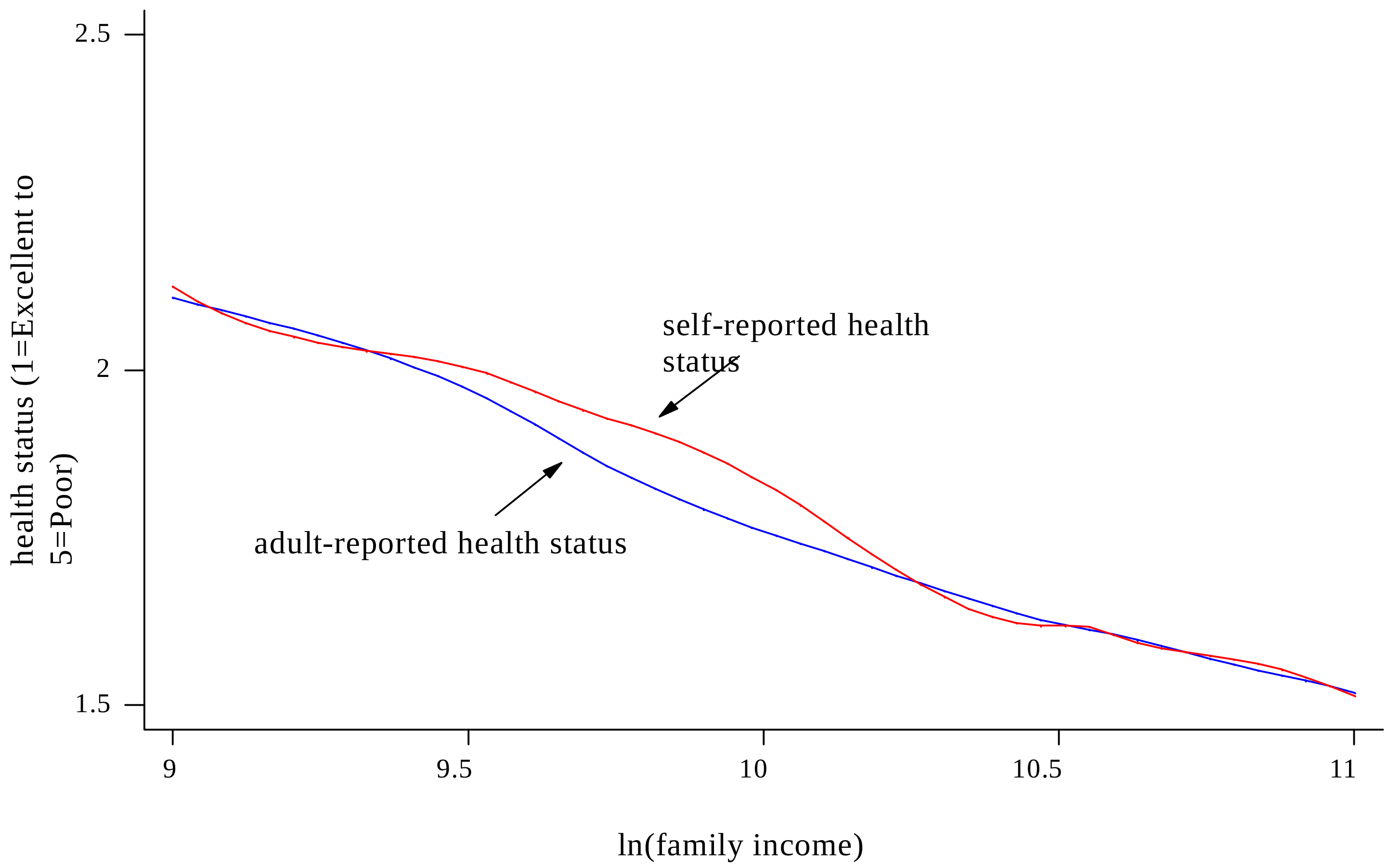

Figure 3.2: Health and income for 17-year-olds who did and did not report their own health status. NHIS 1986-1995.

