Child Health and Young Adult Outcomes

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Motivation

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:

1. How poor child health *after birth* affects long-term outcomes?
2. Whether health at birth matters primarily because it predicts future health or through some other mechanism?
3. 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 from the Canadian province of Manitoba's public health insurance system. We follow 50,000 children born in the Canadian province of Manitoba between 1979 and 1987, until 2006.

- The data combines health information from birth records, hospital records, and outpatient visits with information from other provincial registers about educational and young adult socio-economic outcomes including: grade 12 standardized language arts and math achievement, on time high school completion, and social assistance participation (welfare).

- This health and outcome information is much more complete, and in many ways more accurate, than what is typically available in survey data.

- The Canadian data is also useful because it sheds light on the consequences of disparities in health in a setting that abstracts from differences in access to insurance coverage.

Our results show that:

- Many physical health problems in early life are predictive of future adult outcomes.
- This is largely because poor health in childhood predicts poor health in young adulthood.
- Short term physical health events generally have little long-term impact.
- In contrast, even one-time diagnoses of mental health problems are significant predictors of poor outcomes.

In sum, poor health in childhood may be a significant source of socioeconomic disparity in adulthood.

Background

- Much recent literature links health at birth to future outcomes (Black, Devereux, Salvanes (2005), Currie (1999), Currie and Moretti (2007), Oreopolous, Stabile, and Roos (2005), Royer (2005)).

But few studies look at health after birth.

- Smith (2007) investigates the relationship between child health and future outcomes using data from the 1999 Panel Study of Income Dynamics. 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 comparisons, Smith finds significant negative effects of poor overall health status in childhood on earnings.
- Case, Fertig, and Paxson (2007) show that chronic disease in early childhood is related to inferior future outcomes in the 1958 British Birth Cohort.
- Case and Paxson (2006) show that adult height (a proxy for child health) affects cognition.

Our study improves on previous work by:

- by using continuous and objectively reported health measures
- in addition to sibling comparisons (which are not possible in the 1958 cohort study).

The literature suggests that some classes of child health problems are likely to be of particular importance:

1) Mental Health: The MECA Study (Methodology for Epidemiology of Mental Disorders in Children and Adolescents) cited in the 1999 U.S. Surgeon General's Report on Mental Health finds that 1 in 5 children exhibit some impairment from a mental or behavioral disorders, 11% have significant functional impairments, and 5% suffer extreme functional impairment.

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, and that the effects are quite similar in Canada and the U.S. Duncan et al. (2006) report similar results.

2) 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).

3) 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).

4) There are many other serious health problems that can afflict children, but even in a data set of 50,000 children, there are few cases of cancer, blindness, and so on. Hence, we will aggregate these remaining conditions together in order to create a measure of other serious health conditions.

Data

- Main source = records routinely collected through the administration of Manitoba's public health insurance system, including 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 tracks 99 percent of the original sample conditional on remaining in the province until June of their 18^{th} year.

- 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).

Measuring Health:

- Medical providers indicate diagnoses using International Classification of Disease codes. There are over 14,000 codes, so many potential measures of health.

- In order to collapse the number of 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 software groups 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 had any diagnosis with any of the ICD codes in the group in either an outpatient or hospital visit over the past year. The measure does not depend on the number or type of visit.

- A person can have from zero to 32 ADGs, and major injuries and asthma clearly correspond to either unique ADGs or small clusters of ADGs. We code ADHD and conduct disorders using ICD codes. Both are included in a broader ADG24.

Our Measures

We use the ADG codes to construct 5 health measures four 4 age categories (0-3, 4-8, 9-13, 14-18).

1. Indicator for whether a child had a mental health diagnosis.

2. Indicator for whether a child had a major injury.

3. Indicator for whether a child had asthma.

4. "# of Other Major ADGs". We use the Johns Hopkins classification of major.

Appendix Table 2: Top 10 ICD9 Codes for Children with Other Major Conditions,
by Age Group

	0-3 Year Olds (Total Number of Diagnoses=10061)		
ICD9	Description of condition	#Cases	%Cases
378	Strabismus, Other disorder binocular eye	1647	15.57
373	Inflammation of eyelids	1219	12.12
389	Hearing Loss	1060	10.54
579	Intestinal malabsorption	454	4.51
530	Diseases of esophagus	341	3.39
385	Other disorder middle ear and mastoid	233	2.32
560	Intestinal obstruction w/o hernia	232	2.31
518	Other diseases of lung	194	1.47
514	Pulmonary congestion - hypostasis	142	1.41
707	Chronic ulcers of skin	142	1.43
	4-8 Year Olds (Total Number of Diagnoses=9429)		
389	Hearing loss	2334	24.75
378	Strabismus, other disorder binocular eye	1323	14.03
373	Inflammation of eyelids	1216	12.90
385	Other disorder middle ear and mastoid	266	2.82
541	Acute appendicitis	217	2.30
540	Appendicitis, unqualified	182	1.93
707	Chronic ulcer of skin	146	1.55
259	Other endocrine disorder	117	1.24
540.9	Acute appendicitis w/o peritonitis	115	1.22
448	Disease of capillaries	112	1.19
	9-13 year olds (Total Number of Diagnoses= 10084)		
373	Inflammation of eyelids	1431	14.09
389	Hearing loss	872	8.65
378	Strabismus, other disorder binocular eye	791	7.84
717	Internal derangement of knee	736	7.30
540	Acute appendicitis	476	4.72
718	Other derangement of joint	430	4.26
541	Appendicitis, unqualified	338	3.35
5409	Acute appendicitis w/o peritonitis	279	2.77
259	Other endocrine disorders	265	2.63
905	Late effect musculoskeletal & connective tissue injury	186	1.84
	14-18 year olds (Total Number of Diagnoses=16646)		
717	Internal derangement of knee	1557	9.35

373	Inflammation of eyelids	1548	9.30
718	Other derangement of joint	839	5.04
296	Affective psychoses	776	4.66
530	Diseases of esophagus	639	3.84
540	Acute appendicitis	535	3.21
389	Hearing loss	486	2.92
541	Appendicitis, unqualified	421	2.53
303	Alcohol dependence syndrome	393	2.36
370	Keratitis	356	2.14

Appendix Table 3: Top 10 ICD9 Codes for Children with Major Injuries, by Age Group

