Preliminary Draft: Do Not Cite or Quote

Economic Status in Childhood, Birth Weight, and Adult Health and Labor Market Outcomes

Rucker C. Johnson
University of California, Berkeley
ruckerj@berkeley.edu

Robert F. Schoeni
University of Michigan
bschoeni@umich.edu

March 2005

This research was supported by the National Institute on Aging, grant P30 AG012846. We thank Karen Ross for providing exceptional research assistance.

Economic Status in Childhood, Birth Weight, and Adult Health and Labor Market Outcomes

I. Introduction

The fetal origins hypothesis developed by David Barker and colleagues proposes that when nutritional intake of a fetus is limited, the body's physiology and metabolism are changed fundamentally, and some of the consequences of these changes would become visible much later in life. Coronary heart disease and stroke would arise more quickly, and health in general would deteriorate more rapidly in old age. A voluminous literature supports this finding, drawing largely on data from the United Kingdom. (Barker, 1998).

At the same time, socioeconomic status and health status are highly correlated. This strong association holds for a variety of health status measures, is true in countries with varying levels of economic development and government-sponsored medical care, and has existed as far back in time as data are available. The association also holds across the entire life course, although the gap appears to widen with age through about age 60, and then declines (Smith, 2004). The direction of causality between health and economic status is unclear. While it is most likely the case that health causally affects economic status, and economic status causally affects health, the magnitude of each effect is uncertain (Smith, 1999). But if causality runs in both directions, then a life course model would imply that health problems early in life could affect health later in life because the problem is chronic, because the health shock damaged health stock making it more susceptible to deterioration later in life, and because the health problem affects socioeconomic outcomes such as education which in turn influences health later in life (Kuh and Wadsworth, 1993).

In this paper we investigate the linkages between health and economic status in the initial stages of life, and health, education, and labor market outcomes in adulthood using nationally representative longitudinal data covering a 33-year period in the U.S. There is little empirical evidence on the fetal origins and related hypotheses in the U.S. The data set, the Panel Study of Income Dynamics (PSID), has the additional unique feature of allowing analyses of siblings throughout much of their life course. Moreover, prior studies of the connection between early life health and economic status and adult health have relied on health surveys that have very limited economic data. The PSID is one of the premier income surveys in the world, while at the same time collecting significant detail on health.

A series of questions are addressed. We begin by providing the first ever evidence on the association between birth outcomes and adult health for a nationally representative sample in the U.S. We find that the association is substantial, and it is robust to the inclusion of sibling fixed effects. Moreover, the harmful effect of low birth weight increases as adults age (consistent with Case, Fertig, and Paxson, 2003), and it is smaller for children whose families had health insurance. We then find that poor birth outcomes affect labor market earnings in adulthood, and this effect is to a limited degree explained by the fact that children with poor birth outcomes have lower educational attainment. Good health in adulthood is positively associated with childhood economic status. Because economic status has a substantial effect on birth weight, the evidence is consistent with a negative reinforcing intergenerational transmission of disadvantage within the family, where economic status influences birth outcomes, which in turn has long reaching effects on health and economic status in adulthood, which in turn leads to poor birth outcomes for one's own children.

II. Data

The PSID began interviewing a national probability sample of families in 1968, and it has re-interviewed the members of those families every year since, with bi-annual interviewing beginning in 1997. Most importantly, when children of the 1968 PSID families became adults and left their parents' homes, these children were interviewed themselves in each year. As a result, the PSID sample today includes numerous adult siblings.

Given the differences in health status, health behavior, and labor market outcomes for men and women, and the complexity of the health status changes for women during the childbearing years, the paper focuses on men. Our initial sample selection is on PSID sample members born between 1951 and 1975, which consisted of roughly 4,300 boys. Of these boys, 2,717 had at least one valid report of general health status (GHS) in adulthood (i.e., roughly 18 or older), which is the key dependent variable. GHS was not asked in the PSID until 1984, and the question is only asked of heads and wives, except in 1986 when it was asked of all family members. Therefore, the resulting sample includes people into their upper 40s (in 2001).[1]

The ability to conduct analyses within families is a unique feature of our study. These 2,717 children were from 1,432 different PSID families. 1,187 families had at least 2 boys. Data are combined across all waves for each person, and in total there are 25,142 person-year observations, or an average of 9.3 observations per person.

In every wave since 1984, the PSID has asked respondents their general health status (GHS): "Would you say [your/his/her] health in general is excellent, very good, good, fair, or poor?" General health status is highly predictive of morbidity measured in clinical surveys (Larue et al. 1979; Linn et al. 1980; Mays et al. 1992). It is also one of the most powerful predictors of mortality, even when controlling for physician-assessed health status and health-related behaviors, and it is a strong determinant of whether patients choose to use medication and health services. GHS is also frequently used as a global measure of health status and allows us to compare findings with those from related studies such as Case, Fertig, and Paxson (2003).

In order to scale the GHS categories, we use the health utility-based scale that was developed in the construction of the Health and Activity Limitation index (HALex). (A discussion of the various options for treatment of the GHS variable is described in the appendix.) The HALex scores associated with GHS categories are based on the U.S. National Health Interview Survey, which contains a fuller health instrument than utilized in the PSID. A multiplicative, multiattribute health utility model was used to assign scores and quantify the distance between the different GHS categories. The technical details of the scaling procedures are discussed at length elsewhere (Erickson, Wilson, Shannon, 1995; Erickson, 1998). Thus, using a 100-point scale where 100 equals perfect health and zero is equivalent to death, the interval health values associated with GHS used in this paper are: [95, 100] for excellent, [85, 95) for very good, [70,85) for good, [30,70) for fair, and [1,30) for poor health. Consistent with previous research, the skewness and nonlinearity of this scaling is reflected in the fact that the "distances" between excellent health, very good health, and good health are smaller than between fair and poor health. This scaling is currently used by the National Center for Health

[1] While a decline in the initial sample of 37 percent ((4300-2717)/4300)) is substantial, it is quite low given the long period over which these children and their families are followed. The 95-98% wave-to-wave response rate of the PSID makes this possible. In a future draft, we will investigate the extent to which sample selection, including mortality, may bias the reported estimates. Studies have concluded that the PSID sample of heads and wives remains representative of the national sample of adults (Gottschalk, et al, 1999; Becketti et al, 1997)

Statistics to estimate health-related quality of life measures and years of healthy life (*Healthy People* 2000). We then estimate all of the regression models using the interval regression method. While the HALex approach with interval regressions is superior to alternatives, as described in the appendix, we also estimated identical models to those reported in the tables but using poor/fair/good health as the dependent variable in a linear probability model, and using a simple linear specification for GHS ranging from 1 to 5. The substantive conclusions are unchanged.

