Maternal Health Behaviors and the Childhood Health Gradient
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Poor people die sooner and report poorer health while they are alive than their wealthier counterparts. The relationship between income and health generally holds not only for the very poor but continues throughout the income distribution; thus the term "the gradient" coined by the academic literature. Mountains of research spanning many disciplines have failed to adequately explain the mechanisms responsible for the gradient. While most of the literature has focused on adult socioeconomic status and health, recent work has also traced the gradient back to childhood, finding a significant relationship between family income and children's health. If the well-documented relationship between income and health in adults has its roots so early in life, it is important to identify the mechanisms through which children acquire such an unfortunate disadvantage.

This paper will build upon previous work on the childhood health gradient by testing more thoroughly the extent to which maternal health behaviors mediate the relationship between family income and child health. We find that while a detailed set of maternal health behaviors during pregnancy and early infancy does nothing to explain the relationship between family income and parental assessed health status of the child in our sample, a smaller set of behaviors does explain the gradient in asthma, one of the most prevalent childhood illnesses.

The first section discusses advantages to the study of children in "gradient" research. The next section briefly reviews the recent literature linking family income and children's health. Next, we present estimates of the childhood health gradient in the

U.S. with a new sample, and compare those results with previous work. Outcomes of interest include parental-assessed health status of the child on a scale of 1-5, number of hospitalization episodes, and the presence of acute and chronic health conditions.

The next section discusses a set of maternal behaviors during pregnancy and early infancy that are linked to child health, and verifies that most of these behaviors have significant associations with education of the mother and family income. The paper then moves on to explicitly test whether detailed measures of maternal health behaviors during and after pregnancy can account for the relationship between income and parental assessed health of the child, as well as the relationship between family income and asthma. The final section concludes.

I. *Advantages to the study of children*

Examining the causes of the income gradient in childhood health has several advantages over similar research in adults. First, the study of children reduces the risk of one of the most difficult confounders in the study of income and health; reverse causality. Since children in the U.S. are not significant contributors to family income, researchers need not worry that the income-health correlation is due to a sick child failing to earn their keep. While it is still possible that parents with sick children may cut back on their labor supply, this issue can be examined more directly with appropriate data. Using data from the PSID, Case, et al (2002) find no evidence that women whose children are sick at birth are less likely to work in the first three years of the child's life.

A further advantage to looking for the causes of the gradient in children comes from the fact that the time frame for potential intervening variables to exert their influence is much compressed compared to similar surveys in adults. Some have suggested that the failure of reasonable explanations such as health behaviors and access to medical care to explain the gradient in adult health is due to the fact that contemporaneous health inputs may not be strongly correlated with health later in life (Garber 1989). In a sense, we have higher percentage of the total information regarding a 3-year old's lifetime health inputs that we do for a 50-year old (in cross-sectional data), and this theoretically should enhance our ability to explain the health outcomes of interest.

II. Previous literature

In their 2002 paper, "Economic Status and Health in Childhood, the Origins of the Gradient" Case, Lubotsky and Paxson (2002) document a significant relationship between income and childhood health in the United States. Using household data from the National Health Interview Survey (NHIS), the Panel Study of Income Dynamics (PSID), and the Third National Health and Nutritional Examination Survey (NHANES III), they find that children's health is positively related to parental income, and that this relationship grows stronger as children age. Case, et al establish this relationship for overall health status as well as for chronic conditions facing children. Case, et al conclude that the health disadvantages of low income for children accumulate over time, such that poorer children arrive at adulthood with lower health status as well as more absences from school, both of which may adversely affect their future earnings, perpetuating the

gradient. Currie and Stabile (2002) estimate a similar childhood gradient using Canadian household data, and like Case, et al they find that the relationship between income and health grows stronger for older children. Their evidence suggests that this steepening of the gradient with age results from more frequent negative health shocks for poorer children rather than an inability to recover as well from a given health shock.