	0-3 Year Olds (Total Number of Diagnoses=31583)		
ICD9	Description of condition	#Cases	%Cases
873	Other open wound of head	8483	26.86
995	Certain adverse effects, not elsewhere classified	3184	10.08
854	Intracranial injury other unspecified nature	2814	8.91
883	Open wound of finger(s)	1478	4.68
977	Poison-other/unspecified drugs/medicinal	1134	3.59
879	Open wound other unspecified site except limbs	936	2.96
892	Open wound foot except toe(s) alone	799	2.53
850	Concussion	659	2.09
882	Open wound of hand except finger(s)	575	1.82
360	Disorders of the globe-eye, adnexa	535	1.69
	4-8 Year Olds (Total Number of Diagnoses= 31508)		
873	Other open wound of head	8103	25.72
995	Certain adverse effects, not elsewhere classified	3199	10.15
854	Intracranial injury other unspecified nature	1886	5.99
892	Open wound foot except toe(s) alone	1639	5.20
883	Open wound of finger(s)	1580	5.01
891	Open wound knee, lower leg and ankle	1315	4.17
879	Open wound other unspecified site except limbs	1213	3.85
882	Open wound of hand except finger(s)	868	2.75
930	Foreign body on external eye	6.43	2.04
850	Concussion	653	2.07
	9-13 year olds (Total Number of Diagnoses=30384)		
873	Other open wound of head	3419	11.25
995	Certain adverse effects, not elsewhere classified	2642	8.70
844	Sprains and strains of knee and leg	1978	6.51
883	Open wound of finger(s)	1875	6.17
891	Open wound knee, lower leg and ankle	1861	6.12
892	Open wound foot except toe(s) alone	1311	4.31
854	Intracranial injury other unspecified nature	1208	3.98
814	Fracture of carpal bones	1106	3.64
815	Fracture of metacarpal bones	1014	3.34
882	Open wound of hand except finger(s)	977	3.22
	14-18 year olds (Total Number of Diagnoses=35232)		
844	Sprains and strains of knee and leg	2915	8.27

995	Certain adverse effects, not elsewhere classified	2721	7.72
873	Other open wound of head	2708	7.69
883	Open wound of finger(s)	2513	7.13
882	Open wound of hand except finger(s)	1452	4.12
815	Fracture of metacarpal bones	1335	3.79
850	Concussion	1145	3.25
814	Fracture of carpal bones	915	2.60
891	Open wound knee, lower leg and ankle	907	2.57
824	Fracture of ankle	891	2.53

of Major ADGs and Incidence of Major Health Problems, by Age

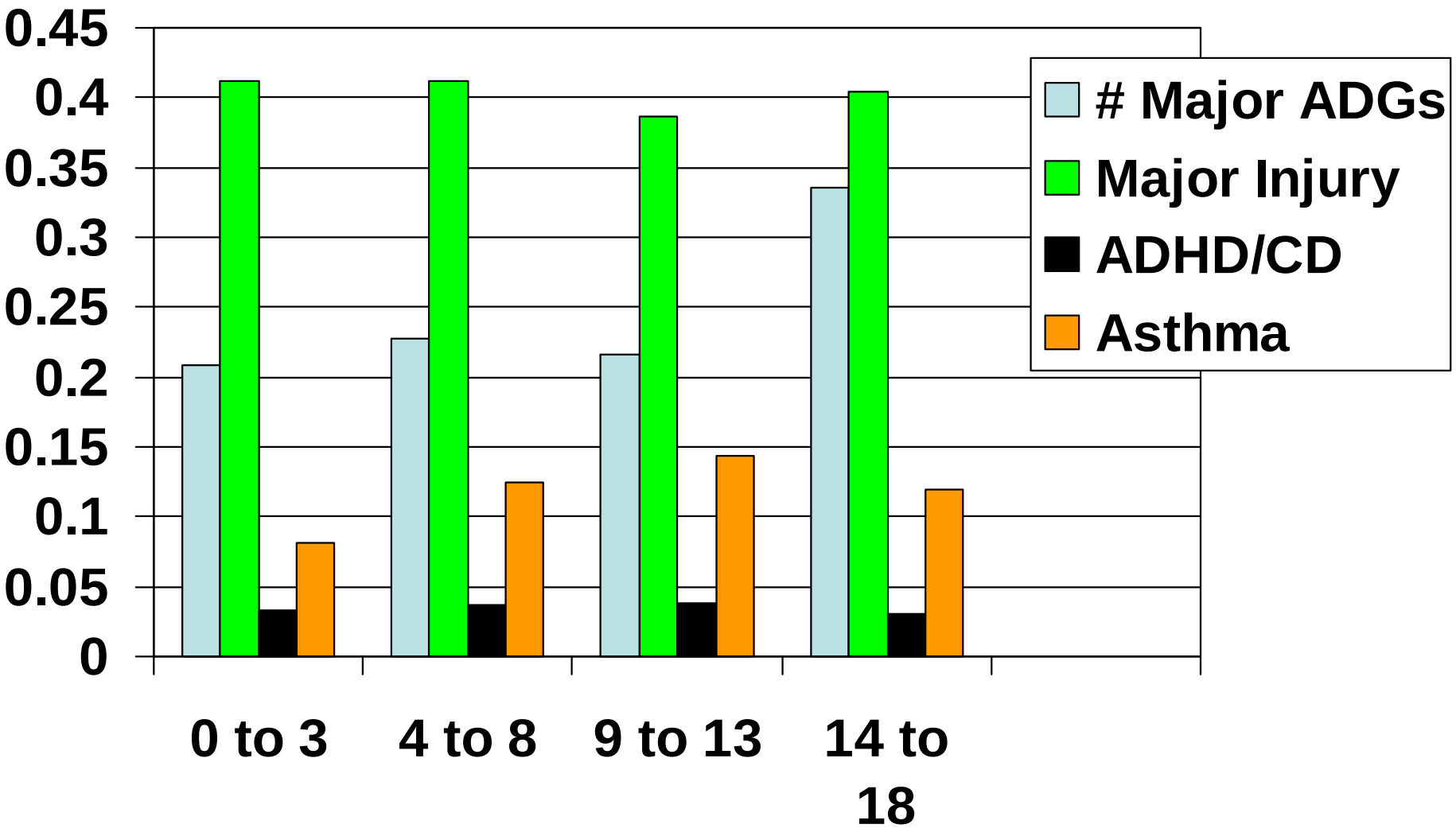


Table 1: Means of Health Variables at Various Ages

Diagnoses related to:	**0 to 3**	**4 to 8**	**9 to 13**	**14 to 18**
Asthma	0.081	0.125	0.144	0.120
Major Injury	0.412	0.412	0.386	0.404
ADHD/Conduct disorder	0.033	0.037	0.038	0.030
Congenital/Perinatal Problem	0.156	0.016	0.012	0.013
Any other major condition	0.154	0.148	0.153	0.219
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 minor	10.500	10.320	9.45	10.01
	[5.28]	[5.72]	[5.76]	[6.48]
Number of Observations	50404			

Notes: Standard deviations of continuous variables in brackets.