Table 1 reports descriptive statistics of the samples, both the full sample and the sample of people who have at least one sibling reporting GHS. Low birth weight, which is reported by the mother of the child, is measured by an indicator taking the value 1 if the newborn was less than 5.5 pounds, 0 otherwise. The exact weight is not reported. Less than 1% of the sample had missing data for birth weight, and these cases were dropped from the analyses. 6.47 percent of the unweighted sample had low birth weight. Income is the total for the family in which the child lives. Earnings are total labor market earnings during the previous calendar year. All dollar values are expressed in 2001 prices. (Expenditures for smoking, drinking, and food are in current dollars; they will be adjusted upon revision.) Drinking and smoking of parents are indicated by whether the family spent any money on these goods. In all regression models, clustering is permitted at the person level.

III. Birth Weight and Adult Health

A series of models that examine the relationship between birth weight and health in adulthood are reported in Table 2. The evidence is consistent with prior work from other countries and selective samples in the U.S. (Rich-Edwards et al, 1997; Curhan et al, 1996). That is, low birth weight is associated with worse health outcomes in adulthood (column 1). The magnitude of the relationship is substantial. A useful way to interpret the estimate is in relationship to the size of the effect of age on health, with the effect of low birth weight on adult health equivalent to being 10 years older. That is, GHS is 2.832 points lower for adults who were born of low birth weight, which is almost identical to the reduction in health by 2.831 points for each 10-year increase in age.

Inclusion of demographic factors reduces the effect by 12 percent, but the estimate remains substantial and statistically significant (column 4). Several variables among the demographic factors are interesting in their own right. First, there are large racial differences in adult health, which has been widely documented (Anderson, Bulatao, and Cohen, 2004). Second, first births are on average lighter, but controlling for birth weight, those who are later in birth order have worse health, although the effect size is modest. Third, being born into a single parent family and having an older mother at birth are both insignificant.

Inclusion of family fixed effects does not reduce the estimated relationship between birth weight and adult health (column 3). Low birth weight babies go on to have health in adulthood that is much lower than those who were not low in weight, and the effect is equivalent to being roughly 11 years older. Because the estimated effect is larger when the sample is restricted to individuals who have siblings in the data, estimates without the fixed effects are shown for both the full sample (column 1) and the sample with siblings (column 2). The increase in the estimated effect of low birth weight between columns 1 and 3 is largely accounted for by the change in the sample (column 2).

The negative effect of birth order increases when fixed effects are included (columns 5 and 6): being born one higher parity lowers GHS by 0.7961, which is equivalent to being 2.5 years older. Having an older mother becomes significant in the fixed effects model (column 5), implying an improvement in GHS of 2.501 for each 10-year increase in age. Nonlinearities in birth order and mother's age at birth will be examined in the next draft.

Recent evidence on the evolution of the effects of birth weight on health across the life cycle is mixed. Almond, Chay, and Lee (2004) find in the U.S. that low birth weight does not causally affect infant mortality, but the effect is much smaller than previously believed. Case, Lubotsky, and Paxson (2003) find that, through the teen years, the effect of poor health at birth diminishes with age, while Case, Fertig, and Paxson (2003, Table 3) find that the association between birth weight and adult health increases with age. Currie and Hyson (1999) conclude that the effect of low birth weight on fair/poor health declines with age for women but increases with age for men. We, too, find that the harmful effect of low birth weight increases with age for men (columns 7-10). Without the fixed effects, the direct effect and the interaction with age are not individually significantly, but the two coefficients are jointly significant. And in the fixed effect specification they are individually and jointly precisely estimated and imply that the effect at age 35 (-2.4360+10*-0.2362) is twice the effect at age 25 (-2.4360).

IV. Childhood Family Income and Adult Health

Because we observe the greatest number of children when they are in their teen years, we focus on the effects of family income when the child was 13-16 years old to boost sample size, although several models are estimated that test whether income received at different stages during childhood have differential effects. Income during the childhood years is positively associate with health in older ages (Table 3). A simple linear specification of income implies a modest effect: a $10,000 increase is associated with an increase in health by 0.5163 points (column 1). The effect is substantial at the bottom of the income distribution: 29 percent of the sample had income of less than $25,000 in childhood (Table 1), and these children had health in adulthood that was 2.9246 points lower than higher income children (Table 3, column 2). This effect is equivalent in size to the effect of low birth weight. Moreover, similar to the effect of birth weight, the effect of childhood income on adult health increases with age (columns 3 and 4). This pattern is consistent with evidence for the United Kingdom (Case, Fertig, and Paxson, 2003).

It has been found that income received in the infant and toddler years has a greater effect on educational attainment than income received at other points in childhood (Duncan, 1990). Case, Lubotsky, and Paxson (2003) find no evidence that stage-specific income matters for health status, rather it is permanent income that is most important. We find some evidence consistent with the hypothesis that income received at younger ages has greater benefits: income at the youngest ages has the largest effect when income at each stage is included simultaneously (column 5).[2] However, stage-specific income is highly correlated across stages, and the point estimates are not statistically significantly different from each other.

The fixed effects models identify the effect of income from differences in income between siblings at the same life stage, e.g., ages 13-15. The linear specification of income implies that income has a negative effect on health for people under roughly 30 years old, but then has a positive effect on health (column 7). The specification that examines the effect of having low income indicates that low income is harmful to health in adulthood, and the effect increases with age.

[2] For model 5, men and women are combined to boost sample size because relatively few children have been observed at all stages of childhood, 0-4, 5-8, 9-12, and 13-16 years old.

