CHILD HEALTH AND YOUNG ADULT OUTCOMES

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ABSTRACT

Previous research has shown a strong connection between birth weight and future child outcomes. But this research has not asked how insults to child health after birth affect long-term outcomes, whether health at birth matters primarily because it predicts future health or through some other mechanism, or whether health insults matter more at some key ages than at others? We address these questions using a unique data set based on public health insurance records for 50,000 children born between 1979 and 1987 in the Canadian province of Manitoba. These children are followed until 2006, and their records are linked to provincial registries with outcomes data. We compare children with health conditions to their own siblings born an average of 3 years apart, and control for health at birth. We find that health problems, and especially mental health problems in early childhood are significant determinants of outcomes linked to adult socioeconomic status.

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Introduction

A large literature has established that low birth weight babies (those under 2500 grams) are more likely to suffer various deficits, including lower average educational attainment. But previous research has not asked how poor child health after birth affects long-term outcomes, whether health at birth matters primarily because it predicts future health or through some other mechanism, and whether health problems matter more at some key ages than at other times?

This study provides a first look at these questions using a unique administrative data set based on public health insurance records from the Canadian province of Manitoba. The data combines information from birth records, hospitalizations, and ambulatory physician visits with information from other provincial registers about educational outcomes and use of social assistance. These outcomes include: achievement on a standardized test of grade 12 language arts, whether children took college-preparatory math courses in high school, whether they were in grade 12 by age 17, and welfare participation in the months immediately after becoming eligible at age 18. This health and outcome information is much more complete, and in many ways more accurate, than what is typically available in survey data. And because Canada has universal public health insurance, this study sheds light on the consequences of disparities in child health in a setting that abstracts from differences in access to insurance coverage.

We follow 50,000 children born in the Canadian province of Manitoba between 1979 and 1987, until 2006, when they are young adults. We are able to compare siblings with different health problems, to control for health at birth (including the presence of congenital anomalies and perinatal problems), and to compare the effects of health problems at different ages.

A growing body of research suggests that adverse conditions in early childhood may have particularly negative long term effects. Cunha and Heckman (2007) hypothesize that this is

because health human capital is complementary to skills and "skill begets skill," so that children who suffer early disadvantages may fall behind and never catch up. On the other hand, to the extent that children are resilient and recover, one might expect more recent health conditions to have greater effects on current outcomes. If both mechanisms are at work, then one might expect to find that both health insults in early childhood and recent health problems have particularly negative effects on young adult outcomes.

We show that early health problems have significant effects on future adult outcomes. For schooling outcomes, this is largely due to effects on future health outcomes. However, early health conditions have lingering effects on social assistance use net of effects of future health conditions. Mental health conditions are an exception: we find that diagnoses of Attention Deficit Hyperactivity Disorder or Conduct disorder at school entry are significant predictors of future outcomes whether or not future diagnoses are controlled. We also find that controlling for early health problems reduces, but does not eliminate the effect of low birth weight, confirming the importance of fetal conditions for future outcomes. We conclude that differences in health in childhood may be a significant source of socioeconomic disparities in adulthood.

2. Background

There is a large literature linking low birth weight to lower average scores on a variety of tests of intellectual and social development (see for example, Breslau et al. 1994, Brooks-Gunn, Klebanov, and Duncan, 1996). Currie and Hyson (1999) show that low birth weight children from the 1958 British birth cohort study (all of the children born in Great Britain in one week in 1958) have lower test scores, educational attainments, wages, and probabilities of being employed as of age 33, even conditional on many measures of family background and

circumstances. Case, Fertig, and Paxson (2005) extend this research by showing that the same is true at age 42, and for adults who suffered chronic conditions as children.

Several studies have used sibling designs and/or large-scale administrative data sets to examine the relationship between low birth weight and future outcomes in models that control more fully for family background characteristics by comparing siblings or twins.   In these studies the "control" for the low birth weight child is the child's non-low birth weight sibling. Using data from the Panel Study of Income Dynamics, Conley and Bennett (2000) find that low birth weight reduces the probability of high school graduation, while Johnson and Schoeni (2007) find that low birth weight is strongly related to poorer adult health and lowers adult annual earnings by 17.5%.

Lawlor et al. (2006) examine the birth weights of Scottish siblings born between 1950 and 1956 and find that lower birth weight siblings had lower scores on a test of intelligence at age 7. Black, Devereux, and Salvanes (2005) examine a large sample of Norwegian twins and find, using twin fixed effects, that a 10% increase in birth weight leads to a one percentage point increase in the probability of graduating from high school and a one percent increase in earnings. Moreover, these effects are surprisingly linear between about 1,500 grams and 3,500 grams, suggesting that an exclusive focus on the 2,500 gram cutoff for low birth weight is unwarranted.

Royer (2005) and Currie and Moretti (2007) use linked mother-child birth certificate data for California. Royer examines mothers who were twins, and finds that each 1,000 gram increase in birth weight is associated with a gain of 0.16 years of education at the time the mother gives birth to her own child. Currie and Moretti (2007) compare mothers who are sisters by conditioning on grandmother fixed effects, and find that a sister who was low birth weight is 3% more likely to live in a poor area at the time she delivers her own child, and 3% less likely to

be married when she gives birth. The low birth weight sister also has about a tenth of a year less education on average.

Oreopoulos, Stabile, Roos, and Walld (2007) examine the Manitoba data used in this study and find results consistent with those discussed above: children with birth weight between 1,500 to 2,500 grams were 8.2 % less likely to reach grade 12 by age 17 than siblings who weighed over 3,500 grams and these children also spent longer on welfare than their siblings who weighed over 3,500 grams.

In one of the very few studies to look at other child health measures, Luo and Waite (2005) use data from the Health and Retirement Survey, a national survey of older adults, and find that the effect of a retrospective self-reported measure of childhood SES on future health, education, and income is attenuated by the inclusion of child health measures, suggesting that child health may explain some of the impact of low childhood SES on future outcomes. But there are issues with self-reported health data, and it is possible that these correlations are due to other characteristics of households that are associated both with poor child health and poorer outcomes.

Smith (2007) examines the long-term effects of child health using a similar retrospective health measure using data from the Panel Study of Income Dynamics. In 1999, the 25 to 47 year old adult children of PSID respondents were asked a retrospective question about the state of their health when they were less than or equal to 16 years old: Whether it was excellent, very good, good, fair or poor? In models with sibling fixed effects, Smith finds significant negative effects of poor overall health status in childhood on earnings.

Case and Paxson (2006) treat adult height as an indicator of childhood health, and show that much of the wage premium associated with adult height can be explained by children's cognitive

test scores. They interpret their results as evidence that early child health affects cognition, which in turn affects earnings.

As Currie (forthcoming) documents, there has been little research examining the long-term effects of other specific health conditions besides low birth weight, with the result that we know little about how other conditions affect children's prospects. Salm and Schunk (2008) use data from an administrative data set in a German city to show that 6 year old children with health problems also have lower test scores, but they are not able to track the children over time.

Moreover, we do not know whether low birth weight and other childhood health conditions matter primarily because they are linked to future health conditions or through other channels. Elo and Preston (1992) show that cohorts who suffered high death rates in childhood also tend to show high death rates in adulthood, presumably at least in part because of the direct effects of childhood health conditions on future morbidity. For example, Linnet et al., 2006 show in a large cohort of Danish children that low birth weight is linked to Attention Deficit Hyper Activity Disorder. Hence, it is possible that the effects of low birth weight on future outcomes could be eliminated by including controls for future health status.

3. Data

Our main source of data is records that are routinely collected through the administration of Manitoba's public health insurance system. These records include enrollment files, physician claims, and hospital claims for every person in Manitoba. These data are matched to administrative records on educational attainment and social-assistance (welfare) take-up and use.

The registry contains information on 96% of all children born in Manitoba over the sample period and tracks 99% of the original sample conditional on remaining in the province

until June of their 18th year.[1] We restrict our sample to families with more than one child born between 1979 and 1987 (excluding 1983 as we are unable to match this cohort to educational information). We track outcomes for these children through to 2006. We restrict our sample to children with siblings also born in the period of interest as our identification strategy (discussed in more detail below) relies on sibling comparisons. Previous work using these data (Oreopoulos et al, 2008) has shown that the sibling cohort and entire cohort of Manitoba births over this period are quite similar.   We also exclude children who ever have a diagnosis of mental retardation. Further details on the construction of the data set are available in the data appendix.

Because the data set includes all hospitalizations and ambulatory visits, there are a very large number of potential health measures. Birth weight, congenital anomalies and perinatal problems are obtained from hospital records.   These measures are important conceptually as summary measures of health at birth: We wish to investigate the effects of health problems after birth, so it is necessary to control for the continuing effects of health at birth.[2] It is also of interest to ask whether the documented effects of health at birth matter primarily because they affect future health, or through some other mechanism.

In order to collapse the available health measures in an objective and arms-length way, we use Adjusted Clinical Group (ACG) software developed by researchers at Johns Hopkins University (The Johns Hopkins University, 2003).   The ACG is designed to measure morbidity by creating constellations of diagnoses. Medical providers indicate diagnoses using what are

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[1] The registry data do suffer from attrition when families move out of the province and can no longer be tracked. Approximately 20% of the sample leaves the province between the birth of the child and their 18th year. Previous studies (Oreopoulos, Stabile, Roos and Walld) find that there does not appear to be a correlation between children being in poor health and the families leaving the province. There is also a small amount of attrition from children who die, but children who died before age eight were much less healthy at birth and most of these deaths (~3/4) occur within the first year of life.