III. Data

Data for this analysis comes from the 1988 National Maternal and Infant Health Survey and 1991 Follow-up (NMIHS). The 1988 NMIHS, a national survey conducted by the National Center for Health Statistics, was designed to explore the causes of negative pregnancy outcomes. The sample was drawn from the vital records of women in the U.S. who had a pregnancy in 1988, with an over sample of fetal deaths, low birth weight babies, and blacks. Women were retrospectively surveyed about prenatal care, pregnancy-related behaviors, family income and relevant demographic information. The 1991 follow-up to the National Maternal and Infant Health Survey provides information on early childhood morbidity and health for those children whose mothers were surveyed in 1988. Linking these two surveys will allow an analysis of the impact of the earliest maternal behaviors on childhood health.

Table I shows summary statistics for the 1991 NMIH sample. Of the 9953 live birth respondents in 1988, 8285 (83%)completed surveys in 1991. 140 respondent mothers who reported that the child had not lived with them for the last 30 days could not complete the full survey, leaving 8145 respondents. There are 1835 observations (22.5%) where family income in 1991 was refused, not known, or missing. The

remaining sample contains 6268 observations with linked 1988 and 1991 data. The children are on average 35 months old. Most are in very good or excellent health, with five percent reported to be in only fair or poor health. The NMIHS over sampled low birth weight babies and blacks, resulting in a sample that is 47% white and 50% black. All analyses include adjustment by sample weights for population-based estimates.

IV. The Income-Gradient in Children's Health

Health Status and Hospitalizations

Table 2 shows the relationship between family income[1] and overall health status in the NMIHS. Health status is a categorical variable reported by the mother for the child, with 1=Excellent, 2= Very Good, 3=Good, 4=Fair, and 5=Poor. While this measure of health status has been a powerful predictor of future mortality and functional decline for adults (Idler and Benyamin 1997), much less is known about the predictive power of this measure in children. In a sample of preterm low-birth weight infants, poor global health ratings by the mother when the child was 24 months were related to increased health care utilization and to increased behavior problems at concurrent measurements and one year later, but mother's ratings did not predict future morbidity, hospital care, or growth measures (Scholle, et al 1995). Given the weak evidence for the validity of this assessed health measure in children, Table 2 also looks at the relationship between family income and the number of hospitalization episodes the child has had since birth.

[1] The NMIHS reports income in 20 groups in 1988 and 27 groups in 1991. I code income as the midpoint of each group and the median income for households in top-coded categories, according to the 1988 and 1991 Current Population Surveys.

Using the PSID, Case, et al find that children's health status is most closely associated with the household's permanent income, and that the timing of the income does not seem to matter for children's health. We test this finding using the two separate years of income data in the NMIHS. 1988 income, which measures family income the year before delivery of the child, is significantly associated with the child's health at age 3, though we can reject equality of the 1988 and 1991 income coefficients at the .09 level of significance. The coefficient on family income is largest when using average income from 1988 and 1991, suggesting either less noise with this average measure or an important role for permanent income. Average income from the two years will be used from this point on as a proxy for permanent income.

The magnitude of the association between family income and children's health status in the NMIHS is very close to the estimate of from Case, et al for children ages 0-3, (0.200 versus 0.183.). Including controls for the parent's education reduces the coefficient on family income by half, but it is still large and significant, again in agreement with the findings of Case, et al. Results for the number of hospitalizations since birth show a similar pattern in the NMIHS, where family income is strongly significant and remains so upon the inclusion of controls for parental education.

Specific Conditions

Given the subjective nature of the reported health-status variable, it is important to see the extent to which income is related to specific health conditions that might afflict young children. Table 3 column 1 shows the relationship between family income and results for specific health conditions. Mothers in the NMIHS were asked to respond yes

or no to whether a doctor, nurse, or other health care professional had ever told her that the child suffered from a list of chronic ailments. Of all the chronic conditions listed in table 3, only speech problems, asthma, other lung problems and epilepsy are more prevalent in lower income groups. This is not inconsistent with the findings of CLP, who find that gradients for conditions such as sight, hearing, and developmental delays didn't emerge until after the 0-3 year age range.

For more acute conditions occurring in the past 30 days, only cough is significantly (at the .10 level) negatively related to income, consistent with the results for chronic lung conditions above. Interestingly, colds and ear infections in the last 30 days are more common for those with higher income, though this association goes away when controlling for attendance at daycare or preschool (not shown).