These specifications of income within the fixed effect models place substantial requirements on the data because few families have family income that was above $25,000 when one child was 13-16 and below $25,000 when another child was 13-16. And the linear specification does not incorporate the fact that prior studies show the income-health relationship is strongest at the bottom of the income distribution. A third specification of income, which accounts for these facts, implies that income and health are in fact related. This specification allows the income effect to differ between poor and nonpoor families (i.e., families who had income below $15,000 at any point when the child was 13-16 years old). For poor families, estimates from the non-fixed effects models imply a decline in GHS by 1.6679 points for each $10,000 increase in childhood family income (column 9). Fixed effects estimates are slightly smaller and also imply that the beneficial effect of childhood income declines with age in adulthood (column 10). Among nonpoor families, the fixed effect estimates imply a negative income effect over some of the age range (column 12). This relationship will be investigated further in the next draft.

Table 4 includes both birth weight and childhood income jointly. For comparison, the first two columns replicate models with just birth weight (column 1) and just income (column 2) from Tables 2 and 3, respectively, although the model including income in Table 4 is slightly different because it excludes some of the demographic controls. The birth weight effect changes very little with the inclusion of either the linear childhood income measure (column 3) or the indicator for low childhood income (column 4). Income effects are weakened, but they remain statistically significant and of the same general magnitude. Fixed effect models are estimated using the same income specification in Table 3, i.e., allowing the linear effect to differ for poor and nonpoor families (although without the interaction with age for simplification). Again, the effect of low birth weight remains large. Income is beneficial to health among the poor families, but a negative income effect is estimated for nonpoor families. However, even among poor families, the income effect is modest in size: a $10,000 increase in income among families with income less than $15,000 – so a very large increase – improves adult GHS by just 0.6691.

V. Additional Childhood Factors and Adult Health

The contemporaneous relationships between health insurance coverage, education, health behaviors and health status have been examined extensively. Here we investigate the extent to which these factors in childhood correspond with health status in adulthood. That is, we are using the data available in the PSID to see if we can identify some of the important family factors that are captured by the fixed effects. Specifically, we examine health insurance coverage, parental education, and parental smoking and drinking, all measured in childhood. Smoking and drinking is measured by total spending on each of these items by the family, on average, between 1968 and 1972. Health insurance is an indicator for whether the family lacks health insurance at some point between 1968 and 1972. While these analyses may shed light on some potentially important childhood determinants of adult health, there are likely to be additional correlated family factors that influence adult health that are not observed.

Children without health insurance have worse health in adulthood, and the effect is large, on the order of magnitude of the effect of low birth weight. Controlling for low birth weight and income reduce the effect of childhood health insurance by about 35 percent, but it is still large (-1.8117) and significant (column 4). Higher food spending in childhood is associated with better health in adulthood, although the effect is fully captured by income (column 8).

Education has been shown to be one of the strongest correlates of health status, and this is true across generations. Children whose parents have more than a high school degree (which accounts for roughly half of the parents in this cohort) have GHS in adulthood that is about 5 points higher. The effect is reduced when income is controlled (column 10), but remains very large. And the income effect also remains significant when education is included.

Roughly three-quarters of the current-day adults in the sample grew up in families that smoked in childhood. And children from these families have much worse health in adulthood, by 2.2969 points. One mechanism through which smoking may affect adult health is birth weight, but there is a strong association between parental smoking in childhood and adult health even after controls for birth weight (column 12). Parental alcohol consumption is harmful if a large amount is consumed; an increase in spending equal to average spending reduces GHS in adulthood by 0.4076 (column 13).

When all factors are included together, birth weight remains large and precisely estimated; childhood family income, health insurance coverage, smoking, drinking, parental education, and food consumption do not account for the fact that low birth weight children have significantly worse health in adulthood (column 16). Among the additional factors, parental education and smoking remain large determinants of adult health even after the full set of factors are accounted for.

The series of models in Table 5 also shed light on racial differences in health status. Blacks have much worse GHS than whites in adulthood (-3.8686), with a gap equivalent in size to being 11.6 years older (column 15). A large proportion of this disparity can be explained the observable childhood factors. Parental education alone reduces the gap by to –2.3534 (column 9), and including controls for income and education drives the gap down to –1.8668. The full set of controls – parental education, income, health insurance coverage, drinking, smoking, and food consumption – can explain just over half of the disparity.

VI. Do Birth Weight and Other Risk Factors in Childhood Interact?

A family's ability to respond to a health shock, such as low birth weight, may mitigate the lasting effect of the shock. Currie and Hyson (2003) find that socio-economic status reduces the harmful effects of low birth weight among Canadian women. We investigate this hypothesis by interacting the low birth indicator with health insurance coverage in childhood, childhood family income, and race (Table 6), all with the fixed effect specification. Having health insurance in childhood mitigates the effects of low birth weight: the harmful effects of low birth weight are three times larger for those who do did not have insurance. Surprisingly, the effect of low birth weight on adult health is actually smaller for low-income families and black families, although the interaction with income disappears once all factors are included simultaneously (column 4). Moreover, these results are consistent wit the Currie and Hyson (1999) who find that low birth weight has a larger harmful effect on educational attainment among high socio-economic than low socio-economic children. These findings will be investigated further.

VII. Low Birth Weight and Educational Attainment

Health shocks in childhood may have lasting effects on socio-economic status in adulthood through several mechanisms. Here we investigate one such channel: educational attainment. Prior research has found that low birth weight influences education (Conley and Bennette, 2000), and our estimates support this conclusion (Table 7). At the low end of the educational distribution, being low birth weight has very large effects. The linear probability estimate implies that low birth weight children are 5.56 percentage points more likely to drop out of high school (column 1). The effect is robust to direct controls for family income in childhood (columns 2-3), and to family fixed effects (column 4).[3]

VIII. Low Birth Weight, Childhood Family Income, and Labor Market Outcomes in Adulthood?

Low birth weight is strongly associated with future labor market outcomes: children born of low weight have 33 percent lower earnings in adulthood (column 1, Table 8). Consistent with the literature on intergenerational transmission of economic status (Solon, 1992; Zimmerman, 1992), family income in childhood is also closely related to subsequent labor market earnings (columns 2-4). And controlling for family income reduces the association between low birth weight and adult labor market earnings, but not substantially (columns 5-6). Controlling for completed education reduces the coefficient on low birth weight, but only modestly (column 7). This pattern implies that the effect of birth weight on adult labor market earnings does not work primarily through education.