How Do We Interpret these Measures?

Even with universal health insurance, high SES families are more likely to seek care than low SES families. However, we look at serious conditions, and whether they received any care in a 4 year window. Moreover, our results are not dependent on the number of visits, just whether they had any visit. It seems likely that with free care, most children with a serious condition will see a doctor at least once in a 4 year period.

Hence we interpret our indicators as measures of whether or not a child had a particular condition in a given age range.

The condition is not necessarily a new condition, but the emergence of new conditions, and the amelioration of old conditions can be captured. (e.g. 0,0,1,1 differs from 1,1,0,0).

The last set of measures (14-18) are roughly contemporaneous with our outcome variables, so we interpret these as a measure of health status at the time of the outcomes.

Table 2: Pattern of Health Conditions Across Age Groups

Age Pattern	Asthma	Major Injury	ADHD/ Conduct Disorder	Congenital Perinatal	Other Major Condition
0000	71.69	17.94	89.82	82.65	52.64
0001	4.29	7.97	1.37	0.56	12.02
0010	4.70	6.47	1.67	0.44	6.28
0011	2.46	5.00	0.70	0.07	2.99
0100	4.03	7.62	1.99	0.6	6.46
0101	0.54	4.70	0.12	0.04	1.72
0110	1.95	4.47	0.50	0.05	1.54
0111	2.26	4.59	0.51	0.03	0.97
1000	3.45	8.73	2.46	14.41	7.45
1001	0.30	4.52	0.07	0.13	2.05
1010	0.35	4.31	0.12	0.14	1.15
1011	0.30	3.85	0.06	0.04	0.6
1100	1.07	5.70	0.35	0.35	1.77
1101	0.27	4.23	0.02	0.07	0.63
1110	0.79	4.32	0.10	0.12	0.79
1111	1.55	5.58	0.13	0.32	0.93

Notes: Reported numbers are percentages. N=50404.

Though there is a good deal of variation from period to period (i.e. children do get well), these patterns also imply considerable state dependence:

e.g. for injuries, a child who was injured last period has a 50/50 chance of being injured this period, whereas for a child who was not injured, the probability is 30-40%.

A child who had an ADHD diagnosis at time 1 and time 2 has a 30-40% probability of having a diagnosis in time 3, whereas the if they had no diagnosis at time 2, the probability is only 2-6%.

Hence, early diagnosis may be predictive of future outcomes because they predict future health problems.

Outcomes:

1. On social assistance after age 18. We follow all sample members for 70 weeks after their 18^{th} birthday (mean is 5.5%).
2. In grade 12 by age 17 (mean is 69%).
3. Took college-preparatory math courses in high school (mean is 21.4%).
4. Standardized score on a literacy test administered in grade 12 (mean 0, std. 1).

Conceptual Model

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

(1) $Y_t = aH_t^{\alpha}C_t^{\beta}$
(2) $\log C_t = b_0 + b_1 \log C_{t-1} + b_2 \log H_{t-1}$
(3) $\log H_t = \gamma \log H_{t-1} + u_t$

where Y_t is one of the outcomes of interest, H_t is contemporaneous health, and C_t is contemporaneous cognitive ability. We assume that outcomes are produced using inputs of health and cognitive ability, that cognitive ability depends on ability last period (so it is cumulative) and also on health last period. Finally, health depends on health last period, and is subject to random shocks, u_t.

Taking logs and solving the model recursively yields an equation of the form:

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

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

$\delta_3 = \alpha$

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

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

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

Some interesting special cases:

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

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

3. $\alpha = \beta = .5$; $b_1 = 1.5$; $b_2 = .2$; $\gamma = .7$. In this case $\delta_3 = .5$, $\delta_4 = .45$, $\delta_5 = .47$, $\delta_6 = .56$, so it is the health shocks in the first year of life, and the contemporaneous health shocks that matter most. In other words, the pattern of coefficients is U-shaped.

Econometric Approach

The question we wish to address is: What is the impact of poor health in childhood on young adult health, educational and labor market outcomes?

We include measures of health at birth to proxy for endowments, and augment (4) by adding a vector of controls, X:

(5) $Y_{14\text{-}18} = \delta + \delta_1 X + \delta_2 HEALTH_{Birth} + \delta_3 u_{14\text{-}18} + \delta_4 u_{9\text{-}13} + \delta_5 u_{4\text{-}8} + \delta_6 u_{0\text{-}3} + e.$

X includes marital status, sex of the child, and mother's age at birth, and dummy variables for birth order of the child, and year of birth indicators.

Because there may be omitted variables that are correlated with health shocks and also with outcomes, we also include a fixed effect for each mother in the data:

(6) $Y_{14\text{-}18} = \delta + \delta_1 X + \delta_2 HEALTH_{Birth} + \delta_3 u_{14\text{-}18} + \delta_4 u_{9\text{-}13} + \delta_5 u_{4\text{-}8} + \delta_6 u_{0\text{-}3} + MOM\_FE + e,$

The inclusion of mother fixed effects will help us to control for unobserved variables such as the family's propensity to use medical care and the home environment.