Case et al, break down the effects of specific conditions into prevalence and severity effects. Even if certain illnesses are no more common in lower income children, it is possible that those illnesses are more severe. To test whether a given chronic condition has a worse impact on lower income children, Table 3 column 4 also shows results of interacting family income and the presence of each individual condition on the probability of reporting poor or fair health. We see some evidence for the hypothesis that higher income children are buffered from the effects of chronic illness. Hearing problems, allergies, and epilepsy all show a stronger effect on the probability of predicting poor health for poorer children. Heart conditions, chronic respiratory problems, vision problems, and ear tubes also show a similar pattern but are not significant at conventional levels. Surprisingly, asthma, which was strongly related to income in prevalence, does not show a similar gradient in severity in this sample.

Testing the severity hypothesis with more acute conditions, we find significant interaction effects for colds and tonsillitis, and a marginally significant effect for ear infections. Again, this result could be the due to the fact that for whatever reason, having more income buffers children against the harmful effects of each acute condition. Another possibility to keep in mind however, is that lower income mothers are more likely to *report* their child in ill health given the presence of a the same objective health condition. Compared to chronic conditions, it is more difficult to imagine why a cold, essentially a virus that must run its course, would be more devastating to the overall health of a poorer child than a wealthier child, especially since wealthier kids appear to get colds more often. There is no evidence that income is related to the total number of these acute conditions reported in the last thirty days (not shown), so substantial co-morbidity of these acute conditions does not seem to explain the difference.

V. Potential Mechanisms

Maternal Health, Pregnancy Behaviors, and Early Childhood Exposures

There are many avenues through which the decisions of parents, especially mothers, can impact the health of their children. Many of these decisions, as we shall see, are also associated with income and education, making them plausible candidates to explain the relationship between family income and children's health.

From the standpoint of the three-year old children in the NMIHS, the experiences of the womb are not very distant in their biological past. Research strongly supports the notion that the intrauterine environment is an important determinant of an offspring's childhood as well as adult health. David Barker and his colleagues have

brought attention to the idea of fetal "programming," a process whereby a stimulus or insult at a critical period of development has long-term effects on the individual's physiology and subsequent disease risk. Barker's hypotheses also imply that the effects of a poor intrauterine environment can continue across generations, since the development of a female child's own womb is adversely affected if she is deprived in the womb. In addition to Barker's survey research with humans, experimental studies in animals have documented many examples of the impact of maternal nutrition on long-term health of the offspring (Langely SC). While Barker's work has focused on health consequences of the womb environment that emerge later in life, other researchers have found that children exposed to under nutrition in the womb are more likely to develop insulin intolerance and obesity in childhood (Strauss 1994).

For our purposes, the "quality" of the intrauterine environment is divided into two categories. The first group of variables is designed to capture the more permanent attributes of the mother's health at the time of pregnancy, and includes the mother's age, birth weight, pre-pregnancy weight, an indicator for whether she gave birth less than 18 months prior, and the number of previous children she has delivered. As mentioned above, the Barker hypothesis suggests that the mother's own birth weight can indicate whether she was deprived in the womb in a way that might affect her offspring. Short birth intervals between children are associated with reduced nutritional reserves of the mother during pregnancy and impairment of the uteroplacental circulatory system early in pregnancy, contributors to poor pregnancy outcomes (Haaga 1998, King 2003). Young maternal age and very low or very high pre-pregnancy maternal weight are also

associated with prematurity and low birth weight (de Weerd et al 2003). Similar results have been found for high birth-order children.

The second group of pregnancy conditions we will look at include activities of the mother during pregnancy that may affect on the child's health and include smoking, drinking, exercise, taking vitamins after conception and seeking prenatal care in the first trimester. Maternal smoking and excessive drinking during pregnancy have both been shown to raise the risk of intrauterine growth retardation (de Weerd, et al 2003). Exercise during pregnancy has been shown to reduce the risk of gestational diabetes and hypertension during pregnancy (Sorensen, et al 2003). Supplementation with vitamins such as folic acid and iron can insure a lower risk of certain birth defects and nutritional deficiencies during pregnancy.