The majority of the estimated relationship between low birth weight and adult labor market earnings is explained by unobserved family differences. The fixed effect models imply an earnings penalty of 12 percent associated with being low birth weight. While much smaller than the estimate without fixed effects, the effect is still large, on par with the effect of 1-2 additional years of schooling, and a bit greater than half the size of human capital-adjusted gender gaps in earnings (Blau and Kahn, 2000). The evidence is also consistent with Smith's (2004) analysis of retrospectively reported childhood health status; he finds that adults who report that there health in childhood was excellent or very good health had substantially higher family income and labor market earnings, even after adjusting for unobserved time invariant family effects.

IX. Conclusions

Low birth weight has large effects on adult health and labor market outcomes. For health, the effect is equivalent to being 10 years older, and for labor market earnings it is nearly as large as the difference in earnings between men and women, and between blacks and nonblacks.

[3] Boys and girls are pooled to boost the sample. Estimates just for boys are of similar magnitude, but not precise. And probit models lead to nearly identical estimates as the linear probability models.

Consistent with prior studies, these findings suggest that early life events can have large and lasting effects on health and economic well-being.

While poor birth outcomes reduce human capital accumulation, this consequence explains only a fraction of the total effect of low birth weight on labor market earnings. Other pathways through which birth outcomes affect adult labor market outcomes, such as adult health, should be examined. Moreover, the pathways through which birth weight and childhood family income affects health status in adulthood have not been tested. It may be that the health shock at birth is persistent and measurable with standard health variables throughout the childhood and adult years. Or, on the other hand, it may be that the effect does not arise until older age, which would be more consistent with the strict programming or fetal origins hypothesis.

Adult health is positively associated with childhood family income, especially for improvements in income at the very bottom of the income distribution. The average effects over the entire income distribution are smaller, implying that gains in income are likely to translate in substantial improvements in health for a small, although typically more vulnerable, population.

Given the fact that poor health outcomes in childhood are concentrated among low-income families, the evidence implies significant intergenerational transmission of health and well-being. At the same time, unlike Case, Lubotsky, and Paxson (2993), we find that the harmful effects of low birth weight can be mitigated to a substantial degree by having health insurance coverage in childhood.

Health disparities increase with age, at least through roughly age 60 (Smith, 2004). We find that the effect of low birth weight on adult health becomes more salient as adults age, increasing by roughly 10 percent with ever 10-year increase in age (column 10, Table 2). While other factors likely help account for the widening gap in health disparities as people age, early life events also appear to play some role in accounting for this pattern.

In the next version of this paper we will investigate several issues including: the effects of early life events on the onset of specific chronic conditions in adulthood; the robustness of the effects of birth order and maternal age at birth to functional form; and the importance of adjusting for fixed effects to the estimated income effects in light of the fact that health status may be driven largely by permanent differences in income and not temporary fluctuations.

Appendix

Health Index

A number of previous studies using surveys have demonstrated that a change in GHS from fair to poor represents a much larger degree of health deterioration than a change from excellent to very good or very good to good (e.g., Van Doorslaer & Jones 2003; Humphries & Van Doorslaer 2000). More generally, this research has shown that health differences between GHS categories increase with lowering GHS categories. Thus, assuming a linear scaling would not be appropriate.

To analyze health disparities in the presence of a multiple-category health indicator, three alternative approaches have previously been employed, each with its own set of advantages and disadvantages. The most common and simplest approach is to dichotomize GHS by setting a cut-off point above which individuals are said to be in good health (e.g., excellent/very good/good vs. fair/poor). The disadvantage of this approach is that it does not utilize all of the information on health. Additionally, it uses a somewhat arbitrary cut-off for the determination of healthy/not-healthy, and the measurement of inequality over time can be sensitive to the choice of cut-off (Wagstaff & Van Doorslaer 1994).

A second approach is to estimate an ordered logit or ordered probit regression using the GHS categories as the dependent variable and rescale the predicted underlying latent variable of this model to compute "quality weights" for health between 0 and 1 (Cutler & Richardson, 1997; Groot, 2000). The key shortcoming of this approach is the probit and logit link functions are inadequate to model health due to the significant degree of skewness in the health distribution (i.e., the majority of a general population sample report themselves to be in good to excellent health). Van Doorslaer and Jones (2003) assess the validity of using ordered probit regressions to impose cardinality on the ordinal responses comparing it with a gold standard of using the McMaster 'Health Utility Index Mark III' (HUI).[4] They conclude "…the ordered probit regression does not allow for any sensible approximation of the true degree of inequality."

The third approach, adopted first by Wagstaff and Van Doorslaer (1994), assumes that underlying the categorical empirical distribution of the responses to the GHS question is a latent,

[4] The McMaster Health Utility Index can be considered a more objective health measure because the respondents are only asked to classify themselves into eight health dimensions: vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain. The Health Utility Index Mark III is capable of describing 972,000 unique health states (Humphries & van Doorslaer 2000).

continuous but unobservable health variable with a standard lognormal distribution. This assumption allows "scoring" of the GHS categories using the mid-points of the intervals corresponding to the standard lognormal distribution. The lognormal distribution allows for skewness in the underlying distribution of health. The health inequality results obtained using this scaling procedure have been shown to be comparable to those obtained using truly continuous generic measures like the SF36 (Gerdtham et al. 1999) or the Health Utility Index Mark III (HUI) (Humphries & van Doorslaer 2000) in Canada, but has not been validated as an appropriate scaling procedure using U.S. data. The disadvantage of this approach is it inappropriately uses OLS on what remains essentially a categorical variable and does not exploit the within-category variation in health. This is particularly problematic for the analysis of health dynamics over a relatively short time horizon. Ignoring within-category variation in health will cause health deterioration estimates to be biased and induce (health) state dependence because within-category variation increases when going down from excellent to poor health.