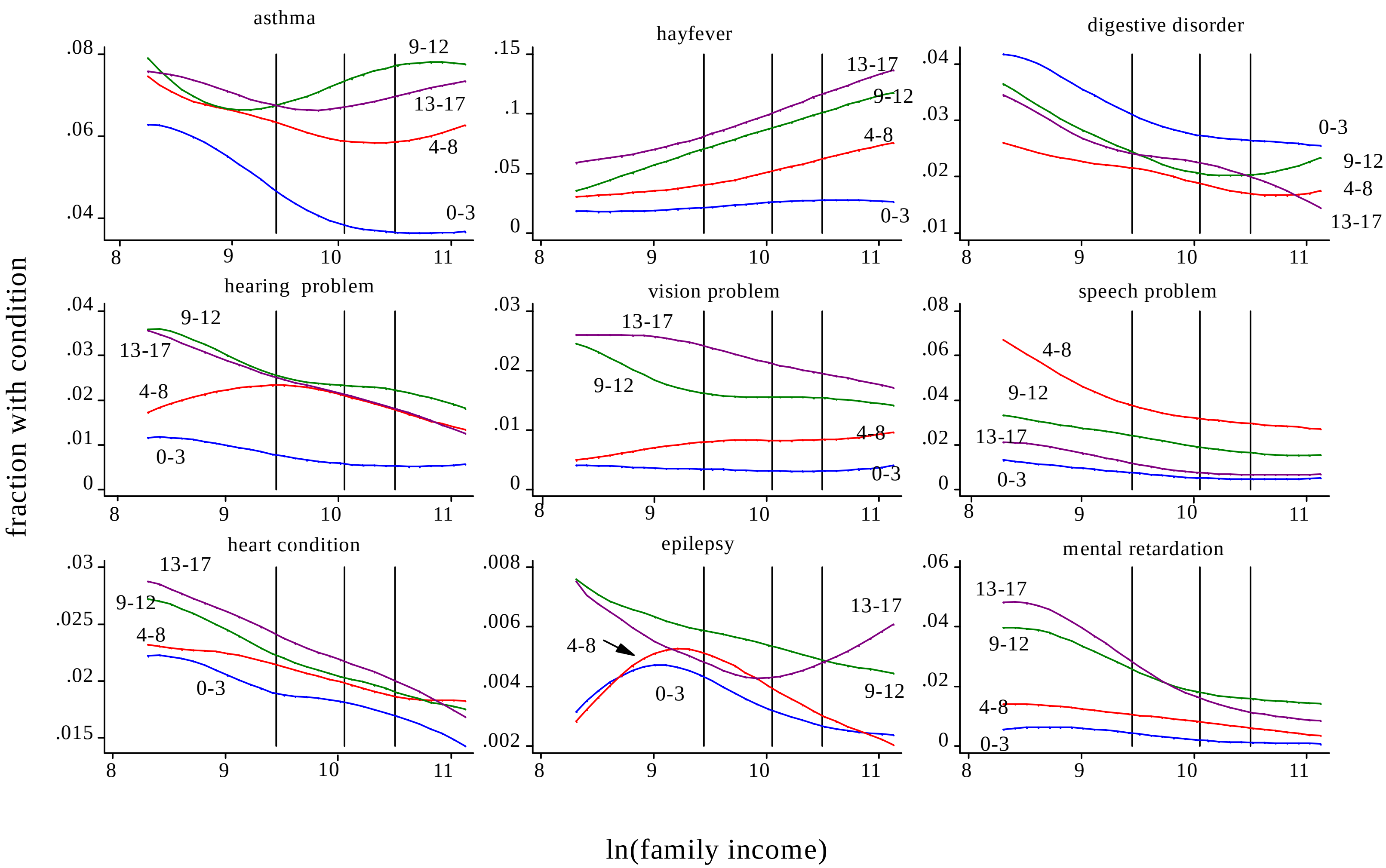

Figure 3.3: Gradients in chronic conditions. NHIS 1986-1995.