In addition to the pregnancy controls, our analysis will look at two potentially important health inputs from early in the child's life; whether the child was breastfed and whether there is a smoker currently in the house. Breastmilk contains a variety of immune factors that help protect infants from disease. Breastfeeding has been linked to near term benefits for the child such as lower rates of diarrhea and ear infections, as well as longer term health benefits such as lower rates of asthma, childhood obesity, and Type I diabetes (Scariati, et al 1997; Mayer, et al 1988; Wright, et al 1995; Gillman, et al 2001). Young children whose mothers smoke are much more likely to develop wheezing and to have diminished pulmonary function, potentially predisposing them to asthma and chronic bronchitis (Martinez, et al 1995).

Table 4 shows the relationship between these pregnancy controls and education and income. We see that almost across the board, higher income and education are

associated with pregnancy conditions and behaviors that are known to promote healthier pregnancies and healthier babies. Next we will test the extent to which these behaviors can explain the observed relationship between family income and parental assessed-health of the child.

VI. Can Health Behaviors Explain the Gradient in Health Status?

Case, et al find that an indicator for low birth weight does not account for relationship between income and health in their paper, and we get similar results, as shown in Table 5 column 2. While low birth weight is one indicator of poor maternal health status or health habits during pregnancy, as outlined above it may be too crude to capture all of the ways in which the womb environment affects the future health of the child.

Table 5, column 3 shows ordered probits of health status including four dummies for the mother's birthweight, four dummies for her BMI prior to pregnancy, a dummy for whether she had delivered another child in the previous eighteen months, and eight dummies for birth order. Again, these controls are meant to capture the general quality of the mother's womb at the time of pregnancy. While these variables are jointly significant as predictors of health status, we see that their inclusion does little to change the relationship between family income and health status.

Next, Column 4 looks at whether more immediate pregnancy inputs can explain the gradient in children's health status. Controls include dummies for whether the mother smoked during pregnancy, drank more than 5 drinks a week during pregnancy, exercised during pregnancy, took a multivitamin during pregnancy, and got prenatal care in the first

trimester. While these pregnancy behaviors are known to contribute to intrauterine growth retardation and low birth weight, they are not significantly associated with parental assessed health status of the child, and the inclusion of these pregnancy controls has very little impact on the relationship between family income and assessed health.

Next we turn to two important health decisions by the mother during the child's early life; whether the child was ever-breastfed and whether the mother is a current smoker. Column 5 of Table 5 includes indicators for these two variables, and again we see very little diminution of the effect of income on health.

Finally, to see whether the whole might be greater than the sum of its parts, Column 6 of Table 5 includes all health controls mentioned above. Comparing the first to the last columns, the most striking feature is the incredible robustness of the income-health status relationship despite the inclusion a rich set of controls for potential physical pathways known to influence child health.

VII. Can health behaviors explain the gradient in specific conditions?

It may be the case that parental assessed health is too broad and subjective an outcome to be directly tied to specific health behaviors. The following section tests the extent to which maternal health behaviors can explain the gradient in specific child health conditions. Previous work along these lines includes Meara (2001), who uses the NMIHS to show that a limited number of maternal health habits during pregnancy, particularly smoking, can account for about half of the correlation between SES, as measured by education and income, and low birth weight.

Health behaviors and chronic conditions: The case of asthma

Asthma is the most prevalent chronic disease of children in industrialized countries, as well as the largest cause of hospitalization and health-related absenteeism of children. Case, et al find that the severity and prevalence of asthma explains nearly 20 percent of the income gradient in their sample. While full knowledge of the causes of asthma remains elusive, many factors are known to increase the risk. Premature babies have immature lungs and immune systems, both conceivable physical links to asthma. Prematurity is the leading cause of low-birth weight, which has been linked to higher rates of asthma later in childhood (Mai, et al 2003) Lung function at birth has been found to be lower among newborns whose mother smoked during pregnancy (Lodrup 2002). As mentioned above, maternal smoking in childhood has been linked with childhood asthma, and some research suggests that breastfeeding may be protective.

Column 1 Table 6 shows that higher income is associated with a lower incidence of asthma in the NIMHS sample. Column 2 adds controls for low birth weight, smoking during pregnancy, breastfeeding, and smokers currently in the household. We see that upon adding these four controls, the association between income and asthma drops dramatically in magnitude and is no longer statistically significant. Table 6 also shows the same exercise for the category of other reported chronic respiratory problems. Again we see a significant inverse relationship with family income that is reduced to statistical insignificance with the inclusion of controls for birth weight, smoking exposure and breastfeeding.