Several surveys have been undertaken that contain both the GHS question and questions underlying a health utility index. In this paper, we adopt a latent variable approach that combines the advantages of approaches two and three above, but avoids their respective pitfalls. Specifically, utilizing external U.S. data that contain both GHS and health utility index measures, we use the distribution of health utility-based scores across the GHS categories to scale the categorical responses and subject our indicators to the transformation that best predicts quality of life. This scaling thus translates our measures into the metric that reflects the underlying level of health.

References

Almond, D., Chay K.Y., Lee, D.S., (2004). The Costs of Low Birth Weight. Working Paper, U.C. Berkeley.

Anderson, N. Bulatao, R., Cohen, B. (2004). Critical Perspectives on Racial and Ethnic Differences in Health in Late Life. National Academy Press, Washington, D.C.

Barker D.J. (1998). *Mothers, Babies and Health in Later Life*. Edinburgh: Churchill Livingstone, 1998.

Blau, F.D., and Kahn, L.M. (2000). "Gender Differences in Pay." *Journal of Economic Perspectives*. 14(4): 75-100.

Case, A., Fertig, A., and Paxson, C. (2003). "From Cradle to Grave? The Lasting Impact of Childhood Health and Circumstances." NBER working paper No. 9788.

Case, A., Lubotsky, D., Paxson, C. (2002). "Socioeconomic Status and Health in Childhood: Origins of the Gradient." *American Economic Review*, 92(5): 1308-34.

Conley, D., Bennett, N.G. (2000). "Is Biology Destiny? Birth Weight and Life Chances." *American Sociological Review*. 65(June): 458-467.

Curhan, GC, Chertow G.M., Willett W.C., Spiegelman D., Colditz, GA, Manson J.E., et al. (1996). Birth Weight and Adult Hypertension and Obesity in Women. *Circulation*. 94: 1310-1315.

Currie, J., Hyson, R. (1999). "Is the Impact of Health Shocks Cushioned by Socioeconomic Status? The Case of Low Birthweight." *American Economic Review*, 89(2): 246-250.

Currie, J., and Stabile, M. (2003). "Socioeconomic Status and Child Health: Why is the Relationship Stronger for Older Children?" *American Economic Review*, 93(5): 1813-1822.

Elo IT, Preston SH. (1992). Effects of Early-life Conditions on Adult Mortality: A Review. *Population Index.* 58(2): 186-212

Kuh D, Hardy R, Chaturvedi N, Wadsworth ME. Birth Weight, Childhood Growth and Abdominal Obesity in Adult Life. Int J Obes Relat Metab Disord 2002; 26:40-7.

Kuh, D.J. and Wadsworth, M.E. (1993). "Physical Health Status at 36 Years in the British National Birth Cohort." *Social Science and Medicine* 37(7): 905-916.

Luo, Ye, and Linda J. Waite. (2005). "The Impact of Childhood and Adult SES on Physical, Mental, and Cognitive Well-Being on Later Life*." Journals of Gerontology: Social Sciences*. 60B(2): S93-101.

Rich-Edwards J.W., Stampfer M.J., Manson JE, Rosner B, Hankinson SE, Colditz GA, et al. (1997). "Birth Weight and Risk of Cardiovascular Disease in a Cohort of Women Followed Up Since 1976." *British Medical Journal*. 315: 396-400.

Smith, J.P. (2004). "The Impact of SES on Health Over the Life-Course." RAND, mimeo, October.

Smith, J.P. (1999). "Healthy Bodies and Thick Wallets: The Dual Relation between Health and Economic Status." *Journal of Economic Perspectives*. 13(2): 145-166.

Solon, G. (1992). "Intergenerational Income Mobility in the United States." *American Economic Review*. 82(June): 393-408.

Zimmerman, D.J. (1992). "Regression Toward Mediocrity in Economic Stature." *American Economic Review.* 82(June): 409-429.

Table 1. Unweighted Descriptive Statistics of the Analytic Samples

	Full Sample Person-year obs: 25,142		Sample with at least 1 sibling Person-year obs: 18,317	
	Mean	Std. Dev	Mean	Std. Dev
Measures of Adulthood				
Health Status:				
Excellent	.3105		.3110	
Very good	.3629		.3612	
Good	.2415		.2398	
Fair	.0678		.0694	
Poor	.0173		.0186	
Educational attainment:				
Years of education	12.7327	2.0179	12.8612	1.9552
High school dropout	.1766	.3814	.1544	.3615
Labor earnings:				
No annual labor earnings	.0670	.2499	.0705	.2560
Annual labor earnings (unconditional, and in 2001$)	27,355	28,142	26,988	29,302
Age (range: 16-47)	31.9	6.0778	31.7	5.9763
Year born (range: 1951-1974)	1960		1960	
Measures of Childhood				
Sibling-specific variables:				
Low birth weight (<5.5 lbs)	.0647	.2461	.0640	.2449
Childhood average family income at ages:				
0-4	34,419	19,909	34,887	20,261
5-8	37,966	23,776	38,065	23,479
9-12	41,638	29,175	41,302	27,786
13-16	43,911	30,607	44,106	30,633
Low family income at ages 13-16 (average<=$25,000)	.2914	.4545	.2822	.4506
Birth order:				
First born	.3167		.2500	
Second born	.2616		.2530	
Third or fourth born	.2852		.3282	
Fifth or higher born	.1366		.1687	
Mother's age at child's birth	26.8	6.2089	27.0	6.1195
Born into two-parent family	.8597	.3474	.8677	.3389
Family-specific variables:				
Average fam inc at age 13-16 <=$15,000, for at least 1 child	.2418	.4283	.2150	.4110
Race				
White	.5448		.5221	
Black	.4327		.4568	
Hispanic	.0140		.0141	
Other	.0850		.0070	
Parental education (head):				
High school dropout	.5371		.5309	
High school graduate	.2734	.4458	.2822	.4502
Some college	.0935	.2912	.0904	.2868
College graduate	.0618	.2409	.0645	.2456
M.A. or higher	.0343	.1819	.0320	.1760
No parental health insurance (at some point, 1968-1972)	.5145	.4999	.5135	.4500
Parental health behaviors:				
Smoked cigarettes (at some point, 1968-1972)	.7519	.4320	.7570	.4290
Annual cigarette expenditures (5-year average, 1968-1972)	118	127	118	124
Drinks alcohol (at some point, 1968-1972)	.6485	.4775	.6563	.4751
Annual alcohol consumption (5-year average, 1968-1972)	90	146	94.11	152
Annual food consumption (5-year average, 1968-1972)	1,980	727	2,075	730