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
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]
14-18	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]
14-18	11055	0.004	-0.033	-0.026	-0.082
		[0.003]	[0.004]	[0.004]	[0.009]
ADHD/Conduct Dis.	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]
14-18	1332	0.070	-0.215	-0.117	-0.468
		[0.011]	[0.015]	[0.011]	[0.026]

	# Sib pairs w diff	Diff in on SA	Diff in grade 12 by 17	Diff College Math	Diff in Literacy
Other Major Condition	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]
14-18	8103	0.035	-0.020	-0.023	-0.029
		[0.003]	[0.005]	[0.005]	[0.011]
Congenital Anomalies & Perinatal Problems 0-3	5868	0.004	-0.009	-0.014	-0.031
		[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: Regressions of Outcomes on Health Problems at Age 0-3, Birth Weight, and and Congenital or Perinatal Problems.

	On Social Assistance	Grade 12 by Age 17	College Math	Literacy Score
# Major Conditions, Age 0-3	0.010**	-0.006**	-0.007**	-0.015**
	[0.002]	[0.003]	[0.003]	[0.006]
ADHD/Conduct, Age 0-3	0.016**	-0.044**	-0.011	-0.058**
	[0.007]	[0.012]	[0.012]	[0.025]
Asthma, Age 0-3	-0.004	-0.003	0.005	-0.019
	[0.005]	[0.008]	[0.008]	[0.017]
Major Injury, Age 0-3	0.004	-0.008**	-0.002	-0.01
	[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	0.004	-0.006	-0.011**	-0.015**
0-3	[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. Each column reports the results of a regression (or linear probability model) for the outcome listed in that column. On Social Assistance, Reaching Grade 12 by Age 1, and Taking College Math are 0/1 variables. The literacy score is normalized (0,1). In addition to the controls listed, all regressions also include mother fixed effects and controls for marital status, sex of the child, mother's age at birth, dummy variables for birth order of the child, family size, and year of birth indicators. * denotes statistical significance at the 10% level. ** denotes significance at the 5% level.

How Large are These Effects?

- children with an early diagnosis of ADHD/conduct disorder are 1.6 pp more likely to end up on welfare (baseline=5.5%) and 4.4% less likely to be in grade 12 by age 17.
- An additional major condition increases the probability of being on welfare by 18%, reduces the probability of being in grade 12 by age 17 by 1%, reduces the probability of taking college prep. Math by 3%, and reduces the literacy score by .15 of a standard deviation.
- No effect of asthma at 0-3.
- Major injury only significant in regressions for in grade 12 by 17.

How much of the effect of health at 0-3 comes through effects on later health?

Table 5: Regressions of Outcomes on Childhood Health Conditions at Various Ages

	On Social Assistance	Grade 12 by Age 17	College Math	Literacy Score
# Major Conditions, Age 0-3	0.006**	-0.001	-0.004	-0.004
	[.002]	[0.003]	[0.003]	[0.006]
# Major Conditions, Age 4-8	0.005**	-0.005	-0.004	-0.009
	[.002]	[0.003]	[0.003]	[0.007]
# Major Conditions, Age 9-13	0.000	-0.004	0.001	-0.005
	[.002]	[0.004]	[0.004]	[0.008]
# Major Conditions, Age 14-18	0.017**	-0.012**	-0.010**	-0.025**
	[.002]	[0.003]	[0.003]	[0.006]
ADHD/Conduct, Age 0-3	0.010	-0.028**	-0.002	-0.025
	[.007]	[0.012]	[0.012]	[0.024]
ADHD/Conduct, Age 4-8	0.021**	-0.071**	-0.024**	-0.145**
	[0.007]	[0.011]	[0.012]	[0.024]
ADHD/Conduct, Age 9-13	0.024**	-0.121**	-0.053**	-0.234**
	[0.007]	[0.012]	[0.012]	[0.025]
ADHD/Conduct, Age 14-18	0.060**	-0.132**	-0.075**	-0.268**
	[0.008]	[0.013]	[0.013]	[0.027]
Asthma, Age 0-3	-0.005	-0.004	0.007	-0.021
	[.005]	[0.008]	[0.008]	[0.017]
Asthma, Age 4-8	0.007*	0.007	0.007	0.018
	[0.004]	[0.007]	[0.007]	[0.015]
Asthma, Age 9-13	-0.007*	0.008	-0.013*	0.011
	[0.004]	[0.007]	[0.007]	[0.014]
Asthma, Age 14-18	0.008**	-0.012	-0.011	-0.028*
	[0.004]	[0.007]	[0.007]	[0.015]

Major Injury, Age 0-3	0.004**	-0.006	-0.002	-0.006
	[0.002]	[0.004]	[0.004]	[0.009]
Major Injury, Age 4-8	0.000	-0.002	-0.001	0.002
	[0.002]	[0.004]	[0.004]	[0.009]
Major Injury, Age 9-13	0.001	-0.011**	-0.013**	-0.033**
	[0.003]	[0.004]	[0.004]	[0.009]
Major Injury, Age 14-18	0.005**	-0.015**	-0.018**	-0.027**
	[0.002]	[0.004]	[.004]	[0.009]
Birth weight<=1000 grams	-0.019	-0.262**	-0.102	-0.347**
	[.047]	[.078]	[.080]	[.165]
1000<Birth weight<=1500	0.046**	-0.069*	0.036	-0.051
	[.022]	[.038]	[.039]	[.080]
1500<Birth weight<=2500	0.011	-0.044**	-0.006	-0.022
	[.007]	[.012]	[.012]	[.025]
2500<Birth weight<=3500	-0.002	-0.016**	-0.006	-0.017*
	[.003]	[.005]	[.005]	[.010]
# Congenital/Perinatal	0.001	-0.003	-0.012**	-0.009
0-3	[.002]	[.004]	[.004]	[.008]
R-squared	0.614	0.736	0.65	0.756
Mean of Outcome:	0.055	0.691	0.214	-0.014
# fixed effects	22692			
# Obs.	50404			

Notes: Standard errors in brackets. Each column reports the results of a regression (or linear probability model) for the outcome listed in that column. On Social Assistance, Reaching Grade 12 by Age 1, and Taking College Math are 0/1 variables. The literacy score is normalized (0,1). In addition to the controls listed, all regressions also include mother fixed effects and controls for marital status, sex of the child, mother's age at birth, dummy variables for birth order of the child, family size, and year of birth indicators. * denotes statistical significance at the 10% level. ** denotes significance at the 5% level.