VIII. Conclusions

We have shown that while the most serious maternal health behaviors during pregnancy and early infancy are strongly related to income, they do not explain the relationship between family income and parental assessed health status of the child on a 1-5 scale. However, we do find that maternal health behaviors can explain the relationship between family income and asthma, the most prevalent childhood illness in developed countries. The same behaviors also explain the relationship between family income and other chronic respiratory illnesses in this sample. Given that chronic childhood illness is relatively uncommon, sample sizes larger than the NMIHS should be used to further examine the mechanisms behind the gradient in specific diseases. The finding that a rich set of controls for physical risk factors related to both income and health does not diminish the income gradient in subjective health status suggests that this measure may be capturing more of a psychological quality of the mother that is unlikely to be explained by physical risk factors. More work is needed to verify the usefulness of this subjective health measure in children. In the meantime, specific conditions, especially those for which we have an understanding of the physical pathways, may be more amenable to analysis as we work to identify the mechanism responsible for the childhood health gradient.

References

Case, Anne and Christina Paxson. 2002. "Parental Behavior and Child Health." *Health Affairs*, 21: 2.

Case, Anne, Darren Lubotsky and Christina Paxson. 2002. "Economic Status and Health in Childhood: The Origins of the Gradient." *American Economic Review*, 92:5, 1308-34.

Currie, Janet and Mark Stabile. 2002. "Socioeconomic Status and Health: Why is the Relationship Stronger for Older Children?" *NBER Working Paper* No. w9098.

Garber, Alan M., 1989, "Pursuing the links between socioeconomic factors and health: critique, policy implications, and directions for future research," in John P. Bunker, Deanna S. Gombey, and Barbara Kehrer, eds., Pathways to health: the role of social factors, Menlo Park, Ca. Kaiser Family Foundation, pp. 271-315.

Godfrey, Keith M and David JP Barker. 2000. "Fetal nutrition and adult disease." *American Journal of Clinical Nutrition* 71(suppl): 1344-52

Gillman MW, Rifas-Shiman SL, Camargo CA Jr, Berkey CS, Frazier AL, Rockett HR, Field AE, Colditz GA. "Risk of overweight among adolescents who were breastfed as infants." *Journal of the American Medical Association.* 2001; 285(19):2461-2467.

Haaga JG. 1988. "How is birthspacing related to infant health*?" Malays J Reprod Health*. 1988 Dec;6(2):108-20.

Idler, Ellen L, and Yael Benyamini, 1997, "Self-rated Health and Mortality: A Review of Twenty-Seven Community Studies, " *Journal of Health and Social Behavior* **38** (March): 21-37

Joseph CL, Ownby DR, Peterson EL, Johnson CC. 2002. "Does low birth weight help to explain the increased prevalence of asthma among African -Americans?" *Ann Allergy Asthma Immunol*. 2002 May;88(5):507-12.

King JC. 2003. "The risk of maternal nutritional depletion and poor outcomes increases in early or closely spaced pregnancies." *J Nutr*. 2003 May;133(5 Suppl 2):1732S-1736S.

Langley SC, Jackson AA. "Increased systolic blood pressure in adult rats induced by fetal exposure to maternal low protein diets." *Clin Sci* 1994; 86: 217-22

Lodrup Carlsen KC. 2002. "The environment and childhood asthma (ECA) study in Oslo: ECA-1 and ECA-2." *Pediatr Allergy Immunol*.;13 Suppl 15:29-31.

Mai, X-M, Gaddlin P-o, Nilsson L, Finnstrom O, Bjorksten B, Jenmalm MC, Leijon I. "Asthma, lung function and allergy in 12-year old children with very low birth weight: A prospective study." *Pediatric Allergy and Immunology* 2003: 14 184 -192.

Martinez, F.D., et al., "Asthma and Wheezing in the First Six Years of Life," New England Journal of Medicine 322, no 3 (1995) 133-138.