Table 2. Birth Weight and Adult Health
(Dependent variable: general health status in adulthood: 100pt-scale, 100=perfect health)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Low birth weight	-2.8320**	-3.4701**	-3.7050***	-2.4900**	-2.8155*	-3.9260***	-1.5174	-1.0167	-1.1200	-2.4360***
	(1.1113)	(1.4261)	(0.5437)	(1.1898)	(1.4641)	(0.5360)	(1.0048)	(1.1393)	(1.4277)	(0.6885)
Age - 25	-0.2831***	-0.2983***	-0.3147***	-0.3154***	-0.3264***	-0.3174***	-0.2707***	-0.3019***	-0.3100***	-0.3036***
	(0.0305)	(0.0368)	(0.0176)	(0.0331)	(0.0397)	(0.0203)	(0.0310)	(0.0326)	(0.0388)	(0.0206)
Age*low birth weight							-0.2080	-0.2282	-0.2616	-0.2362***
							(0.1484)	(0.1619)	(0.1970)	(0.0686)
Black (referenc group: white)				-3.8252***	-3.9213***			-3.8040***	-3.8954***	
				(0.6281)	(0.7183)			(0.6279)	(0.7187)	
Hispanic				0.9252	1.3326			0.9544	1.3516	
				(1.5081)	(1.7721)			(1.4970)	(1.7552)	
Other race				1.4883	3.0000			1.5123	3.0558	
				(1.9975)	(2.1092)			(1.9969)	(2.0812)	
Birth order				-0.3080*	-0.3127	-0.7961***		-0.3041*	-0.3089	-0.7856***
				(0.1642)	(0.1983)	(0.1488)		(0.1641)	(0.1982)	(0.1488)
Mother's age at child's birth				-0.0088	-0.0428	0.2501***		-0.0095	-0.0425	0.2446***
				(0.0469)	(0.0622)	(0.0613)		(0.0468)	(0.0622)	(0.0613)
Born into a two-parent family				0.4660	0.6046	-0.1347		0.4786	0.6219	-0.1203
				(0.9692)	(1.1106)	(0.5480)		(0.9666)	(1.1071)	(0.5478)
Constant	88.7112***	88.6250***	93.6690***	90.9221***	91.7851***	87.8320***	88.6279***	90.8218***	91.6358***	87.8421***
	(0.2276)	(0.2628)	(2.1140)	(1.3646)	(1.6034)	(2.7517)	(0.2255)	(1.3652)	(1.6074)	(2.7506)
F-test (p-value) for birth weight							6.54	4.67	4.01	
variables							(.038)	(.097)	(.135)	(<.01)
Full or sibling sample?	Full	Sibling	Sibling	Full	Sibling	Sibling	Full	Full	Sibling	Sibling
Family fixed effects?	No	No	Yes	No	No	Yes	No	No	No	Yes
Number of families	1,275	758	758	1,180	706	706	1,275	1,180	706	706
Number of individuals	2,379	1,780	1,780	2,130	1,656	1,656	2,379	2,130	1,656	1,656
Person-year observations	22,149	16,371	16,371	20,137	15,340	15,340	22,149	20,137	15,340	15,340

Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1% level.

Table 3. Childhood Family Income and Adult Health
(Dependent variable: general health status in adulthood: 100pt-scale, 100=perfect health)

									Poor Families^		Nonpoor Families^	
	(1)	(2)	(3)	(4)	(5)#	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Average family income,					0.2394*							
age 0-4 (in $10,000's)					(0.1285)							
Average family income,					0.0738							
age 5-8 (in $10,000's)					(0.1680)							
Average family income,					0.1263							
age 9-12 (in $10,000's)					(0.1529)							
Average family income,	0.5163***		0.3194***		0.1435	0.3187***	-0.6307***		1.6679***	1.2726**	0.3321***	-0.7325***
age 13-16 (in $10,000's)	(0.0656)		(0.0610)		(0.0906)	(0.0709)	(0.0973)		(0.5947)	(0.5159)	(0.0649)	(0.0967)
Low family income		-2.9246***		-1.7748***				0.3202				
age 13-16 (average<=$25,000)		(0.5787)		(0.5801)				(0.5275)				
Age - 25	-0.3214***	-0.3180***	-0.4565***	-0.2717***	-0.1488***	-0.4659***	-0.4286***	-0.2896***	-0.2108	-0.2092*	-0.5103***	-0.4373***
	(0.0282)	(0.0283)	(0.0499)	(0.0321)	(0.0309)	(0.0614)	(0.0302)	(0.0199)	(0.1564)	(0.1086)	(0.0849)	(0.0354)
Age*avg fam inc age 13-16			0.0300***			0.0297***	0.0189***		-0.1108	-0.1066*	0.0365***	0.0203***
			(0.0083)			(0.0100)	(0.0055)		(0.0850)	(0.0585)	(0.0134)	(0.0058)
Age*low fam inc age 13-16				-0.1674**				-0.1320***				
				(0.0650)				(0.0385)				
Black (reference group: white)	-2.5324***	-2.7863***	-2.4806***	-2.7319***		-2.6532***						
	(0.4969)	(0.5101)	(0.5017)	(0.5114)		(0.5939)						
Hispanic	-3.6108*	-1.8642	-3.9267*	-1.8413		-3.9096						
	(2.1781)	(2.1807)	(2.2279)	(2.1623)		(2.7084)						
Other Race	1.4384	1.4732	1.3931	1.3631		1.3542						
	(1.5461)	(1.6903)	(1.5477)	(1.6973)		(1.5348)						
Female					-2.0859***							
					(0.3776)							
Constant	87.0161***	90.2036***	87.8925***	89.8760***	86.3561***	87.9182***	97.2337***	93.4032***	82.5495***	92.6974***	87.2004***	97.8320***
	(0.4752)	(0.2515)	(0.4719)	(0.2478)	(0.4415)	(0.5549)	(2.2322)	(2.1748)	(1.3623)	(12.9876)	(0.4821)	(2.1273)
Include women?	No	No	No	No	Yes	No	No	No	No	No	No	No
Full or sibling sample?	Full	Full	Full	Full	Full	Sibling	Sibling	Sibling	Sibling	Sibling	Sibling	Sibling
Family fixed effects?	No	No	No	No	No	No	Yes	Yes	No	Yes	No	Yes
Number of families	1,423	1,423	1,423	1,423	872	844	844	844	172	172	672	672
Number of individuals	2,701	2,701	2,701	2,701	1,680	1,986	1,986	1,986	426	426	1,560	1,560
Person-year observations	25,063	25,063	25,063	25,063	11,800	18,265	18,265	18,265	3,426	3,426	14,839	14,839

Robust standard errors in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1% level.