[2] Congenital problems may continue to generate diagnoses, or may even be discovered as the child ages. For example, we code a 10 year old's visit related to a congenital heart defect as a congenital problem, and control for it.

called International Classification of Disease codes (ICD9 or ICD10 codes depending on the year). The ACG software groups 14,000 ICD codes into 32 groups (called Aggregated Diagnostic Groups or ADGs) on the basis of 5 criterion: 1) Duration of the Condition (acute, recurrent, or chronic), 2) severity of the condition (e.g. minor and stable versus major and unstable), 3) diagnostic certainty (symptoms focusing on diagnostic evaluation versus documented disease focusing on treatment), 4) etiology of the condition (infectious, injury, or other), and 5) specialty care involved (medical, surgical, obstetric, etc.) Individuals are assigned an ADG code if they have been diagnosed with any of the ICD codes in the group in either an outpatient or hospital visit over the past year.

The ADG system has been extensively validated in the U.S. (Weiner, Starfield, Steinwachs et al., 1991; Weiner, Starfield, and Lieberman, 1992; Powe, Weiner, Starfield et al., 1998; Wiener, Dobson, Maxwell et al., 1996). The Manitoba Center for Health Policy has also evaluated the application of the ACG software to the Manitoba administrative data (Reid et al., 1999). See the data appendix for further details.

We use the ADG codes to construct several health measures. First, the Johns Hopkins software classifies some ADGs as major and some as minor for each age group, and we start by looking at their definition of major diagnoses for children. However, this definition excludes several diagnoses that are highly prevalent among children, and which are thought to have important effects: While the Johns Hopkins definition includes acute, unstable mental health conditions such as psychosis, it excludes "stable" mental health conditions such as Attention Deficit Hyper Activity Disorder (ADHD) and Conduct disorders, two of the most common mental health conditions among children. Also excluded are asthma and major injuries.[3]

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[3] "Major injuries" are not included as a major ADG for 0 to 17 year olds, but they are included for 18 year olds. In order to construct a more consistent measure, we use the same definition of a major

These are potentially significant exclusions. Using retrospective questions about onset, Kessler et al. (1995) find that those with early onset psychiatric problems were less likely to have graduated from high school. Using large-scale national surveys of children from both the U.S. and Canada, Currie and Stabile (2006, 2007) show that mental health conditions in childhood are associated with lower future test scores and schooling attainments in both countries. Externalizing disorders such as ADHD and conduct disorders were found to have the largest effects on future outcomes. Duncan et al. (2006) report similar findings.

Injuries are the leading cause of death among children over one year of age in developed countries, notwithstanding a dramatic reduction in deaths due to injuries in the past 30 years (Glied, 2001). Yet we have little information about the burden of morbidity caused by injuries among surviving children (Bonnie et al, 1999).

Asthma is the leading cause of school absence and pediatric hospitalizations in children, and one of the most common chronic conditions of childhood (U.S. Environmental Protection Agency, 2006). The available evidence suggests however, that when properly managed asthma may have little impact on children's functioning or academic achievements so it is not clear that asthma in childhood should be expected to have consistent effects on young adult outcomes (Annett et al. 2000; Gutstadt et al., 1989).

In view of these literatures, we examine the effects of asthma, major injuries, two specific stable mental health problems (ADHD and conduct disorders), as well as the number of major health conditions as classified by the ADG software. In each case the measure is constructed to cover a specific age range starting from the date of birth of the child. So, for example, we define a child as having a major injury between ages 0 and 3 if the child has a diagnosis of a major injury at any point between birth and their 4th birthday. We construct similar measures for the

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conditions for 18 year olds as we do for younger children. Further details are in the data appendix.

age ranges 4 to 8, 9 to 13, and 14 to 18. We chose these age ranges to correspond to important stages of childhood: The preschool years, early elementary school, early adolescence, and the late teen years.

The data appendix shows the mapping between our measures and the most common ICD9 codes in each category (the rankings are much the same for ICD10 codes). For example, Appendix Table 3 shows that open wounds of the head are one of the most important major injuries at all ages.

Of course, given that we are using administrative data, what we observe is whether a child had any interaction with the health care system for a specific ADG over a four year interval.   However, it is reasonable to expect that over a four year period a fully insured child who is experiencing a severe health condition, or being treated for that condition, would need to interact with the health care system at least once. For example, a child who was on medication for asthma would need to see a physician periodically to have his or her prescription renewed, even in the absence of acute asthma attacks. Moreover, our measure is not affected by the number of visits for a particular condition, only by whether there is at least one visit. Hence, we believe that our measure, while imperfect, offers a reasonable proxy for whether or not a child had a particular condition in a given age range, and for the number of major conditions a child had.

Table 1 shows the means of our measures for each age range.   Because the first age range is one year smaller than the others, the estimates are pro-rated so that they all apply to a 5 year interval. The fraction of children with a medical contact for asthma ranges from 8% among 0 to 3 year olds, to 14.4% among 9 to 13 year olds. These numbers compare very closely with the best available evidence of asthma prevalence for the U.S., which suggest that 13.1% of 0 to

17 year old children have ever been told by a doctor that they have asthma (Bloom and Cohen, 2007).

Major injuries are clearly the most common reason for seeking medical attention, with around 40% of children having at least one visit for major injury over each age interval. U.S. data suggest that in 2000, 11.9% of children less than 10 and 17.9% of children 10 to 19 received medical attention for an injury, which suggests that over a 4 or 5 year period, a rate of 40% is not unreasonable.

In comparison, contacts for externalizing mental health problems are not nearly as prevalent: 3 to 4% of children receive a medical contact for ADHD or conduct disorders over each period. U.S. rates of ADHD prevalence are higher than this. For example, Froehlich et al. (2007) report that 8.7% of 8 to 15 year old children in the National Health Interview Survey have been told by a doctor that they have ADHD. But there is evidence that Canadian rates of mental health diagnosis are lower than in the U.S. Currie and Stabile (forthcoming) found that 9.3% of children in the U.S. National Longitudinal Survey of Youth were being treated for mental health conditions compared to 4.5% in a similar Canadian survey. This disparity in the rates suggests that Canadian children who are diagnosed may display more severe behavior problems than treated children in the U.S., a comparison which should be born in mind when interpreting the results below.[4]

Congenital and perinatal (pertaining to the period from 22 weeks gestation to one week after birth) problems are common among 0 to 3 year olds. We retain only those problems that are considered "major" health conditions by the ADG system. Appendix Table 3 lists these conditions and shows that they include problems such as birth asphyxia and neonatal jaundice

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[4] We have repeated our analyses with a broader measure of mental health conditions as discussed further below.

accompanying preterm delivery. A small number of older children have contacts for congenital problems such as heart defects. Though these contacts occur later, they result from health conditions present at birth, so we control for them in our examination of the effects of health after birth.

About 15% of children 0 to 13 have major conditions. Appendix Table 2 provides a breakdown of the ICD9 codes represented by this variable. This table demonstrates that although it is relatively common to have a medical contact for a major health problem, most individual types of problems have low prevalence. For example, the 629 children who had a medical contact related to hearing lost when they were 0 to 3 represent only 1.2% of the sample. This is the main reason that we group these major health conditions together. The average number of major health conditions is a little over .2 for children 0 to 13 (vs. .335 for 14 to 18 year olds) which suggests that most children with a major health condition have only one such condition. There are however a small number of children who have multiple conditions, with the maximum being 10 to 12 for 0 to 13 year olds (14 for 14 to 18 year olds). Finally, the table shows the effects of limiting our attention to major conditions. While the average number of major conditions identified is far less than 1, the average child has an average of 5 different major *and* minor conditions diagnosed over a five year period.

Table 2 explores the temporal pattern of health problems for the children in our sample. For example, a child is assigned the pattern 0000 if he or she did not have a diagnosis for a particular health condition in any age range. The fractions ever diagnosed with asthma, ADHD/conduct disorder or major injuries are 28.31, 10.18, and 82.06 respectively, while 47.36% ever have anmajor condition. Relatively small numbers of children have a diagnosis

related to the same condition in each period. However, 5.58% of sample children have a major injury in every period.

There is clearly state dependence in diagnoses. For asthma, a child who is diagnosed with asthma has about a 50% chance of being diagnosed with asthma in the next period, whereas a child with no diagnosis has about a 10 to 20% probability of having a diagnosis in the next period. For ADHD/conduct disorder, children diagnosed in the first period have a 20% chance of having a medical contact for this diagnosis in the second period; and children with a previous diagnosis become more likely to be diagnosed in the current period as they age. Even for major injuries, a child who has a major injury in the current period has about a 50% chance of having a diagnosis for major injury in the next period, while a child without a diagnosis this period, has only a 30 to 40% probability of such a diagnosis in the next period.

Still, the variation in our data over time periods suggests that in each period, some children without initial health conditions develop them, and other children with health conditions recover from them. Such variation is the key if we are to be able to use the data to examine the impact of health conditions at different ages.

The outcome variables we examine are created by linking the health care registry information to administrative data on education, and social assistance.[5] We link education enrollment records with the provincial registry to determine whether a student has attained Grade 12 by age 17. This measure is available for all birth cohorts. Overall, about 70% of children are in grade 12 by age 17. Not attaining grade 12 by this age could indicate that a student entered school late, has been held back in a grade at least once, or has dropped out. Hence, we also

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[5] These data are available only for Manitoba residents. The analysis of the effects of health on these longer-term outcomes, therefore, is conditional on both survival and on remaining a resident in the province. This issue is discussed further in the data appendix.

looked at whether the child was in school at age 17, but did not find significant effects of early health on this measure. Therefore, it seems that "grade 12 by age 17" mostly captures the effect of starting school late or of being delayed.