Mayer EJ, Hamman RF, Gay EC, et al. "Reduced risk of IDDM among breastfed children" *Diabetes*. 1988; 37: 1625-1632

Scariati, Paula D**,** Laurence M. Grummer-Strawn**,** and Sara Beck Fein. 1997. "A Longitudinal Analysis of Infant Morbidity and the Extent of Breastfeeding in the United States." *Pediatrics* Jun 1997; 99:5.

Scholle, S.H, L. Whiteside, K. Kelleher, R. Bradley and P. Casey. 1995. "Health Status of preterm low-birth-weight infants. Comparison of maternal reports." *Archives of Pediatrics and Adolescent Medicine* Dec 1995: 149: 12.

Strauss, RS, "Effects of the intrauterine environment on childhood growth" *British Medical Journal*, Vol 53, Issue I 81-95

Wright, AL, Holberg CJ, Taussig LM, Martinez FD. "Relationship of infant feeding to recurrent wheezing at age 6 years." *Arch Pediatr Adolesc Med.* 1995; 149: 758-763.

Table 1=Summary Statistics NMIHS

Variable	Mean	SD	N
Child's Age (Months)	35.416	4.784	6268
1988 Income ($1991)	27874	23992	6268
1991 Income ($1991)	27493	25004	6268
Health Status	1.766	0.902	6265
Health Status very good or excellent	0.798	0.402	6268
Health Status fair or poor	0.050	0.218	6268
Hospitalization episodes (since birth)	0.362	1.374	6203
Female	0.497	0.500	6267
White	0.470	0.499	6268
Black	0.502	0.500	6268
Mother's Education	12.671	2.235	6263
Father's Education	12.948	2.227	3590
Mother's Age	28.827	5.705	6268
Father's Age	32.307	6.395	4760
Father present in family	0.616	0.487	6268

(totals less than 6268 indicate missing data)

Table 2 Health Status, Hospitalizations and ln(family income) NMIHS

	Health Status (1=Excellent to 5=poor)	Hospital Episodes since birth
NMIHS Model I:		
ln(income)	-0.158	-0.051
(Family Income 1991)	[0.022]**	[0.014]**
ln(income)	-0.110	-0.047
(Family Income 1988)	[0.019]**	[0.014]**
ln(income)	-0.200	-0.083
(Avg. Family Income '88&'91)	[0.027]**	[0.018]**
NMIHS Model 2:		
ln (Avg. Family Income)	-0.134	-0.072
	[0.029]**	[0.020]**
Mother's education	-0.159	-0.014
=12 years	[0.060]**	[0.043]
Mother's education	-0.210	-0.024
>12 years	[0.066]**	[0.043]
Father's education	-0.107	-0.070
=12 years	[0.076]	[0.068]
Father's education	-0.234	-0.098
>12 years	[0.081]**	[0.066]
Black	0.005	-0.023
	[0.041]	[0.033]
Observations	6306	6242

Standard errors in brackets
* significant at 5%; ** significant at 1%
Ordered probit models for Health Status (1=excellent, 5=poor)
OLS regressions for # of hospitalizations since birth

Other controls for all models include age, sex, and race of the child, log of household size and a dummy for presence of the father in the household