Table 5 shows that when health at older ages is controlled:

1. ADHD/conduct disorder at 4-8 or later is predictive of much more negative outcomes.

2. # Major conditions at 0-3 and 4-8 remains predictive of social assistance, but not of school outcomes.

3. Major injuries in early childhood do not have lingering effects.

4. No long-term effect of asthma in early childhood.

Figure 1: Coefficients on Social Assistance for each Condition and Age

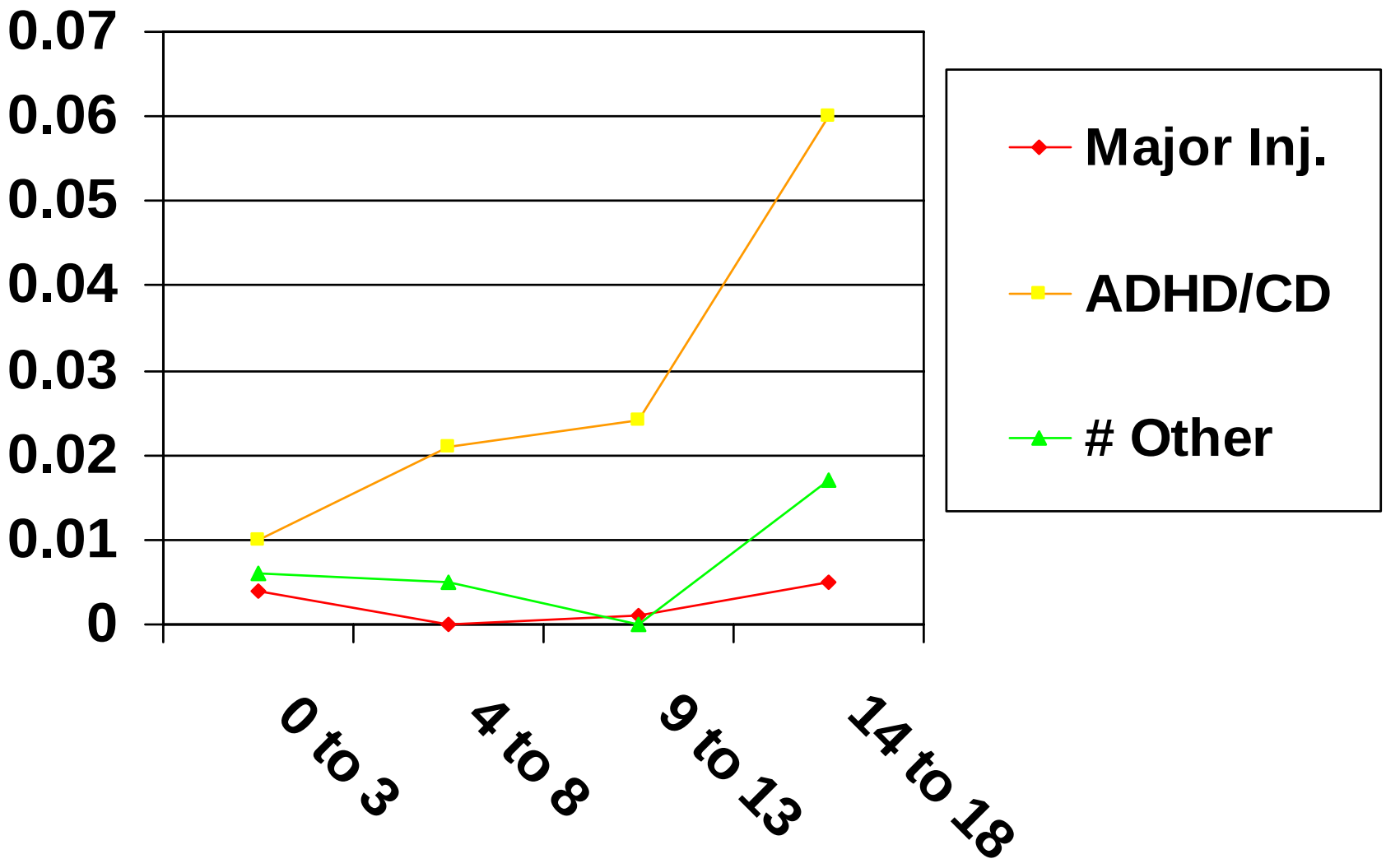


Figure 2: Coefficients on College Math for each Condition and Age

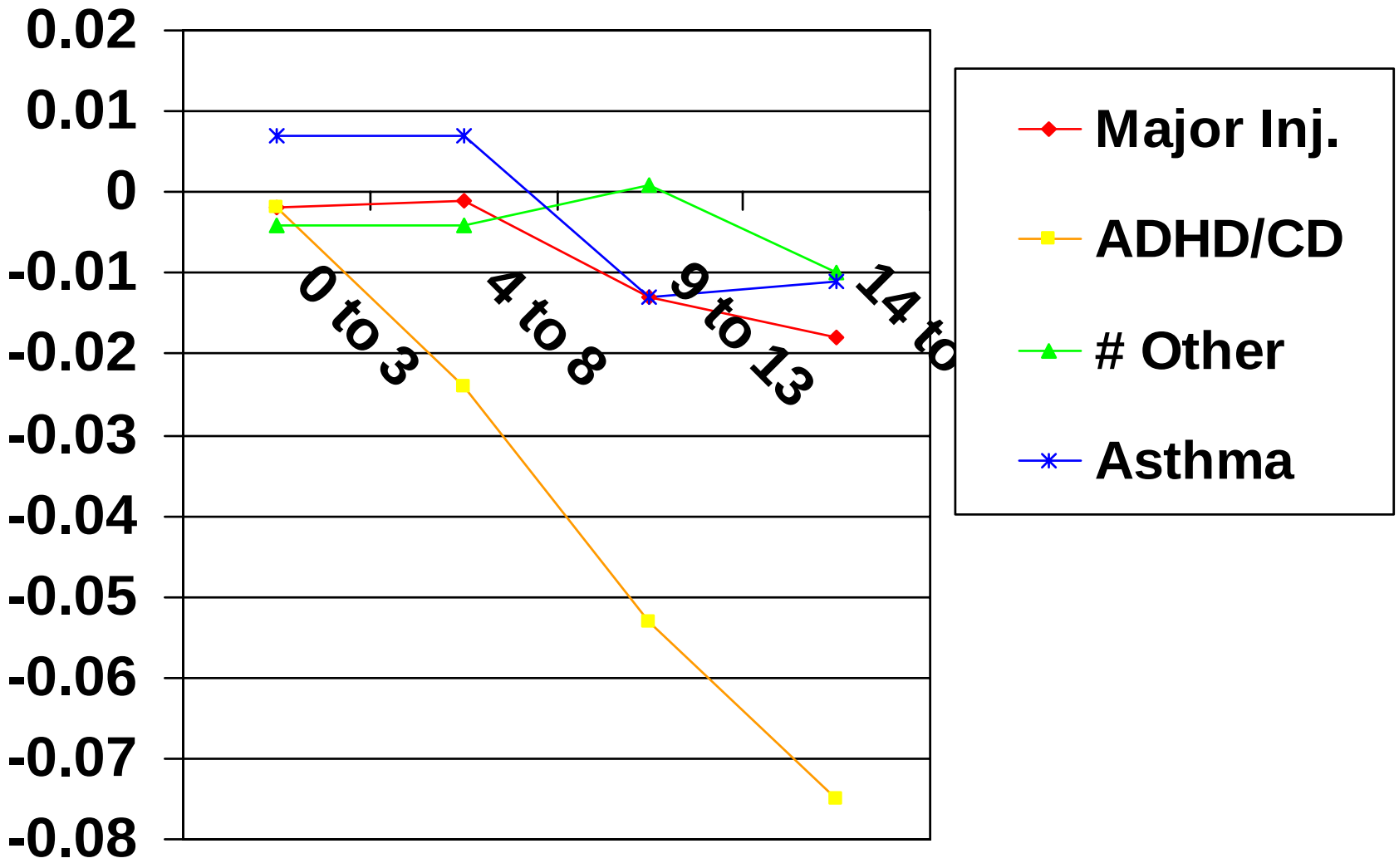


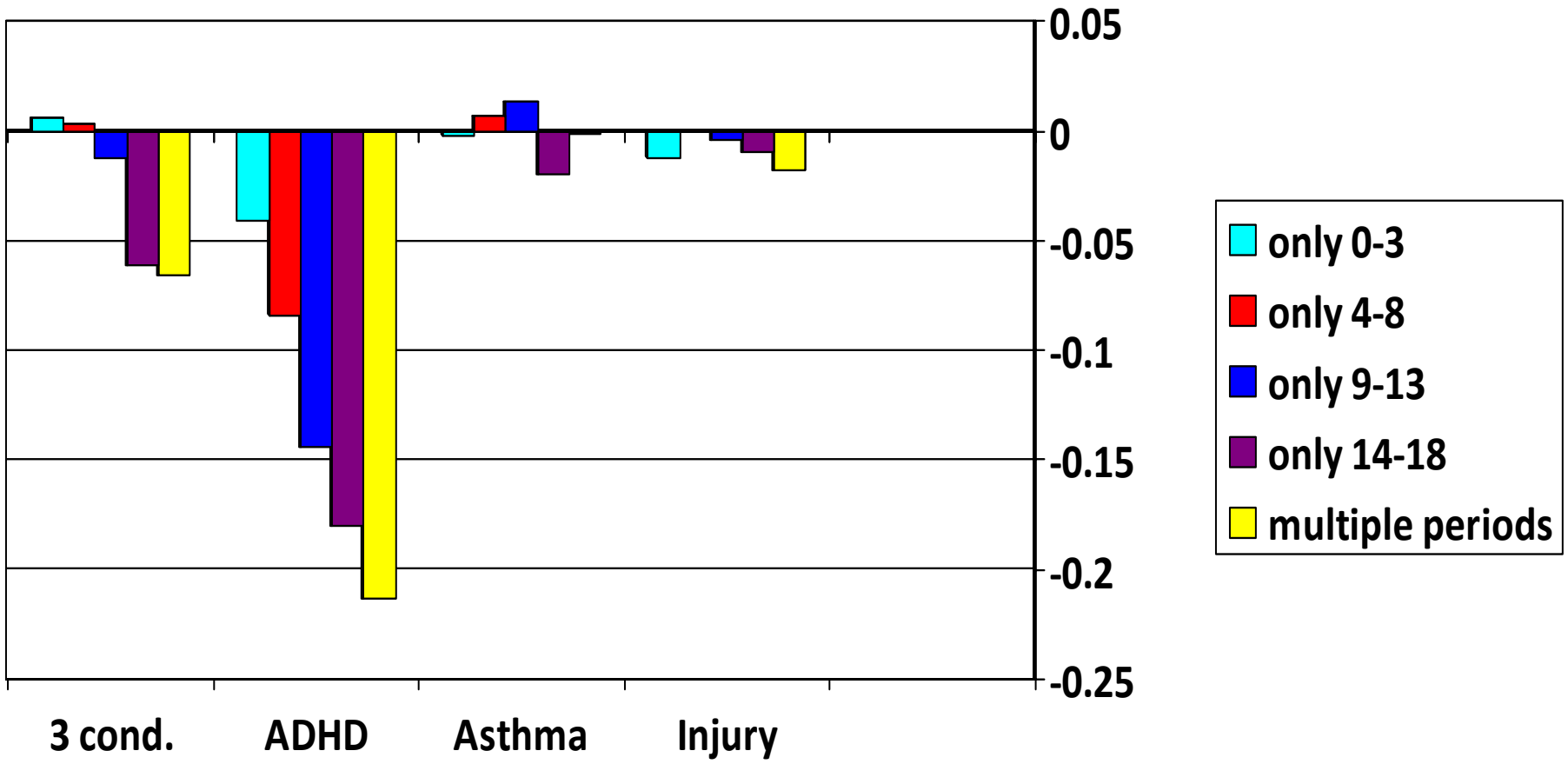
Table 6: Health Problems in Single Periods vs. Multiple Periods