We also have information from provincial language arts standards tests taken in grade 12. These tests contribute 30% to the students' final course grade. Individuals pass the language arts test by scoring 50% or more on a comprehensive exam.[6] The score on the test is normalized to have a mean of zero and a standard deviation of one for the entire population of students in Manitoba. Within each birth cohort, some test scores are missing and we have imputed scores for these children based on the reasons for the failure to write the test, as discussed further in the data appendix.

Students in the province can select into one of several math tracks. While the courses offered differ by year and school, they always include courses that would prepare the student for college level mathematics. In each year we classify high school courses into college versus non-college preparatory mathematics based on the difficulty of the course and the course material. The number of college preparatory math courses available increased over our sample period, and as a result the number of students in college preparatory courses also increased. In our empirical analysis, year fixed-effects will help to account for this trend.[7] We calculate that 22% of the sample took college-preparatory math courses.

Finally, the sample of Manitoba residents is matched to monthly social assistance records (the provincial welfare program). Residents become age-eligible to participate in welfare in

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[6] The test focuses on reading comprehension, exploring and expanding on ideas from texts, the management of ideas and information, and writing and editing skills.

[7] To further ensure that our results are not overly sensitive to the fact that the number of courses increases, we estimated alternative models using information on the grade obtained in the course and assign students with a grade of 80% or better to college-level math. Results using this specification are quite similar to the results using just the course assignment and we present our results using only the course assignment here.

their own right (rather than as a dependent child) on their 18th birthday. Our youngest birth cohort can only be followed for 1.25 years after the age of 18. While the older cohorts can be tracked for longer, we define our social assistance exposure window to be a consistent 1.25 years for each cohort (or 70 weeks). Using this exposure window, 6% of our sample went on social assistance in the 70 weeks after they became eligible on their 18th birthday.

Note that our last age group, 14 to 18, encompasses the ages when some of our outcomes are measured. This, combined with the fact that some people might delay seeking treatment for conditions first noted at say age 16, leads us to consider the health measures for 14 to 18 as roughly contemporaneous with the outcomes we are examining. Hence, we have measures of early health, health in middle childhood, and measures that are roughly contemporaneous with the outcomes examined.

Appendix Table 1 shows the means of the other variables that we control for in our models. The administrative and registry records provide information on the characteristics of the mother at the birth of the child, and on the number of children in the family. We use 2004 as the fixed point to determine family size and the birth order of the child. This year, many years after the final birth cohort used in the analysis (1987), was chosen in order to try to ensure that families were past the childbearing phase.

4. Conceptual Framework

The simplest model that captures key elements of our approach is:

(1) $Y_t = aH_t^{\alpha}C_t^{\beta}$

(2) $c_t = b_0 + b_1 c_{t-1} + b_2 h_{t-1}$

(3) $h_t = \gamma h_{t-1} + u_t$

where Y_t is a young adult outcome, H_t is contemporaneous health, C_t is contemporaneous cognitive ability, and h_t and c_t are log health and log cognitive ability, respectively. We assume that outcomes are produced using inputs of health and cognitive ability, and that cognitive ability depends on ability last period and also on health last period. Finally, health depends on health last period, and is subject to random problems, u_t. Solving the model recursively yields an equation of the form:

(4) $\log(Y_t) = \delta + \delta_1 c_{t-4} + \delta_2 h_{t-4} + \delta_3 u_t + \delta_4 u_{t-1} + \delta_5 u_{t-2} + \delta_6 u_{t-3}$

where, in our context, $(\delta_1 c_{t-4} + \delta_2 h_{t-4})$ represent endowments at birth, u_t is a contemporaneous health problem, and u_{t-3} is a health problem in the first 3 years of life. The coefficients δ_3 to δ_6 are given by:

$\delta_3 = \alpha$

$\delta_4 = \alpha\gamma + \beta\, b_2$

$\delta_5 = \gamma\delta_4 + \beta\, b_2\, b_1$

$\delta_6 = \gamma\delta_5 + \beta\, b_2\, b_1^2$.

We can consider several interesting special cases:

Case 1. $b_2 = 0$ so that cognition does not depend on health. If it is also true that $\gamma=1$ then all health problems have the same effect. If $\gamma < 1$ then health depreciates, and the effects of health problems die out over time. In this case, more recent health problems always have a larger effect. In order for early health problems to have a large effect in this model, it must be the case that $b_2 > 0$.

Case 2: $b_2 > 0$ and $\gamma=1$. Now early health problems matter more than later health problems. The reason is that early health problems affect the development of cognitive ability through multiple periods.

Case 3. if $b_2 > 0$ and $\gamma < 1$ then it is possible to generate many interesting patterns in the data, even with this simple model. For example, if $\alpha=\beta=.5$; $b_1=1.5$; $b_2=.2$; $\gamma=.7$, then $\delta_3=.5$, $\delta_4=.45$, $\delta_5=.47$, $\delta_6=.56$ then health problems in the first year of life and contemporaneous health problems matter most. In other words, the pattern of coefficients is U-shaped rather than monotonically increasing or decreasing.

The intuition is that there are two different mechanisms at work. On the one hand, early health problems affect early cognitive ability, which affects future cognitive ability. Hence, the effects of these early problems cumulate. Second, people tend to recover from health problems over time, so that the main effect of the health problem per se diminishes with time.

The empirical analogue of (4) is given by:

(5) $OUTCOME = a + b_1 X + b_2 HEALTH_0 + b_3 HEALTH_{0-3} + b_4 HEALTH_{4-8} + b_5 HEALTH_{9-13} + b_6 HEALTH_{14-18} + e$,

where OUTCOME is one of the young adult outcomes described above, X is a vector of controls including marital status, sex of the child, and mother's age at birth, dummy variables for birth order of the child, and year of birth indicators, $HEALTH_0$ are measures of health at birth and $\{HEALTH_{0-3}, HEALTH_{4-8}, HEALTH_{9-13}, HEALTH_{14-18}\}$ is a vector of age specific health problems. We use a number of different measures of health, as described above.

These models show the correlations between young adult outcomes and an individual's health history, but they may be biased by omitted characteristics of families, including characteristics that affect young adult outcomes, the health of children in the family and the propensity of the family to seek medical care.

Hence, our main focus is on models of the following form:

(6) $OUTCOME_{ya} = a + b_1 X + b_2 HEALTH_0 + b_3 HEALTH_{0-3} + b_4 HEALTH_{4-8} + b_5 HEALTH_{9-13} + b_6 HEALTH_{14-18} + MOTHER + e$,

where MOTHER is an indicator for each mother in the data. The inclusion of mother fixed effects will help us to control for many unobserved family background characteristics that may be correlated with the propensity to use medical care, true health status, and with young adult outcomes. The fact that we observe families over a relatively short period of time is also helpful, as siblings will be less likely to be exposed to different environments over a short time than over a long time. The mean difference in age between two siblings is only 3 years, and most children and 74% of children are born less than 4 years apart.

Several other issues arise when using family fixed effects models. First, there may be characteristics of the individual child that are correlated with health conditions and also with future outcomes. While we cannot control for all such factors, it is important to note that we have very thorough controls for health at birth, and that the degree of serial correlation in many of our outcomes (such as injuries) is modest. Second, health conditions of one sibling may have an impact on the other sibling. To the extent that the household is disrupted by a child's illness, we might expect both children to be negatively affected in which case our sibling comparisons will tend to underestimate the effects of health conditions.

Third, sibling fixed effects models may exacerbate the effects of measurement error. This last point highlights a strength of our analysis in that our measures of health are much more accurate than those used in previous studies, and less likely to be subject to bias due to self/parental reports, forgetting, etc. Moreover, a comparison of OLS and fixed effects estimates can shed some light on the importance of measurement error.

We estimate all of our models using linear probability models for dichotomous outcomes both for ease of interpretation, and for ease of including fixed effects.

5. Estimation Results

In order for models that include family fixed effects to be informative there must be variation within families in both the health problems children experience and the outcomes observed later in life. To explore the extent of this variation we report the average difference in each outcome for families with children who have different health measures in each age group. The results are reported in Table 3, and the mean differences for each health measure are plotted in Figures 1 to 4.

The first column of Table 3 reports the number of siblings with different health measures at each age. So, for example, there were 3177 pairs of siblings with differences in whether they were ever treated for asthma between age 0 to 3. The remaining columns report the average difference in outcomes for these pairs. In each case the difference is reported as the outcome for the child with the worse health measure minus the outcome for the child with the better health outcome.

Many of the mean differences reported in Table 3 are significantly different than zero. They are all of the anticipated sign except for the case of asthma at age 0 to 3. Although siblings with an asthma diagnosis are more likely that those without to lag behind in school and they score lower on literacy tests, they are less likely to be on welfare in young adulthood. As shown in Figure 1, sibling differences for asthma show inconsistent patterns across outcomes. Asthma in early childhood seems to have a large effect on the literacy score, with the effect on literacy declining with age.

Figure 2 shows that sibling differences in major injuries have surprisingly little effect on welfare use, but quite consistent negative effects on school outcomes which grow larger with child age. Consistent with what we will show below, Figure 3 indicates that sibling differences in externalizing mental health conditions have large effects of the anticipated sign on all our outcomes, and that these effects grow larger as children age.