Table 3--Chronic and Acute Conditions, Income, and Poor/Fair Health, 1991 NMIHS

Condition, C	Fraction with C=1	α_1	β_1	β_2	β_3
Hearing Problem	0.027	-0.003	-0.020	0.118	-0.081
[6297]		[0.0033]	[0.004]**	[0.039]**	[0.035]*
Speech problem	0.058	-0.0099	-0.022	0.107	0.006
[6301]		[0.0043]*	[0.004]**	[0.028]**	[0.024]
Vision Problem	0.022	-0.0048	-0.021	0.125	-0.077
[6303]		[0.0030]	[0.004]**	[0.049]*	[0.052]
Food Allergy	0.050	-0.0029	-0.020	0.068	-0.038
[6289]		[0.0057]	[0.004]**	[0.024]**	[0.026]
Other Allergies	0.085	0.0095	-0.016	0.097	-0.093
[6288]		[0.0058]	[0.004]**	[0.022]**	[0.026]**
Asthma	0.104	-0.0143	-0.019	0.124	-0.008
[6289]		[0.0053]**	[0.004]**	[0.022]**	[0.022]
Chronic Lung Problems	0.065	-0.0106	-0.019	0.148	-0.054
[6297]		[0.0046]*	[0.004]**	[0.028]**	[0.033]
Heart Condition	0.016	-0.0005	-0.022	0.111	-0.080
[6302]		[0.0023]	[0.004]**	[0.055]*	[0.054]
Mental Retardation	0.021	-0.0002	-0.023	0.189	0.062
[6301]		[0.0014]	[0.004]**	[0.055]**	[0.070]
Epilepsy	0.012	-0.0065	-0.020	0.092	-0.155
[6301]		[0.0026]*	[0.004]**	[0.037]*	[0.058]**
Orthopedic problems	0.022	-0.0002	-0.022	0.084	-0.068
[6300]		[0.0027]	[0.004]**	[0.038]*	[0.058]
Tubes in Ears	0.063	0.0034	-0.020	0.078	-0.044
[6291]		[0.0052]	[0.004]**	[0.024]**	[0.028]
Last 30 days					
Diarrhea	0.061	-0.0066	-0.022	0.052	-0.013
[6302]		[0.0051]	[0.004]**	[0.020]**	[0.020]
Ear infection	0.116	0.0134	-0.020	0.059	-0.030
[6291]		[0.0071]	[0.004]**	[0.016]**	[0.019]
Cold, runny nose	0.585	0.0259	-0.015	0.015	-0.014
[6303]		[0.0106]*	[0.006]**	[0.007]*	[0.008]
Tonsillitis	0.056	-0.0054	-0.020	0.085	-0.059
[6301]		[0.0047]	[0.004]**	[0.024]**	[0.027]*
Cough, fever, croup	0.096	-0.0114	-0.020	0.055	-0.020
[6305]		[0.0064]	[0.004]**	[0.016]**	[0.018]

Notes: H=1 if the child is reported to be in fair or poor health, 0 otherwise.
Each row shows means and regression results the individual health condition
C=1 if the parent has ever been told by a health care professional that the child has the health condition listed in the first column, and otherwise is 0.
For acute conditions, C=1 if the parent reports that the child has experienced the condition in the last 30 days, 0 otherwise.
Regression equations are as follows:

$$C = \alpha_0 + \alpha_1 \ln y + X\delta^C + \varepsilon^C$$

$$H = \beta_0 + \beta_1(\ln y - \overline{\ln y}) + \beta_2 C + \beta_3(\ln y - \overline{\ln y})C + X\delta^H + \varepsilon^H$$

All models also include controls for age, sex, race of the child, and the logarithm of family size,
Standard errors in brackets
* significant at 5%; ** significant at 1%

Table 4--Maternal Health Status, Health Behaviors, and Income

Variable	Last Child <18 months ago	Mother's BMI pre-pregnancy	Mother's Age at birth	Total Number o Children	Mother's Birthweight
Black=1	0.155	0.694	0.098	0.267	-3.81
	[0.065]*	[0.158]**	[0.161]	[0.035]**	[0.792]**
Ln(family income)	-0.134	-0.845	2.309	-0.179	1.345
	[0.045]**	[0.125]**	[0.107]**	[0.025]**	[0.603]*
Mother's education	-0.191	0.576	0.736	-0.482	0.771
=12 years	[0.093]*	[0.224]*	[0.262]**	[0.055]**	[1.316]
Mother's education	-0.134	0.483	2.584	-0.757	1.416
>12 years	[0.102]	[0.254]	[0.279]**	[0.059]**	[1.368]
Observations	6115	6107	6115	6115	6115
R-squared					

Standard errors in brackets
* significant at 5%; ** significant at 1%
Each column represents an individual regression, except the birth interval which is a probit model