	On Social Assistance	Grade 12 by Age 17	College Math	Literacy Score
# Major Conditions, only ages 0-3	0.002	0.000	-0.006	-0.01
	[0.005]	[0.008]	[0.008]	[0.016]
only ages 4-8	-0.001	0.001	-0.008	-0.004
	[0.005]	[0.008]	[0.008]	[0.025]
only ages 9-13	0.000	-0.004	-0.001	-0.009
	[0.005]	[0.008]	[0.008]	[0.017]
only ages 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 ages 0-3	0.008	-0.041**	-0.003	-0.039
	[0.008]	[0.013]	[0.013]	[0.027]
only ages 4-8	0.01	-0.084**	-0.027*	-0.161**
	[0.009]	[0.014]	[0.015]	[0.030]
only ages 9-13	0.027**	-0.144**	-0.072**	-0.303**
	[0.009]	[0.015]	[0.016]	[0.033]
only ages 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 ages 0-3	-0.01	-0.002	0.012	-0.023
	[0.007]	[0.011]	[0.011]	[0.023]
only ages 4-8	-0.001	0.007	0.007	0.016
	[0.006]	[0.010]	[0.011]	[0.022]
only ages 9-13	-0.003	0.013	-0.011	0.026

	[0.006]	[0.009]	[0.010]	[0.020]
only ages 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 ages 0-3	0.002	-0.012	-0.01	-0.021
	[0.005]	[0.008]	[0.008]	[0.017]
only ages 4-8	-0.003	0.000	0.006	0.031*
	[0.005]	[0.008]	[0.008]	[0.018]
only ages 9-13	0.002	-0.004	0.000	-0.012
	[0.005]	[0.009]	[0.009]	[0.019]
only ages 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]
Birth weight<=1000 grams	-0.012	-0.265**	-0.109	-0.357**
	[0.047]	[0.078]	[0.080]	[0.165]
1000<Birth weight<=1500	0.048**	-0.071*	0.033	-0.053
	[0.022]	[0.038]	[0.039]	[0.080]
1500<Birth weight<=2500	0.012*	-0.044**	-0.005	-0.021
	[0.007]	[0.012]	[0.012]	[0.025]
2500<Birth weight<=3500	-0.001	-0.016**	-0.006	0.018*
	[0.003]	[0.005]	[0.005]	[0.010]
# Congenital/Perinatal	0.002	-0.004	-0.017**	-0.008
0-3	[0.004]	[0.016]	[0.006]	[0.013]
R-squared	0.613	0.735	0.65	0.756
# fixed effects	22692			
# Obs.	50404			

Notes: Standard errors in brackets. Each column reports the results of a regression (or linear probability model) for the outcome listed in that column. On Social Assistance, Reaching Grade 12 by Age 1, and Taking College Math are 0/1 variables. The literacy score is normalized (0,1). In addition to the controls listed, all regressions also include mother fixed effects and controls for marital status, sex of the child, mother's age at birth, dummy variables for birth order of the child, family size, and year of birth indicators. * denotes statistical significance at the 10% level. ** denotes significance at the 5% level.

Effects of Health Problems on P(Grade 12 by 17)



Extensions:

1. Do by SES. 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 an SES measure using income measured at the enumeration area level (similar to a U.S. Census tract, 400-700 people) from the1986 Canadian Census. Used the area where the child lived as of Dec. 31, 1987. We then used residence in the bottom quintile, or bottom two quintiles of enumeration areas as an indicator of "lower SES". The correlation between individual-level income and median income in the enumeration area is about .44 (Roos et al, 2005).

Clear gradients by this SES proxy: e.g. 5.5% of the full sample are on social assistance compared to 9.5% of the low SES sample.

Some of the point estimates are higher for the low SES than for the full sample, but standard errors are also higher.

2. Different Health Measures

Break out head injuries (intracranial injuries and skull fractures).

Use a broader measure of mental health problems (ADG24, “Recurrent or Persistent, Stable Psychosocial conditions”)