Children with major conditions have consistently worse outcomes than their siblings, as shown in Figure 4. Table 3 shows that most of the mean differences are statistically significant. These effects show a variety of age patterns – the effects of major conditions on welfare use increase with age, while the effect on school progression is constant from age 4 on. The effects on college preparatory math are greatest for older children, while the mean differences for literacy follow an inverse U.

Finally, Table 3 indicates that children with congenital or perinatal problems do worse than their siblings in terms of both welfare use and the schooling measures. The estimates are generally much larger for children with medical contacts at older ages, which probably reflects selection: Only the most serious congenital or perinatal problems require follow up at older ages.

We next turn to estimation of models of the effects of birth weight which show that we can replicate the results of earlier studies that focused exclusively on this measure. We will then use these estimates as a baseline to see how the inclusion of health measured at later ages changes inferences about the about the effect of birth weight.

The first panel of Table 4 presents Ordinary Least Squares estimates of the effects of birth weight. These models include all of the controls listed in Appendix Table 1. The estimates suggest that lower birth weight has negative effects on all of our outcomes. Moreover,

the effects are monotonic: The lower the birth weight of the surviving infant, the more likely the young adult is to be on social assistance, the less likely they are to have been in grade 12 by age 17, the lower the probability that they take college preparatory math, and the lower their literacy score.

The second panel shows that including mother fixed effects (so that lower birth weight siblings are compared to their own siblings of higher birth weight) reduces, but does not entirely eliminate these effects. It becomes difficult to identify the effects of birth weight less than 1000 grams, probably because there are relatively few surviving children in this birth weight category, though birth weight in this category is estimated to have large negative effects on the probability of being in grade 12 by age 17 and on the literacy score.

For welfare use and grade 12 by age 17, there are however significant effects of birth weight between 1000 and 1500 grams which are larger in absolute value that the effects of birth weight between 1500 and 2500 grams. These estimates suggest that children of lower birth weight are indeed more likely to end up on welfare, and are less likely to have reached grade 12 by age 17. The estimated effects on literacy scores are monotonic, and suggest increasing scores with birth weight. The contrast between the two panels of Table 4 shows the importance of adequately controlling for family background when examining the effects of ill health.

Table 5 shows estimates of a model similar to (6) except that we include only measures of health at 0 to 3. There has been a good deal of popular discussion of the idea that the earliest ages are a uniquely vulnerable period, so it is of interest to see if health conditions at these ages have long term effects. On the other hand, it must be kept in mind that some conditions such as ADHD, may be very difficult to diagnose at this age.

When we control for all of these health conditions (in contrast to Table 3) we find no significant effects for asthma in either OLS or fixed effects models. Major injuries are highly significant in OLS, but controlling for sibling fixed effects eliminates most of these effects though there is still a significant negative effect on grade 12 by age 17.

OLS estimates of ADHD/conduct disorder show large point estimates, but also large standard errors with the result that they are not always statistically significant. The sibling fixed effects models indicate much stronger effects which are significant for every outcome except college preparatory math. The fact that the estimates rise when fixed effects are included suggests that these estimates are not driven by measurement error. The estimates indicate that children with an early diagnosis of one of these conditions are 1.6 percentage points more likely to end up on welfare immediately after becoming eligible (on a baseline of 5.5%). They are also 4.4% less likely to be in grade 12 by age 17, and obtain scores that are .06 of a standard deviation less on the literacy test.

Finally, the number of major conditions has a strong effect, which is significant across the board in both OLS and the sibling fixed effects models. In fact, the estimates are quite similar in the two specifications. In the fixed effects models, an additional major condition increases the probability of being on welfare by 18%. The probability of being in grade 12 by age 17 is reduced by about 1%, the probability of taking college preparatory math is reduced by 3%, and the literacy score is reduced by .15 of a standard deviation. Finally, congenital and perinatal problems are important determinants of future outcomes, with significant effects on 3 out of the 4 outcomes.

The addition of these controls reduces but does not eliminate the effect of low birth weight. Indeed, the pattern of significant effects is much the same as it was in Table 4. Hence,

on the one hand, low birth weight continues to exhibit negative effects on future outcomes net of the effects of health at early ages. On the other hand, a reduction in the magnitude of the estimated effects suggests that some of the long term effect of low birth weight comes about because low birth weight is predictive of future conditions such as ADHD or conduct disorder, and/or major health conditions.

But this observation raises the question of how much of the effect of early health conditions is due to the fact that they are predictive of later health conditions? Table 6 takes up this question by adding all but the contemporaneous health measures to the model. For the sake of brevity, we show only the sibling fixed effects models from here on.

There are some small negative effects of asthma in this table: A diagnosis at age 4 to 8 is estimated to increase the probability of welfare use, and a diagnosis at age 9 to 13 is estimated to reduce the probability of taking college preparatory math. Major injuries at 0 to 3 no longer have any significant effect, while a major injury at age 9 to 13 has a significant negative effect on all of the schooling variables: A major injury at this age is estimated to reduce the probability of being in grade 12 by age 17 or of taking college preparatory math by 2%, and to reduce the literacy test score by .035 of a standard deviation.

The estimated effects of ADHD/conduct disorder at 0 to 3 are reduced and remain significant only for the probability of being in grade 12 by 17. However, a diagnosis of this type at school entry (ages 4 to 8) has large negative effects, and a diagnosis at age 9 to 13 has effects which are even larger. The estimates suggest that a child who was seen for one of these disorders at both ages would be 6.8 percentage points more likely to be on welfare after age 18, 35% less likely to be in grade 12 by age 17, and 50% less likely to take college preparatory math,

and that these children also have scores on the literacy test that are half a standard deviation lower than others on average.

The addition of controls for health at later ages also reduces the estimated effects of the number of major conditions from 0 to 3, though a significant effect on welfare use, and the probability of taking college preparatory math remains. The probability of welfare use appears to be impacted similarly by the number of major conditions at each age, while the number of conditions has an increasingly negative effect on the probability that a child is in grade 12 by age 17. Only major conditions at 9 to 13 are estimated to significantly impact the literacy score.

Table 7 shows estimates from a model of the form (6) which includes both childhood health conditions, and conditions for those 14 to 18. When asthma in the oldest age group is controlled, the estimated effect of asthma at 4 to 8 on welfare use, and the estimated effect of asthma from 9 to 13 on college preparatory math become slightly smaller and are significant only at the 90% level of confidence.

A major injury at age 9 to 13 remains a significant determinant of schooling outcomes, and the coefficients are little changed by the addition of a measure of major injuries at 14 to 18. Moreover, injuries at the two ages have fairly similar effects on these outcomes. ADHD/conduct disorders at school entry and at age 9 to 13 also continue to have large effects on all outcomes, even when additional diagnoses at age 14 to 18 are controlled for.

Turning to major conditions, the number of major conditions at age 0 to 3 and at age 4 to 8 continues to be a significant predictor of eventual welfare use in young adulthood. But the number of health conditions during childhood has no effect on the schooling outcomes when the number of conditions at age 14 to 18 is controlled.

The models shown in Tables 6 and 7 also included controls for birth weight categories, but the estimated coefficients were almost identical to those shown in Table 5. That is, adding additional controls for health at older ages did not alter the size or significance of the birth weight coefficients.

These estimates suggest that while childhood health conditions do affect outcomes through their effects on future health, some conditions have additional effects on outcomes independent of future health. In particular, early diagnoses of mental health conditions have strong effects independent of future diagnoses of these and other conditions, and other early major health conditions impact the probability of being on social assistance after age 18.

Finally, Table 2 suggests one additional way to look at the data, which is in terms of health trajectories. The largest single category in Table 2 is children who never have a given condition. The next largest categories are generally those children who had a condition only once. We might then compare children who have a given condition at age 0 to 3 and then recover, to those who have the same condition at a different age. Table 8 carries out this comparison. We include a dummy for having a condition only at 0-3, having it only at 4-8, having it only at 9-13, and having it only at 14-18. A fifth dummy is added for children who have a condition over multiple periods. The left out group for each condition is children who never had the condition.

The table suggests that for most physical health conditions, children who have the condition and then recover (so that there are no future contacts related to the same condition) do not suffer lingering effects. Children with major health conditions at 14 to 18 suffer severe consequences, as do children who have conditions and do not recover quickly (i.e. the condition persists across multiple periods). It is interesting that we find no effects for asthma in this

formulation, and the effects of injuries mirror those discussed above, that is, injuries at 9-13 and 14-18 appear to be important determinants of schooling outcomes. Repeated injuries are also important.

Once again, mental health proves an exception. We see that children with ADHD or conduct disorders at 4-8 suffer lingering effects even if they subsequently appear to recover. And as in Table 7, the effects only grow larger with age. They are also larger when contacts for the condition cover multiple age ranges.

6. Extensions

While the ADG system is a well established way to construct health measures from underlying ICD9/ICD10 codes, some arbitrariness in grouping diagnoses and in classifying diagnoses as major or minor is inevitable. The fact that the software was written by a third party with no vested interest in our study is a significant advantage. Still, it is tempting to try to look at a greater number of individual diagnoses.

It is especially tempting to try to break down the injury category, since it is so large. We have tried to estimate the effect of serious head injuries (skull fractures and intracranial injuries including concussion) since there is a literature positing long term effects of such injuries (Hawley et al, 2008). However, although 4 to 7% of children have such injuries in each age group, we did not find any statistically significant effects. It is possible that to do so may require larger samples.