^Poor families: families with <$15,000 family income measured when children are 13-16, for at least one child. Nonpoor families: all other families.

#Model 5 includes both men and women to boost the sample size because relatively few sample members are observed at every stage in childhood.

Table 4. Birth Weight, Childhood Family Income, and Adult Health
(Dependent variable: general health status in adulthood: 100pt-scale, 100=perfect health)

	(1)	(2)	(3)	(4)	(5)	(6)
Low birth weight	-2.8320**		-2.7495**	-2.8143**	-2.7013**	-3.3226***
	(1.1113)		(1.1046)	(1.1140)	(1.1073)	(0.5488)
Average family income		0.6729***	0.6202***			
age 13-16 (in $10,000's)		(.0684)	(0.0687)			
Low family income				-3.9350***		
age 13-16 (average<=$25,000)				(0.5500)		
Poor family^					-2.0164*	
					(1.1826)	
Effect of average family income, age 13-16					0.6691***	0.6833*
among poor families^ (in $10,000's)						(0.3768)
Effect of average family income, age 13-16					0.5290***	-0.6124***
among nonpoor families^ (in $10,000's)					(0.0699)	(0.0983)
Age - 25	-0.2831***	-0.3163***	-0.2856***	-0.2821***	-0.2927***	-0.3341***
	(0.0305)	(0.0284)	(0.0300)	(0.0300)	(0.0298)	(0.0180)
Constant	88.7112***	85.2876***	85.7823***	89.6347***	86.5750***	96.8174***
	(0.2276)	(0.3979)	(0.4207)	(0.2443)	(0.4678)	(2.1722)
Family fixed effects?	No	No	No	No	No	Yes
Number of families	1,275	1,423	1,272	1,272	1,272	757
Number of individuals	2,379	2,701	2,372	2,372	2,372	1,775
Person-year observations	22,149	25,063	22,101	22,101	22,101	16,338

Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1% level.
^Poor families: families with <$15,000 family income measured when children are 13-16, for at least one child.
Nonpoor families: all other families.

Table 5. Additional Childhood Factors and Adult Health
(Dependent variable: general health status in adulthood: 100pt-scale, 100=perfect health)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
No parental health insurance		-2.2410***	-1.9097***	-1.8117***												-0.8224
at some point 1968 to 1972		(0.5227)	(0.5253)	(0.5218)												(0.5304)
Annual food consumption (in $100's)						0.1137***	0.0880***	0.0105								-0.0273
5-year average 1968 to 1972						(0.0277)	(0.0292)	(0.0323)								(0.0348)
Parent's (head's) education:																
High school graduate									2.6444***	2.3880***						1.9289***
(reference group: High school dropout)									(0.5146)	(0.5177)						(0.5374)
Some college									4.6004***	3.9724***						3.6819***
									(0.6293)	(0.6459)						(0.6374)
College graduate									5.0978***	4.0384***						3.1846***
									(0.7299)	(0.7692)						(0.7956)
M.A. or higher									4.8999***	3.4625***						2.8638***
									(1.0130)	(1.1062)						
Parental health behaviors:																(1.0032)
Smoked cigarettes											-2.2969***	-2.0661***				-1.4680**
at some point 1968 to 1972											(0.5855)	(0.5893)				(0.5777)
Annual cigarette expenditures (in $100's),											-0.1067	-0.1350				-0.0253
5-year average 1968 to 1972											(0.2503)	(0.2559)				(0.2511)
Drank alcohol													0.5173	0.4961		0.3734
at some point 1968 to 1972													(0.5136)	(0.5151)		(0.4962)
Annual alcohol consumption (in $100's)													-0.4076**	-0.3669**		-0.3917**
5-year average 1968 to 1972													(0.1807)	(0.1706)		(0.1750)
Low birth weight	-2.4900**		-2.3478*				-2.8132**					-2.3084*		-2.3619*		-2.2986*
	(1.1898)		(1.2171)				(1.1131)					(1.2174)		(1.2093)		(1.1956)
Average family income										0.2761***						0.2749***
age 13-16 (in $10,000's)										(0.0706)						(0.0702)
Low family income				-1.8167***	-2.4787***			-2.4335***								
age 13-16 (average<=$25,000)				(0.6863)	(0.6865)			(0.6832)								
Black (referenc group: white)	-3.8252***	-3.0657***	-3.1372***	-2.5592***	-2.9704***			-2.9373***	-2.3534***	-1.8668***	-3.8185***	-3.8075***	-3.8411***	-3.7947***	-3.8686***	-1.7824***
	(0.6281)	(0.5898)	(0.5984)	(0.6206)	(0.6010)			(0.6171)	(0.5795)	(0.6020)	(0.5683)	(0.5763)	(0.5608)	(0.5694)	(0.5585)	(0.6308)
Age - 25	-0.3154***	-0.3323***	-0.3154***	-0.3301***	-0.3294***	-0.3322***	-0.2950***	-0.3320***	-0.3125***	-0.3140***	-0.3287***	-0.3118***	-0.3290***	-0.3115***	-0.3327***	-0.2860***
	(0.0331)	(0.0314)	(0.0314)	(0.0314)	(0.0315)	(0.0291)	(0.0308)	(0.0321)	(0.0307)	(0.0306)	(0.0315)	(0.0315)	(0.0318)	(0.0317)	(0.0317)	(0.0313)
Constant	90.9221***	91.6406***	91.8134***	91.7847***	91.0891***	86.2019***	86.9966***	90.9146***	88.3275***	87.3829***	92.3321***	92.5980***	90.3462***	90.6725***	90.5653***	89.7369***
	(1.3646)	(1.3306)	(1.3437)	(1.3510)	(1.3273)	(0.5819)	(0.6234)	(1.3908)	(1.3555)	(1.3807)	(1.3095)	(1.3155)	(1.3135)	(1.3209)	(1.3037)	(1.4614)
Family fixed effects?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
Number of families	1,180	1,218	1,180	1,213	1,213	1,432	1,275	1,213	1,210	1,205	1,218	1,180	1,218	1,180	1,218	1,170
Number of individuals	2,130	2,214	2,130	2,205	2,205	2,717	2,379	2,205	2,195	2,186	2,214	2,130	2,214	2,130	2,214	2,105
Person-year observations	20,137	20,916	20,137	20,863	20,863	25,142	22,149	20,863	20,759	20,706	20,916	20,137	20,916	20,137	20,916	19,935