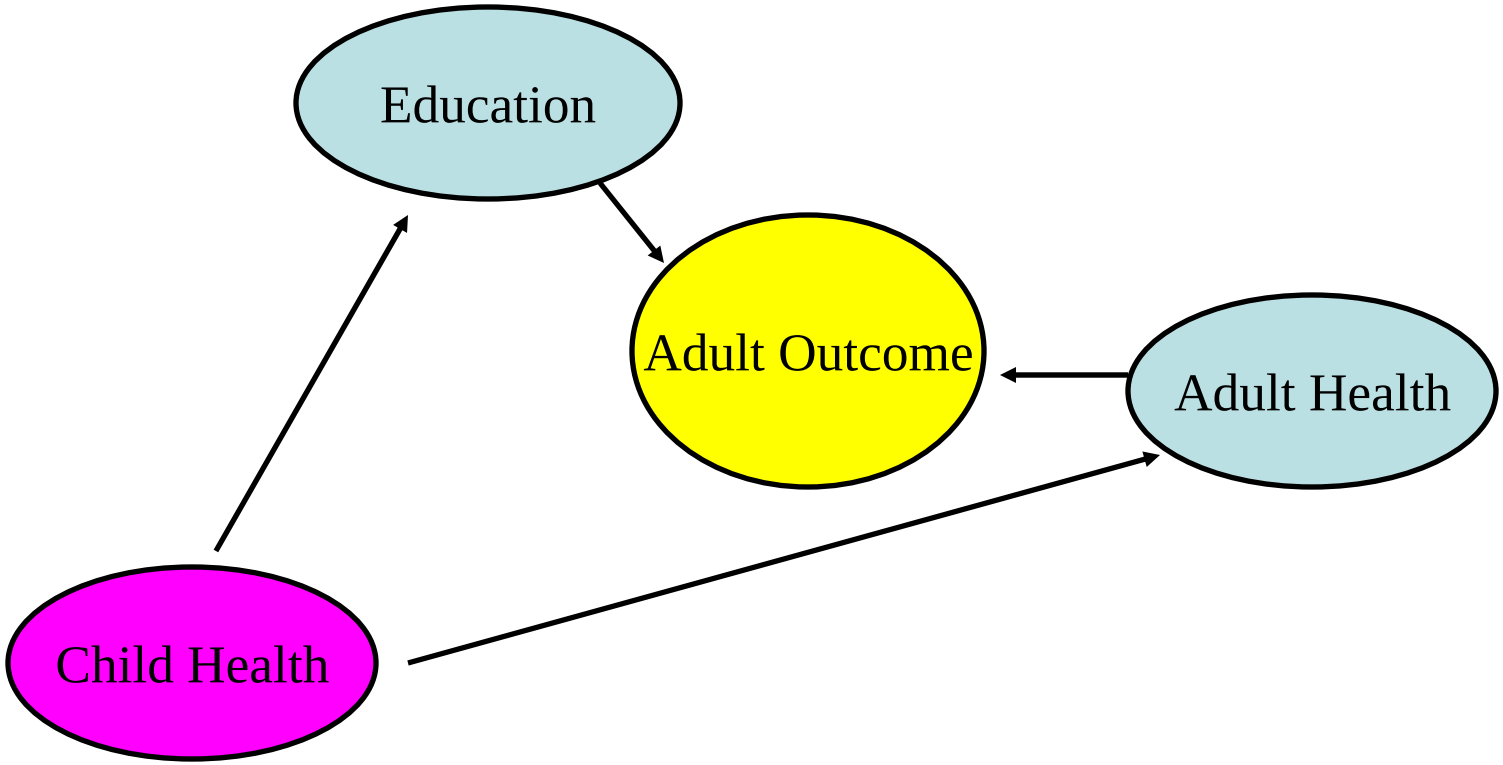
Discussion

Strengths:
- large sample
- coverage from birth to follow-up & long follow-up period
- objective vs. self-reported or retrospective health measures
- sibling comparisons

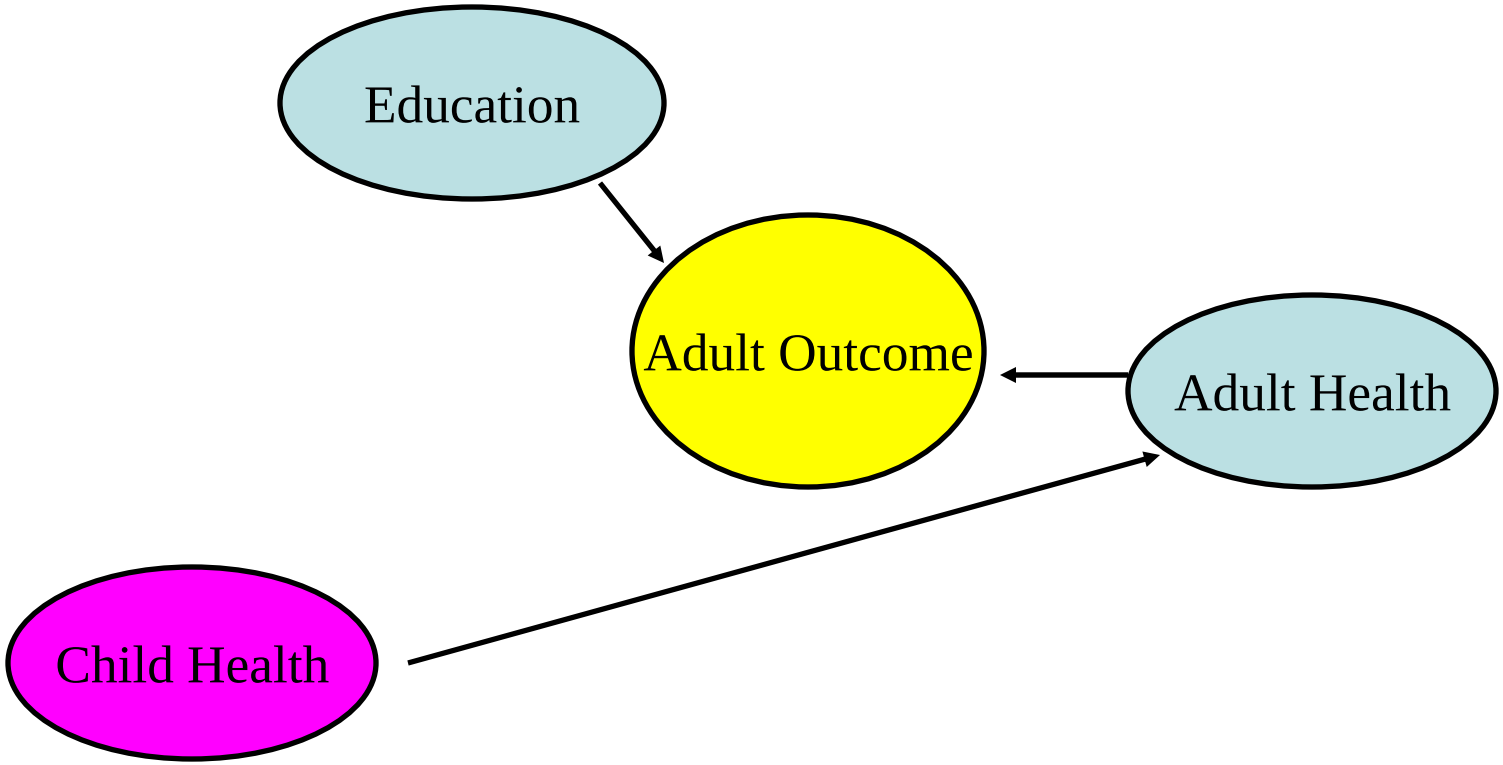
Weaknesses:
- sibling comparisons not a pancea
    - Although we control for individual health at birth, there may be other individual differences
    - Parents may treat sick children differently (note that if parents compensate disadvantaged children, effects of illness will be underestimated).
    - Sickness of one sibling may impact the other—again, this will likely lead to underestimates of effects of illness.
    - Fixed effects may exacerbate measurement error—again, will lead to underestimates of effects of health.

- difficulties inferring health from utilization data
    - But children are fully insured and we focus on major illnesses.
    - Over 98% of sample children have a contact with the medical system each period.
    - Our measures are not affected by the number of visits.

Pathways for Child Health to Affect Adult Outcomes



For Physical Health Main Effects Are through Adult Health



Conclusions

- poor health at birth and mental health problems in early childhood are associated with worse outcomes even conditional on future health.
- Physical health problems in early childhood are associated with poorer long-term outcomes, but this is because they predict poorer future health. Unless they persist over time, even serious early health problems have little association with future schooling attainment or welfare use.
- Little effect of childhood asthma on the outcomes we examine.

Overall conclusion: health problems in early childhood may be significant determinants of adult socioeconomic status even in countries with universal health insurance. Hence prevention and better care for children with early health problems could significantly improve children's prospects.