Our findings with regard to ADHD/conduct disorders are provocative and beg the question of how other mental illnesses affect child outcomes. We have repeated our analyses with a somewhat broader measure of mental health conditions defined using all of the conditions

included in ADG 24 "Recurrent or Persistent, Stable Psychosocial conditions" the ADG category that includes both ADHD and conduct disorder. This exercise produced similar though somewhat larger estimates of the effects of mental health conditions.

Reliance on administrative data entails some limitations on our analysis. For example, we have no information about measures of socioeconomic status (SES) such as parent's income or education. SES-related gaps in maternal reports of child health status tend to grow with child age in both the United States and Canada (Case, Lubotsky and Paxson, 2002; Currie and Stabile, 2003). And poor children receive more insults to their health than richer children, including more injuries, chronic conditions and acute conditions (see for example, Newacheck, 1994; Newacheck and Halfon, 1998; Currie and Lin, 2007; Case, Lubotsky and Paxson, 2002). Hence, it would be of great interest to break down our results by SES.

We constructed a measure of socioeconomic status (SES) using income measured at the enumeration area level (an area similar to a U.S. Census tract with 400 to 700 people) from the1986 Canadian Census. We used the area in which the child's family resided as of Dec. 31, 1987 (see the data appendix for further discussion) and ranked enumeration areas by their median incomes. We then used residence in the bottom two quintiles of enumeration areas as an indicator of "lower SES" (the results were similar if we focus on residence in the lowest quintile as our measure). Other work using these data suggests that the correlation between individual-level income and median income in the enumeration area is about .44 (Roos et al, 2005).

Our outcome measures show a clear gradient by this measure which suggests that it is capturing real differences between groups. For the entire sample of siblings, 5.5% of the full sample are on social assistance compared to 9.5% of the low SES sample. The comparable

figures for reaching grade 12 by age 17 are 69% vs. 53%, while for college preparatory math and the normalized literacy score they are 21.4% vs. 14.8% and 0 vs. -.34.

When we attempt to estimate separate models for the lower SES group, some of the point estimates are higher for the low SES than for the full sample. However, the standard errors are also higher so that it is difficult to draw any firm conclusions about whether the long term effects of health conditions in childhood are greater for those of low SES from these data.

The outcomes that can be tracked are also limited by the availability of administrative data sets that can be merged to the health records. It would be very interesting to be able to measure adult earnings or employment status, but this information is currently unavailable.

6. Discussion and Conclusions

The strengths of our study include: a large sample; virtually complete coverage of the population from birth to follow-up; a long follow up period; and the use of objective health measures rather than self-reports or retrospective measures. The fact that we observe multiple children from the same family is an additional strength because sibling comparisons enable us to control statistically for many unobserved characteristics of families that could be related to health and propensity to seek care.

Large numbers of children suffer from health problems in childhood. Previous research across a number of countries has shown that there is a strong link between socioeconomic status and poor health (see Adler and Ostrove (1999), Marmot and Wilkinson (1999), and Cutler and Lleras-Muney (2006) for reviews) and that low socioeconomic status in childhood is related to poorer future adult health. But it has not been clear whether health problems in early childhood

had any effect on determinants of SES over and above their effects on future health. The paucity of data on health in early childhood has severely limited research in this area.

Our research offers several striking conclusions. First, low birth weight continues to be predictive of long term negative effects even after measures of subsequent health conditions are included in the models. Moreover, the estimates are remarkably similar to those obtained in models without such measures. The main exception is that the effects of birth weight between 1500 and 2500 grams (higher birth weight low birth weight babies) are no longer significant when future health measures are controlled. Birth weight less than 1500 grams has pronounced effects on future outcomes apart from its effects on future health.

Turning to health conditions at age 0 to 3, the measures that are most predictive of negative future outcomes are the number of "other" major conditions and whether the child has a diagnosis related to ADHD/conduct disorders. A child with two major diagnosis over this interval is predicted to be 3% more likely to end up on social assistance after age 18, 1.6% less likely to be in grade 12 by age 17, 2% less likely to take college preparatory mathematics courses in high school, and has a literacy score that is .03 of a standard deviation lower than their own sibling. A diagnosis related to ADHD or conduct disorders has a similar effect on the probability of social assistance use, but a much larger negative effect on being in grade 12 by age 17 (a 6% reduction relative to baseline) and on the literacy score (a reduction of .06 of a standard deviation).

Conditional on health at later ages the number of major conditions at 0 to 3 continues to be an important predictor of social assistance use. But its effects on schooling attainment disappear when future health measures are added to the model suggesting that many early child health conditions affect schooling attainments mainly through their effects on later health.

In contrast, the estimated effects of diagnoses related to ADHD or conduct disorders at school entry (age 4 to 8) are large and largely unaffected by controlling for later diagnoses of these or other health conditions. Children with a stable diagnosis of ADHD or conduct disorder from 4 to 18 are more than 10 percentage points more likely to end up on social assistance, more than 30 percentage points less likely to be in grade 12 by age 17, over 15 percentage points less likely to take college preparatory mathematics courses, and also have literacy scores more than a half a standard deviation lower than unaffected siblings. Major injuries sustained at ages 9 to 13 have significant effects on our measures of academic achievement, which are robust to the inclusion of health measures at age 14 to 18.

In sum, our results suggest considerable heterogeneity in the long term effects of specific early child health conditions. Birth weight less than 1500 grams has long term effects regardless of future health. Many other early health conditions affect future schooling outcomes mainly through their effects on future health, though they remain predictive of future use of social assistance programs. This may in some sense be good news in that it suggests that better treatment of medical conditions as late as high school can help some children to succeed in school.

However, mental health problems at early ages have large and robustly estimated effects on future schooling and social assistance outcomes, regardless of whether they go on to lead to mental health diagnoses at later ages. This result suggests that better screening and treatment of young children with mental health problems, and/or education geared to these children might have a significant effect on eventual schooling attainments.

Our overall conclusion is that health problems in early childhood may be significant determinants of adult socioeconomic status, even in a country like Canada where all children have access to health insurance.

References

Adler, Nancy, and Joan Ostrove. "Socioeconomic Status and Health: What we Know and What we Don't," Socioeconomic Status and Health in Industrialized Nations. Annals of the New York Academy of Sciences 896, 1999:3-15.

Almond, Douglas. "Is the 1918 Influenza Pandemic Over? Long-term Effects of In Utero Influenza Exposure in the Post-1940 U.S. Population," Journal of Political Economy, 114, August 2006: 672-712.

Almond, Douglas and Bhashkar Mazumder. "The 1918 Influenza Pandemic and Subsequent Health Outcomes: An Analysis of SIPP Data," American Economic Review: Papers and Proceedings, 95, 2005: 258-262.

Annett, R.D., E.H. Aylward, J. Lapidus, B.G. Bender, T. DuHamel. "Neurocognitive Functioning in Children with Mild and Moderate Asthma in the Childhood Asthma Management Program," Journal of Allergy and Clinical Immunology, 105 #4 (April 2000): 717-724

Baillargeon, R., Tremblay, R., Willms, J.D., "The Prevalence of Physical Aggression in Canadian Children: A Multi-Group Latent Class Analysis of Data from the First Collection Cycle (1994-1995) of the NLSCY," Human Resources Development Canada, Applied Research Branch, December 1999.

Baker, Michael, Mark Stabile and Catherine Deri. "What Do Self-Reported, Objective Measures of Health Measure?" 2004, *Journal of Human Resources*, 39(4), pp.1067-1093.

Barker, David. 1998. In utero programming of chronic disease. Clinical Science 95:115-28.

Begley, Charles, Carl Slater, Martha Engel, and Thomas Reynolds. "Avoidable Hospitalizations and Socio-Economic Status in Galveston County, Texas," Journal of Community Health, 19, 1994:377-387.

Behrman, Jere, Robert Pollak, and Paul Taubman. "Parental Preferences and Provision for Progeny," Journal of Political Economy, 90 #1, 1982: 52-73.

Behrman, Jere, Robert Pollak and Paul Taubman. "Family Resources, Family Size, and Access to Financing for College Education," Journal of Political Economy, 97 #2, 1989: 398-419.

Behrman, Jere and Mark Rosenzweig. "Returns to Birthweight," Review of Economics and Statistics, 86 #2, 2004: 586-601.

Billings, John, Lisa Zeitel, Joanne Lukomnik, Timothy Carey, Arthur Black and Laurie Newman, "Impact of Socioeconomic Status on Hospital Use in New York City," Health Affairs, 12, 1993: 162-173.

Black, Sandra E., Paul J. Devereux, and Kjells G. Salvanes. "From the cradle to the labor market? The effect of birth weight on adult outcomes," Quarterly Journal of Economics, 2007.

Bloom, Barbara and R.A. Cohen. "Summary Health Statistics for U.S. Children: National Health Interview Survey," 10 #234, 2007: 1-79.

Bonnie, R. J., C. E. Fulco, C. T. Liverman (eds.), Reducing the Burden of Injury, (Washington D.C.: Institute of Medicine) 1999.

Brooks-Gunn, Jeanne, Klebanov, Patricia, and Greg Duncan. 1996. Ethnic differences in children's intelligence test scores: role of economic deprivation, home environment, and maternal characteristics. Child Development 67:396-408.

Breslau, N., J.E. DelDotto, G.G. Brown, S. Kumar, S. Ezhuthachan, K.G. Hufnagle, and E.L. Peterson. 1994. A gradient relationship between low birth weight and IQ at age 6 years. Archives of Pediatric and Adolescent Medicine 148:377-83.