Table 4--continued, Maternal Health Status, Health Behaviors, and Income

Variable	Smoke during pregnancy	Drank during pregnancy	Exercise during pregnancy	Vitamins during pregnancy	Prenatal care first trimester	Smoker in house (1991)	Child ever breastfed
Black=1	-0.295	0.16	-0.037	-0.333	-0.164	-0.144	-0.624
	[0.050]**	[0.165]	[0.042]	[0.048]**	[0.053]**	[0.044]**	[0.043]**
Ln(family income)	-0.249	-0.186	-0.023	0.177	0.296	-0.225	0.242
	[0.036]**	[0.119]	[0.032]	[0.036]**	[0.041]**	[0.033]**	[0.035]**
Mother's education	-0.192	0.022	0.046	0.276	0.149	-0.22	0.237
=12 years	[0.071]**	[0.187]	[0.067]	[0.072]**	[0.078]	[0.068]**	[0.072]**
Mother's education	-0.597	-0.197	0.234	0.524	0.218	-0.587	0.622
>12 years	[0.081]**	[0.225]	[0.072]**	[0.080]**	[0.088]*	[0.073]**	[0.077]**
Observations	6115	6115	6115	6115	6115	6115	6115
R-squared							

Standard errors in brackets
* significant at 5%; ** significant at 1%
Each column represents an individual probit model, where Y=1 if the statement is true, 0 otherwise

Table 5-- Family Income, Health Behaviors, and Health Status (Ordered probits)

Income NOT imputed						
Full Sample	Baseline Controls	Low Birth Weight	Maternal Health Status	Pregnancy Behaviors	Early childhood	Full Model
	Health Status (1-5)	Health Status (1-5)	Health Status (1-5)	Health Status (1-5)	Health Status (1-5)	Health Status (1-5)
Ln (Avg Income)	-0.132	-0.131	-0.127	-0.136	-0.129	-0.128
	[0.030]**	[0.030]**	[0.031]**	[0.030]**	[0.030]**	[0.032]**
Mother's Education	-0.162	-0.162	-0.160	-0.161	-0.158	-0.155
=12 years	[0.061]**	[0.061]**	[0.062]*	[0.062]**	[0.061]**	[0.063]*
Mother's Education	-0.204	-0.202	-0.194	-0.196	-0.195	-0.182
>12 years	[0.066]**	[0.067]**	[0.069]**	[0.067]**	[0.067]**	[0.070]**
Observations	6112	6112	6112	6112	6112	6112

Standard errors in brackets
* significant at 5%; ** significant at 1%

Baseline Controls model includes: log of household size, age of the child, dummies for presence of the father, black, and sex of the child

Low birth weight model includes a dummy variable for whether the child was born weighing less than 2500 grams

Maternal Health Status model includes baseline controls plus:Age of the mother,4 dummies for mother's birthweight, 4 dummies for mother's body mass index, a dummy for whether the mother's last live birth occurred less than 18 months ago, and 8 dummies for birth order

Pregnancy Behavior model include baseline controls plus: dummies for whether the mother smoked, drank over 5 drinks/week during pregnancy, received prenatal care in the 1st trimester, exercised during pregnancy, and took a multivitamin regularly after conception

Early Childhood model includes baseline controls plus: dummy for whether the mother smokes in 1991 and whether the baby was breastfed

Full Model includes all variables mentioned above

Table 6-- Health behaviors, family income, and asthma (Probits)

	Asthma=1	Asthma=1	Chonic Lung	Chronic Lung
ln(Average income)	-0.097	-0.033	-0.130	-0.086
	[0.041]*	[0.045]	[0.047]**	[0.050]
High School Education	0.062	0.092	0.023	0.055
	[0.090]	[0.092]	[0.107]	[0.109]
Some College	-0.065	0.049	0.12	0.198
	[0.099]	[0.102]	[0.119]	[0.125]
Black	0.227	0.197	-0.046	-0.092
	[0.058]**	[0.062]**	[0.066]	[0.070]
Ln(Household Size)	0.198	0.250	0.02	0.063
	[0.103]	[0.110]*	[0.113]	[0.117]
Birthweight under 2500 grams		0.283		0.332
		[0.059]**		[0.065]**
Smoked during Pregnancy		0.153		-0.07
		[0.085]		[0.098]
Baby ever breastfed?		-0.152		-0.09
		[0.071]*		[0.080]
Smoker in the Household (1991)		0.120		0.136
		[0.077]		[0.084]
Observations	6284	6105	6292	6115

Standard errors in brackets
* significant at 5%; ** significant at 1%
Includes controls for mother's age and attendance at a day care or preschool.

Asthma=1 if a health professional ever told the mother that the child had asthma.
Chronic Lung=1 if a health professional ever told the mother that the child had a chronic respiratory illness other than asthma