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% level.
Other covariates in each model include indicator variables for Hispanic and "Other" racial/ethnic group, birth order, mother's age at birth, and whether born into a two-parent family
(with the exception of columns (6)-(7) which do not include these controls).

Table 6. Interaction of Low Birth Weight with Other Childhood Factors
(Dependent variable: general health status in adulthood: 100pt-scale, 100=perfect health)

	(1)	(2)	(3)	(4)
Low birth weight	-1.7049**	-4.2357***	-5.9934***	-3.8413***
	(0.8359)	(0.6298)	(0.8074)	(0.9357)
Low birth weight*no health insurance	-3.4646***			-5.4368***
(at some point 1968 to 1972)	(1.1036)			(1.1851)
Low birth weight*low family income		2.4405**		1.4861
age 13-16 (average<=$25,000)		(1.1638)		(1.3336)
Low birth weight*black			4.2381***	5.4987***
			(1.0961)	(1.2649)
Age - 25	-0.3149***	-0.3159***	-0.3174***	-0.3193***
	(0.0176)	(0.0176)	(0.0176)	(0.0176)
Constant	93.6704***	93.6799***	93.6945***	93.7126***
	(2.1136)	(2.1151)	(2.1133)	(2.1130)
Family fixed effects?	Yes	Yes	Yes	Yes
Number of families	758	757	758	757
Number of individuals	1,780	1,775	1,780	1,775
Person-year observations	16,371	16,338	16,371	16,338

Robust standard errors in parentheses.
* significant at 10%; ** significant at 5%; *** significant at 1% level.

Table 7. Low Birth Weight, Childhood Family Income, and Educational Attainment
(Dependent variable: high school dropout. Estimation: Linear probability model)

	(1)	(2)	(3)	(4)
Low birth weight	0.0556***	0.0516***	0.0518***	0.0447*
	(0.0193)	(0.0189)	(0.0189)	(0.0246)
Average family income		-0.0201***		
age 13-16 (in $10,000's)		(0.0015)		
Low family income			0.1393***	0.0074
age 13-16 (average<=$25,000)			(0.0105)	(0.0210)
Female	-0.0347***	-0.0338***	-0.0379***	-0.0468***
	(0.0099)	(0.0097)	(0.0097)	(0.0109)
Constant	0.1480***	0.2343***	0.1063***	0.1542***
	(0.0071)	(0.0097)	(0.0076)	(0.0095)
Family fixed effects?	No	No	No	Yes
Number of families	1,656	1,656	1,656	1,380
Number of individuals	4,733	4,719	4,719	4,279

* significant at 10%; ** significant at 5%; *** significant at 1% level.
Men and women are pooled to boost the sample size.

Table 8. Birth Weight, Childhood Family Income, and Adult Labor Market Earnings
(Dependent variable: ln(own labor market earnings))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Low Birthweight	-0.3329***				-0.3045***	-0.3289***	-0.2926***	-0.1289***	-0.1190***	-0.1197***
	(0.0819)				(0.0749)	(0.0734)	(0.0756)	(0.0397)	(0.0398)	(0.0399)
Average family income,		0.1109***								
age 0-4 (in $10,000's)		(0.0276)								
Average family income,		-0.0197								
age 5-8 (in $10,000's)		(0.0270)								
Average family income,		0.0041								
age 9-12 (in $10,000's)		(0.0159)								
Average family income,		0.0211	0.0831***		0.0811***					
age 13-16 (in $10,000's)		(0.0173)	(0.0062)		(0.0066)					
Low family income				-0.5325***		-0.5598***	-0.4495***		-0.0851***	-0.0925***
age 13-16 (average<=$25,000)				(0.0349)		(0.0396)	(0.0387)		(0.0330)	(0.0333)
Own years of education							0.1088***			0.0714***
							(0.0073)			(0.0058)
Age - 25	0.0425***	0.0855***	0.0399***	0.0410***	0.0406***	0.0416***	0.0357***	0.0333***	0.0334***	0.0325***
	(0.0017)	(0.0052)	(0.0015)	(0.0015)	(0.0016)	(0.0017)	(0.0016)	(0.0011)	(0.0011)	(0.0011)
Constant	9.7616***	9.2042***	9.3579***	9.8686***	9.3933***	9.9030***	8.4738***	9.7756***	9.7951***	8.8692***
	(0.0158)	(0.0633)	(0.0310)	(0.0155)	(0.0339)	(0.0162)	(0.0998)	(0.0082)	(0.0113)	(0.0765)
Family fixed effects?	No	No	No	No	No	No	No	Yes	Yes	Yes
Number of families	1,231	485	1,427	1,427	1,228	1,228	1,206	735	734	725
Number of individuals	2,216	697	2,593	2,593	2,209	2,209	2,155	1,654	1,649	1,608
Person-year observations	24,505	4,735	28,311	28,311	24,459	24,459	24,281	17,885	17,851	17,720
R-squared	0.0785	0.1629	0.1352	0.1270	0.1434	0.1374	0.1818	0.0555	0.0559	0.0634

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1% level.