Brownell, Marni, Roos, Noralou, Fransoo, Randy, "Is the Class Half Empty? A Population Based Perspective on Socioeconomic Status and Educational Outcomes," *IRPP Choices* 12(5), October, 2006.

Case, Anne and Christina Paxson. "Stature and Status: Height, Ability, and Labor Market Outcomes," NBER Working Paper #12466, August 2006.

Case, Anne, Angela Fertig and Christina Paxson. "The lasting impact of childhood health and circumstance," Journal of Health Economics, March 2005.

Case, Anne, Darren Lubotsky and Christina Paxson. 2002. Economic status and health in childhood: the origins of the gradient. American Economic Review 92, no.5:1308-34.

Conley, Dalton and Neil Bennett. 2000. Is Biology destiny? Birth weight and life chances. American Sociological Review 65 (June): 458-67.

Cunha, F., and J.J. Heckman, "The Technology of Skill Formation," National Bureau of Economic Research Working Paper, 12840, January 2007.

Currie, Janet. "Healthy, Wealthy, and Wise? Socioeconomic Status, Poor Health in Childhood, and Human Capital Development," forthcoming in Journal of Economic Literature.

Currie, Janet and Wanchuan Lin. "Chipping Away at Health: More on the Relationship Between Income and Child Health," Health Affairs, 26 #2, Mar/Apr 2007, 331-344.

Currie, Janet and Rosemary Hyson. "Is the impact of health problems cushioned by socioeconomic status? The case of low birth weight," American Economic Review 89 #2, May, 1999: 245-250.

Currie, Janet and Enrico Moretti, "Biology as Destiny? Short and Long-Run Determinants of Intergenerational Transmission of Birth Weight," Journal of Labor Economics, April 2007.

Currie, Janet and Mark Stabile. 2003. Socioeconomic status and health: why is the relationship stronger for older children? American Economics Review 93, no. 5:1813-23.

Currie, Janet and Mark Stabile. "Child Mental Health and Human Capital Accumulation: The Case of ADHD," Journal of Health Economics, 25 #6, Nov. 2006, 1094-1118.

Currie, Janet and Mark Stabile. "Mental Health in Childhood and Human Capital," forthcoming in An Economic Perspective on the Problems of Disadvantaged Youth, Jonathon Gruber (ed.) (Chicago: University of Chicago Press for NBER), forthcoming.

Cutler, David and Adriana Lleras-Muney. "Education and Health: Evaluating Theories and Evidence," NBER Working Paper # 12352, June 2006.

Duncan, G., Dowsett, C. Claessens, A., Magnuson, K. Hustonb, A. Klebanov, P., Pagani, L. Feinstein, L. Engel, M. Brooks-Gunn, J., Sexton, H. Duckworth, K. and C. Japel "School Readiness and Later Achievement," Northwestern University Working Paper, 2006.

Elo, Irma T. and Samuel H. Preston. "Effects of Early Life Conditions on Adult Mortality: A Review," Population Index, 58, 1992: 186-212.

Fransoo, Randall. "How Helath Status at Birth and Through Childhood Affects Progress and Performance in School: A Population Based Study," Ph.D thesis, Department of Community Health Sciences, Faculty of Medicine, University of Manitoba, August 2007.

Froehlich, T.E., Bruce Lanphear, J.N. Epstein, et al. "Prevalence, Recognition, and Treatment of Attention-Deficit/Hyperactivity Disorder in a National Sample of U.S. Children," Archives of Pediatric and Adolescent Medicine, 161 #9, 2007: 857-864.

Glied, Sherry. "The Value of Reductions in Child Injury Mortality in the U.S.," in David Cutler and Ernst Berndt (eds) Medical Care Output and Productivity (Chicago: University of Chicago Press for NBER) 2001.

Gregg, Paul and Steven Machin. "Child Development and Success or Failure in the Youth Labour Market," Center for Economic Performance, London School of Economics Discussion Paper 0397, July 1998.

Gutstadt, L.B. J.W. Gillette, D.A. Mrazek, J.T. Kukuhara, J.F. LaBrecque, R.C. Strunk. "Determinants of School Performance in Children with Chronic Asthma," American Journal of Diseases in Children, 143 #4 (April 1989): 471-475.

Hawley, C.A., A.B. Ward, A.R. Magnay, J. Long. "Outcomes Following Childhood Head Injury: A Population Study," Journal of neurological Neurosurgery and Psychiatry, 75, 2004: 737-742.

Kessler, Ronald, Cindy Foster, William Saunders, and Paul Stang. "Social Consequences of Psychiatric Disorders, I: Educational Attainment," American Journal of Psychiatry, 152, 1995, 1026-32.

Lawlor, Debbie, Heather Clark, George Davey Smith, and David Leon. "Intrauterine Growth and Intelligence Within Sibling Pairs: Findings from the Aberdeen Children of the 1950s Cohort," Pediatrics, 117 #5, May 2006: 894-902.

Linnet, Karen, Kirsten Wisborg, Esben Agerbo, Niels-Jorgen Secher, Per Hove Thomsen and Tine Brink Henriksen. "Gestational Age, Birthweight and the Risk of Hyperkinetic Disorder," Archives of Disease in Childhood, June 5, 2006.

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

Marmot, Michael, and Wilkinson, Richard (eds.). 1999. *Social Determinants of Health.* Oxford, UK: Oxford University Press.

McLeod, Jane D. and Karen Kaiser. "Childhood Emotional and Behavioral Problems and Educational Attainment," American Sociological Review, 69, October 2004, 636-658.

Mustard, C., Derksen, S., Berthelot. J.M. Wolfson, M, Roos, L., and K.C. Carriere, "Socio-Economic Gradients in Mortality and the Use of Health Care Services at Different Stages in the Life Course" Manitoba Centre for Health Policy Report, December 1995.

Mustard, C., Derksen, S., Berthelot, J.M., Wolfson, M. "Assessing ecologic proxies for household income: a comparison of household and neighbourhood level income measures in the study of population health status," Health and Place 5:2 (1999) 157-171.

National Center for Injury Prevention and Control. CDC Injury Fact Book (Centers for Disease Control and Prevention: Atlanta GA) 2006.

Newacheck, Paul. "Poverty and Childhood Chronic Illness," Archives of Pediatric and Adolescent Medicine, 148 (1994): 1143-1149.

Newacheck, Paul and Neil Halfon, "Prevalence and Impact of Disabling Chronic Conditions in Childhood," American Journal of Public Health, 88 no. 4 (1988): 610-617.

Oreopoulos, Philip, Mark Stabile, Roos, L., and Walld, R., "The Short, Medium, and Long Term Effects of Poor Infant Health," forthcoming, *Journal of Human Resources*.

Powe, N.R., J. Weiner, B. Starfield, M.E. Stuart, A. Baker, D. Steinwachs. "Systemwide Performance in a Medicaid Program: Profiling the Care of Patients with Chronic Illness," medical Care, 1998, 34(8):798-810.

Reid, R.J., MacWilliam, L., Verhulst, L, Roos, N.P., Aitkinson, M. "Performance of the ACG Case-Mix System in Two Canadian Provinces" Medical Care 2001 39(1): 86-99.

Reid, R.J., Roos N.P., MacWilliam, L., Frohlich, N., Black, C., "Assessing Population Health Care Needs Using A Claims Based ACG Morbidity Measure: A Validation Exercise in the Province of Manitoba," Health Services Research 2002, 37(5): 1345-63.

Roos N.P., and C.A.Mustard, "Variation in Health and Health Care Use by Socioeconomic Status in Winnipeg, Canada: Does the System Work Well? Yes and No," Milbank Quarterly, 1997,75(1):80-111.

Roos, LL., Walld, R., Uhanova, J. and R. Bond, "Physician visits, hospitalizations, and socioeconomic status: ambulatory care sensitive conditions in a Canadian setting," Health Services Research 40:4 (August 2005), 1167-1185.

Roos LL., and JP Nicol, "A research registry: uses, development, and accuracy," J Clin Epidemiology 52:1 (1999), 39-47.

Royer, Heather. 2005. Separated at girth: estimating the long-run and intergenerational effects of birthweight using twins. Ford School of Public Policy, University of Michigan, Ann Arbor MI.

Salm, Martin and Daniel Schunk. "The Role of Childhood Health for the Intergenerational Transmission of Human Capital: Evidence from Administrative Data," University of Mannheim, May 2008.

Shaffer, D., P. Fisher, M.K. Dulcan, M. Davies, J. Piacentini et al. "The NIMH Diagnostic Interview Schedule for Children Version 2.3 (DISC-2.3): Description, acceptability, prevalence rates, and performance in the MECA Study. Methods for the Epidemiology of Child and Adolescent Mental Disorders Study," Journal of the American Academy of Child and Adolescent Psychiatry, 35, 1996, 865-877.

Smith, James P. "The Impact of Social Economic Status on Health over the Life Course," Journal of Human Resources, 42 #4, Fall 2007: 739-764.

Starfield, Barbara, S. Shapiro, J. Weiss, K. Liang, K. Ra, D. Paige, and X. Wang. 1991. Race, family income and low birth weight. American Journal of Epidemiology 134:1167-74.

The Johns Hopkins University Bloomberg School of Public Health, Health Services Research & Development Center. *The Johns Hopkins ACG® Case-Mix System Version 6.0 Release Notes.* (Editor in Chief: Jonathan P. Weiner). The Johns Hopkins University. April, 2003.

U.S. Centers for Disease Control. Preventing Chronic Diseases: Investing Wisely in Health, Preventing Dental Caries (Washington D.C.: U.S. Department of Health and Human Services) April 6, 2004.

U.S. Department of Health and Human Services. <u>Mental Health: A Report to the Surgeon General</u> (Rockville MD: U.S. Dept. Of Health and Human Services) (1999).

U.S. Environmental Protection Agency, Indoor Environments Division Office of Air and Radiation, "Asthma Facts," EPA 402-F-04-019 (2006).

Weiner, J. A. Dobson, S. Maxwell, K. Coleman, B. Starfield, G. Anderson. "Risk-Adjusted Medicare Capitation Rats Using Ambulatory and Inpatient Diagnoses," Health Care Financing Review, 1996, 17(3): 77-99.

Weiner, J. B. Starfield, R.N. Lieberman. "Johns Hopkins Ambulatory Care Groups (ACGs): A Case Mix System for UR, QA, and Capitation Adjustment," HMO Pratice, 1992, 6(1): 13-19.

Weiner, J. B. Starfield, D. Steinwachs, L Mumford. "Development and Application of a Population-Oriented Measure of Ambulatory Care Case-Mix," Medical Care, 1991, 29(5):452-72.

Table 1: Means of Health Variables at Various Ages

Diagnoses related to:	0 to 3	4 to 8	9 to 13	14 to 18
Any major condition	0.154	0.148	0.153	0.219
ADHD/Conduct disorder	0.033	0.037	0.038	0.030
Asthma	0.081	0.125	0.144	0.120
Major Injury	0.412	0.412	0.386	0.404
Congenital/Perinatal Problem	0.156	0.016	0.012	0.013
Any of the above	0.599	0.563	0.544	0.642
Number of Major diagnoses	0.208	0.228	0.216	0.335
	[0.580]	[0.691]	[0.628]	[0.806]
Maximum # major diagnoses	11	12	10	14
Number Total diagnoses major and	10.500	10.320	9.45	10.01
minor	[5.28]	[5.72]	[5.76]	[6.48]
Number of Observations	50404			

Notes: Standard deviations of continuous variables in brackets.

Table 2: Pattern of Health Conditions Across Age Groups

Age Pattern	Major Condition	ADHD/ Conduct Disorder	Asthma	Major Injury
0000	52.64	89.82	71.69	17.94
0001	12.02	1.37	4.29	7.97
0010	6.28	1.67	4.70	6.47
0011	2.99	0.70	2.46	5.00
0100	6.46	1.99	4.03	7.62
0101	1.72	0.12	0.54	4.70
0110	1.54	0.50	1.95	4.47
0111	0.97	0.51	2.26	4.59
1000	7.45	2.46	3.45	8.73
1001	2.05	0.07	0.30	4.52
1010	1.15	0.12	0.35	4.31
1011	0.6	0.06	0.30	3.85
1100	1.77	0.35	1.07	5.70
1101	0.63	0.02	0.27	4.23
1110	0.79	0.10	0.79	4.32
1111	0.93	0.13	1.55	5.58

Notes: Reported numbers are percentages. N=50404.
Patterns reflect whether the child had a diagnostic code for a particular condition in each of the age categories 0-3, 4-8, 9-13, and 14-18.
E.g. 0000 denotes have no diagnoses for any of the 4 age categories, while 0001 denotes having a diagnosis between ages 14-18 only

Table 3: Mean Differences Between Sibling Pairs with Divergent Health Measures

	# Sib pairs w diff	Diff in on SA	Diff in grade 12 by 17	Diff College Math	Diff in Literacy
Major Conditions 0-3	6103	0.011	-0.005	-0.012	-0.021
		[0.004]	[0.006]	[0.006]	[0.012]
4 to 8	5986	0.014	-0.020	-0.015	-0.035
		[0.004]	[0.006]	[0.006]	[0.012]
9 to 13	6147	0.011	-0.019	-0.009	-0.038
		[0.004]	[0.006]	[0.006]	[0.012]
14 to 18	8103	0.035	-0.020	-0.023	-0.029
		[0.003]	[0.005]	[0.005]	[0.011]
ADHD/Conduct Disorder	1438	0.011	-0.052	-0.018	-0.084
		[0.008]	[0.013]	[0.012]	[0.026]
4 to 8	1619	0.029	-0.144	-0.062	-0.322
		[.009]	[0.013]	[0.011]	[0.025]
9 to 13	1650	0.038	-0.208	-0.094	-0.463
		[0.008]	[0.013]	[0.010]	[0.024]
14 to 18	1332	0.070	-0.215	-0.117	-0.468
		[0.011]	[0.015]	[0.011]	[0.026]
Asthma 0-3	3177	-0.010	-0.016	0.005	-0.088
		[0.005]	[0.008]	[0.008]	[0.017]
4 to 8	4427	0.000	-0.004	0.003	-0.041
		[0.004]	[0.007]	[0.007]	[0.015]
9 to 13	5217	-0.005	-0.004	-0.015	-0.028
		[0.004]	[0.006]	[0.007]	[0.014]
14 to 18	4675	0.010	-0.010	-0.018	-0.017
		[0.004]	[0.007]	[0.007]	[0.014]
Major Injury 0-3	10789	0.002	-0.016	-0.005	-0.041
		[0.002]	[0.004]	[0.004]	[0.010]
4 to 8	10928	-0.003	-0.016	-0.006	-0.045
		[0.003]	[0.004]	[0.004]	[0.009]
9 to 13	10798	-0.001	-0.025	-0.021	-0.077
		[0.003]	[0.004]	[0.004]	[0.009]
14 to 18	11055	0.004	-0.033	-0.026	-0.082
		[0.003]	[0.004]	[0.004]	[0.009]
Congenital Anomalies	5868	0.004	-0.009	-0.014	-0.031
& Perinatal Problems 0-3		[0.004]	[0.006]	0.006]	[0.012]
4 to 8	755	0.033	-0.058	-0.01	-0.091
		[0.011]	[0.016]	[0.016]	[0.033]
9 to 13	585	0.042	-0.045	0.003	-0.113
		[0.012]	[0.019]	[0.018]	[0.040]
14-18	606	0.033	-0.032	-0.01	-0.093
		[0.013]	[0.018]	[0.017]	[0.039]
Mean of Outcome:		0.055	0.691	0.214	-0.014

Notes: Standard Errors in brackets. Table shows the average over the differences between sibs with a health condition and sibs without a health condition, for all sibling pairs where there is a difference in the specified health condition.

Table 4: Effects of Birth Weight on Future Outcomes

	On Social Assistance	Grade 12 by 17	College Math	Literacy Score
Ordinary Least Squares Estimates				
Birth weight<=1000 grams	0.095	-0.268	-0.148	-0.334
	[0.037]	[0.067]	[0.066]	[0.148]
1000<Birth weight<=1500	0.064	-0.063	-0.062	-0.171
	[0.017]	[0.031]	[0.031]	[0.069]
1500<Birth weight<=2500	0.025	-0.061	-0.028	-0.118
	[0.05]	[0.009]	[0.009]	[0.020]
2500<Birth weight<=3500	0.005	-0.019	-0.016	-0.054
	[0.002]	[0.004]	[0.004]	[0.008]
R-squared	0.075	0.237	0.079	0.232
Sibling Fixed Effects Estimates				
Birth weight<=1000 grams	-0.001	-0.280	-0.125	-0.395
	[0.047]	[0.079]	[0.080]	[0.166]
1000<Birth weight<=1500	0.055	-0.074	0.019	-0.068
	[0.023]	[0.038]	[0.039]	[0.080]
1500<Birth weight<=2500	0.016	-0.052	-0.015	-0.039
	[0.007]	[0.012]	[0.012]	[0.025]
2500<Birth weight<=3500	0.000	-0.018	-0.015	-0.022
	[0.003]	[0.005]	[0.012]	[0.010]
R-squared	0.609	0.731	0.648	0.752
Mean of Outcome:	0.055	0.691	0.214	-0.014
# Observations	50404			

Notes: Models include all of the controls listed in Appendix Table 1. Standard errors in brackets.

Table 5: Sibling Fixed Effects Regressions of Outcomes on Early Health Conditions

	On Social Assistance	Grade 12 by Age 17	College Math	Literacy Score
Ordinary Least Squares Estimates				
# Major Conditions 0-3	0.014	-0.012	-0.006	-0.020
	[0.001]	[0.003]	[0.002]	[0.005]
ADHD/Conduct 0-3	0.030	-0.015	-0.018	-0.032
	[0.005]	[0.010]	[0.010]	[0.022]
Asthma 0-3	-0.001	0.001	0.004	-0.018
	[0.004]	[0.007]	[0.006]	[0.014]
Major Injury 0-3	0.017	-0.015	-0.016	-0.037
	[0.002]	[0.004]	[0.004]	[0.008]
Birth weight<=1000 grams	0.060	-0.220	-0.118	-0.250
	[0.037]	[0.068]	[0.066]	[0.149]
1000<Birth weight<=1500	0.037	-0.022	-0.036	-0.101
	[0.017]	[0.032]	[0.031]	[0.070]
1500<Birth weight<=2500	0.018	-0.045	-0.018	-0.092
	[0.05]	[0.009]	[0.009]	[0.020]
2500<Birth weight<=3500	0.005	-0.019	-0.016	-0.053
	[0.002]	[0.004]	[0.004]	[0.008]
R-squared	0.079	0.239	0.080	0.233
Sibling Fixed Effects Estimates				
# Major Conditions 0-3	0.010	-0.006	-0.007	-0.015
	[0.002]	[0.003]	[0.003]	[0.006]
ADHD/Conduct 0-3	0.016	-0.044	-0.011	-0.058
	[0.007]	[0.012]	[0.012]	[0.025]
Asthma 0-3	-0.004	-0.003	0.005	-0.019
	[0.005]	[0.008]	[0.008]	[0.017]
Major Injury 0-3	0.004	-0.008	-0.002	-0.010
	[0.003]	[0.004]	[0.004]	[0.009]
Birth weight<=1000 grams	-0.026	-0.263	-0.099	-0.348
	[0.047]	[0.079]	[0.080]	[0.167]
1000<Birth weight<=1500	0.038	-0.061	0.038	-0.035
	[0.023]	[0.038]	[0.039]	[0.081]
1500<Birth weight<=2500	0.011	-0.046	-0.007	-0.025
	[0.007]	[0.012]	[0.012]	[0.025]
2500<Birth weight<=3500	-0.001	-0.018	-0.007	-0.021
	[0.003]	[0.005]	[0.005]	[0.010]
# Congenital/Perinatal 0-3	0.004	-0.006	-0.011	-0.015
	[0.002]	[0.004]	[0.004]	[0.007]
R-squared	0.609	0.731	0.648	0.752
Mean of Outcome:	0.055	0.691	0.214	-0.014
# fixed effects	22692			
# Obs.	50404			

Notes: Standard errors in brackets. Models also control for mother fixed effects and the control variables listed in Appendix Table 1.

Table 6: Sibling Fixed Effects Regressions of Outcomes on all Childhood Health Conditions

	On Social Assistance	Grade 12 by Age 17	College Math	Literacy Score
# Major Conditions 0-3	0.007	-0.002	-0.005	-0.006
	[0.002]	[0.003]	[0.003]	[0.006]
# Major Conditions 4-8	0.006	-0.006	-0.004	-0.009
	[0.002]	[0.003]	[0.003]	[0.007]
# Major Conditions 9-13	0.006	-0.008	-0.005	-0.015
	[0.002]	[0.003]	[0.004]	[0.007]
ADHD/Conduct 0-3	0.012	-0.031	-0.005	-0.032
	[0.007]	[0.012]	[0.012]	[0.025]
ADHD/Conduct 4-8	0.026	-0.081	-0.030	-0.166
	[0.007]	[0.011]	[0.012]	[0.024]
ADHD/Conduct 9-13	0.042	-0.161	-0.076	-0.314
	[0.007]	[0.011]	[0.011]	[0.024]
Asthma 0-3	-0.005	-0.004	0.007	-0.022
	[0.005]	[0.008]	[0.008]	[0.017]
Asthma 4-8	0.008	0.005	0.006	0.014
	[0.004]	[0.007]	[0.007]	[0.015]
Asthma 9-13	-0.004	0.004	-0.017	0.001
	[0.004]	[0.006]	[0.006]	[0.014]
Major Injury 0-3	0.004	-0.006	-0.002	-0.006
	[0.002]	[0.004]	[0.004]	[0.009]
Major Injury 4-8	0.001	-0.003	-0.002	0.000
	[0.002]	[0.004]	[0.004]	[0.009]
Major Injury 9-13	0.002	-0.012	-0.014	-0.035
	[0.003]	[0.004]	[0.004]	[0.009]
R-squared	0.611	0.734	0.649	0.755
Mean of Outcome:	0.055	0.691	0.214	-0.014
# fixed effects	22692			
# Obs.	50404			

Notes: Standard errors in brackets. Models also control for mother fixed effects and the birth weight categories, diagnoses related to congenital and perinatal problems at each age and the other control variables listed in Appendix Table 1.

Table 7: Sibling Fixed Effects Regressions of Outcomes on Childhood Health Conditions Conditional on Current Health

	On Social Assistance	Grade 12 by Age 17	College Math	Literacy Score
# Major Conditions 0-3	0.006	-0.001	-0.004	-0.004
	[.002]	[0.003]	[0.003]	[0.006]
# Major Conditions 4-8	0.005	-0.005	-0.004	-0.009
	[.002]	[0.003]	[0.003]	[0.007]
# Major Conditions 9-13	0.000	-0.004	0.001	-0.005
	[.002]	[0.004]	[0.004]	[0.008]
# Major Conditions 14-18	0.017	-0.012	-0.010	-0.025
	[.002]	[0.003]	[0.003]	[0.006]
ADHD/Conduct 0-3	0.010	-0.028	-0.002	-0.025
	[.007]	[0.012]	[0.012]	[0.024]
ADHD/Conduct 4-8	0.021	-0.071	-0.024	-0.145
	[0.007]	[0.011]	[0.012]	[0.024]
ADHD/Conduct 9-13	0.024	-0.121	-0.053	-0.234
	[0.007]	[0.012]	[0.012]	[0.025]
ADHD/Conduct 14-18	0.060	-0.132	-0.075	-0.268
	[0.008]	[0.013]	[0.013]	[0.027]
Asthma 0-3	-0.005	-0.004	0.007	-0.021
	[.005]	[0.008]	[0.008]	[0.017]
Asthma 4-8	0.007	0.007	0.007	0.018
	[0.004]	[0.007]	[0.007]	[0.015]
Asthma 9-13	-0.007	0.008	-0.013	0.011
	[0.004]	[0.007]	[0.007]	[0.014]
Asthma 14-18	0.008	-0.012	-0.011	-0.028
	[0.004]	[0.007]	[0.007]	[0.015]
Major Injury 0-3	0.004	-0.006	-0.002	-0.006
	[0.002]	[0.004]	[0.004]	[0.009]
Major Injury 4-8	0.000	-0.002	-0.001	0.002
	[0.002]	[0.004]	[0.004]	[0.009]
Major Injury 9-13	0.001	-0.011	-0.013	-0.033
	[0.003]	[0.004]	[0.004]	[0.009]
Major Injury 14-18	0.005	-0.015	-0.018	-0.027
	[0.002]	[0.004]	[.004]	[0.009]
R-squared	0.614	0.736	0.650	0.756
Mean of Outcome:	0.055	0.691	0.214	-0.014
# fixed effects	22692			
# Obs.	50404			

Notes: Standard errors in brackets. Models also control for mother fixed effects and the birth weight categories, diagnoses related to congenital and perinatal problems at each age and the other control variables listed in Appendix Table 1.

Table 8: Effects of Health Trajectories on Outcomes

	On Social Assistance	Grade 12 by Age 17	College Math	Literacy Score
# Major Conditions, only 0-3	0.002	0.000	-0.006	-0.010
	[0.005]	[0.008]	[0.008]	[0.016]
only 4-8	-0.001	0.001	-0.008	-0.004
	[0.005]	[0.008]	[0.008]	[0.025]
only 9-13	0.000	-0.004	-0.001	-0.009
	[0.005]	[0.008]	[0.008]	[0.017]
only 14-18	0.031	-0.021	-0.018	-0.042
	[0.004]	[0.006]	[0.006]	[0.013]
multiple periods	0.022	-0.022	-0.020	-0.053
	[0.004]	[0.006]	[0.006]	[0.013]
ADHD/Conduct, only 0-3	0.008	-0.041	-0.003	-0.039
	[0.008]	[0.013]	[0.013]	[0.027]
only 4-8	0.010	-0.084	-0.027	-0.161
	[0.009]	[0.014]	[0.015]	[0.030]
only 9-13	0.027	-0.144	-0.072	-0.303
	[0.009]	[0.015]	[0.016]	[0.033]
only 14-18	0.057	-0.180	-0.106	-0.369
	[0.010]	[0.017]	[0.017]	[0.036]
multiple periods	0.082	-0.213	-0.100	-0.424
	[0.008]	[0.013]	[0.013]	[0.028]
Asthma, only 0-3	-0.010	-0.002	0.012	-0.023
	[0.007]	[0.011]	[0.011]	[0.023]
only 4-8	-0.001	0.007	0.007	0.016
	[0.006]	[0.010]	[0.011]	[0.022]
only 9-13	-0.003	0.013	-0.011	0.026
	[0.006]	[0.009]	[0.010]	[0.020]
only 14-18	0.009	-0.020	-0.001	-0.024
	[0.006]	[0.010]	[0.010]	[0.020]
multiple periods	0.004	-0.001	-0.011	-0.015
	[0.004]	[0.007]	[0.007]	[0.015]
Major Injury, only 0-3	0.002	-0.012	-0.010	-0.021
	[0.005]	[0.008]	[0.008]	[0.017]
only 4-8	-0.003	0.000	0.006	0.031
	[0.005]	[0.008]	[0.008]	[0.018]
only 9-13	0.002	-0.004	0.000	-0.012
	[0.005]	[0.009]	[0.009]	[0.019]
only 14-18	0.006	-0.010	-0.020	-0.028
	[0.005]	[0.008]	[0.008]	[0.017]
multiple periods	0.006	-0.018	-0.022	-0.041
	[0.004]	[0.006]	[0.001]	[0.012]
R-squared	0.613	0.735	0.65	0.756
# fixed effects	22692			
# Obs.	50404			

Notes: Standard errors in brackets. Models also control for mother fixed effects and the birth weight categories, diagnoses related to congenital and perinatal problems at each age and the other control variables listed in Appendix Table 1.