

The Medium Term Schooling and Health Effects of Low Birth Weight: Evidence from Siblings[♦]

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Research has shown that low birth weight is linked to infant mortality as well as longer term outcomes. This paper examines the medium term outcomes that may link low birth weight to adult disadvantage. Results show strong effects on several educational outcomes, including early grade repetition, receipt of special education services, and diagnosis of a learning disability. Results for longer term outcomes are suggestive, though less robust and small in magnitude. Overall, the results suggest that medium term educational disadvantages associated with low birth weight are not driven by family level unobservables and do not accumulate into large long-term disadvantage.

Keywords: Low Birth Weight; Education; Health; Sibling Fixed Effects

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Introduction

There is strong consensus that low birth weight babies experience higher short term mortality as well as other early decrements to health, though results using within twin variation often find smaller effects than the cross-sectional evidence (Almond et al. 2005, Oreopoulos et al. 2008, Black et al. 2007). There is also evidence of long run effects of low birth weight on important adult outcomes such as completed education and labor market success, although the magnitudes of the effects often become much smaller when controlling for family fixed effects (Currie and Hyson 1999, Behrman and Rosenzweig 2004, Black et al. 2007, Oreopoulos et al. 2008, Royer 2009). Currently, almost nothing is known about the potential medium-term outcomes of low birth weight using sibling fixed effects. Although papers such as Corman and Chaikand (1998) show a cross-sectional association between medium term education outcomes and low birth weight, since results using family fixed effects are often vastly different than baseline results, it is difficult to interpret most current findings in the literature. Recently, Oreopoulos et al. (2008) used sibling comparisons to examine some outcomes that may be described as medium term, such as a test score at grade 12 and whether an adolescent has reached grade 12 by age 17 for Canadian adolescents. Similarly, Black et al. (2007) examine IQ measured at age 18 for Norwegian male twins. Still, important earlier health and educational outcomes, especially outcomes for school-age children, have not been sufficiently explored in due in large part to data limitations.¹

Providing a further understanding of the process by which low birth weight may lead to poor adult outcomes could help to shed additional light on interventions that may

¹ Conley et al. (2003b) attempt to use sibling comparisons in the PSID for intermediate outcomes but are limited by small sample sizes (~100 observations) and thus suggest further research is needed.

effectively reduce the costs of low birth weight. While the US government has implemented a number of policies to improve the health of infants and young children, such as the Women, Infants, and Children Program (WIC), often these programs expire early—at age 5 in the case of WIC. It may be useful to extend services to children with poor health as they age and attend school to further blunt any lasting effects of poor infant health. In contrast, it might be the case that the effects of low birth weight are relatively short term in nature and additional interventions may be unnecessary.

Most recent examinations of the effects of low birth weight take advantage of large administrative databases of twins and siblings; although this type of data allows precise estimates of effects due to the large sample sizes available, the range of outcomes that can be examine is often limited, especially outcomes occurring in childhood and adolescence. This paper uses a national sample of adolescents that includes a large subsample of siblings who are followed into young adulthood to provide new evidence of the medium term effects of low birth weight. Findings suggest important links between low birth weight and several educational outcomes, such as early grade repetition, receipt of special education services, and having a learning disability. However, these effects of low birth weight do not seem to accumulate and lead to substantial disadvantage as a young adult for this sample.

Previous Literature

There are large literatures in the social and medical sciences that examine the immediate health effects of low birth weight, such as infant mortality, and a complementary literature that then estimates the long term effects of low birth weight on

adult outcomes such as years of completed schooling and labor market outcomes. However, less is known about the intervening 15-20 years of intermediate health and educational outcomes that may link poor infant health measures such as low birth weight with adult disadvantage. This paper seeks to begin to fill in this void but will first outline some of what is known about the effects of low birth weight on infant and adult outcomes.

There are large literatures in the medical and social sciences linking low birth weight and other poor infant health measures with infant mortality and health costs. One issue with much of the evidence in the medical literature is that omitted variables may increase the estimated effects of low birth weight. Thus, recent work in the social sciences has used siblings and twins data in order to control much of the shared environment of children. For example, Almond et al. (2005) shows that traditional estimates imply that a standard deviation increase in birth weight would reduce hospital costs by 0.5 standard deviations, reduce infant mortality by 0.4 standard deviations, and increase APGAR scores by 0.5 standard deviations. Using twin data, which controls for mother heterogeneity, reduces the effects to 0.08, 0.03, and 0.03, respectively, though these are still important effects.² However, one limitation of research focusing on twins is that they tend to have lower weight than the average singleton birth. More recent work by Oreopoulos et al. (2008) confirm findings from Almond et al. (2005) that low birth weight effects on infant mortality largely disappears using twin comparisons. Similarly, Black et al. (2007) find no effects of birth weight on infant mortality in their sample of twins from Norway.

² Complementary research, such as Conley et al. (2003b), has also used twin data to show that birth weight differences affects infant mortality

There is also a large and growing body of evidence of the longer term effects of birth weight in the literature. Behrman and Rosenzweig (2004) show for a sample of female twins from Minnesota that increases in birth weight of one pound are correlated with a 1/3rd year increase in completed years of school. Interestingly this effect is shown to be stronger using a within-twin estimator. Using siblings from the PSID dataset, Conley et al. (2003a) find that low birth weight effects the likelihood of high school graduation and again finds the within-sibling effects to be larger than the between estimator. In the Norwegian context, Black et al. (2007) show evidence that low birth weight is correlated with education outcomes and earnings using twin comparisons. Royer (2009) also uses twin comparisons and shows the effects of low birth weight on educational attainment to be small. It is possible that the different results are driven by the different country contexts.

Oreopoulos et al. (2008) has recently pushed the literature forward by using an administrative sample of siblings and twins from one Canadian province to examine several issues with previous work, including examining a handful of intermediate outcomes of interest. The authors also make comparisons between sibling and twin samples to examine whether the effects of earlier research are driven by the potentially non-generalizable twin populations used. Further, the authors are able to examine a relatively rich set of outcomes such as educational outcomes, health care costs, and social program participation.³ The authors find little evidence of effects of poor infant health on physician utilization. They find evidence of a negative relationship between low birth

³ Oreopoulos et al (2008) is limited in that their data contains very few family level characteristics (marital status and mother's age at birth) so that they are forced to merge data at the neighborhood level, such as income. The authors note that a study by Mustard et al. (1999) shows that the correlation between neighborhood income and household income is 0.435.

weight and performance on a language arts test at grade 12—low birth weight vs. birth weight above 3,500 grams is associated with a decrease of 0.23 standard deviations, though the effects are not significant after controlling family fixed effects. The authors also examine the effects of low birth weight on reaching grade 12 by age 17, and find that low birth weight reduces reaching grade 12 by 8 percentage points relative to children with birth weights of 3,500 grams or more. The authors find no association with social assistance take-up once family controls are added. They find little evidence that low socioeconomic status (SES) kids fair worse, but their measures of SES are based on neighborhood rather than family SES.

While these papers have made important contributions to the literature, many questions remain. Are there effects of low birth weight during early childhood and adolescence? In particular, what events or outcomes that occur between the ages of 2 and 18 may be responsible for the estimated effects of low birth weight found in some parts of the literature? This paper is able to contribute to knowledge of some of these potential intermediate-term effects of low birth weight for several educational and health outcomes using a national sample of adolescents from the US, including a subsample of siblings. While administrative data is typically used, the use of survey information allows richer outcome variables to be examined as well as a more complete set of individual and family characteristics.

Data and Empirical Methodology

The data for this study come from the restricted version of the National Longitudinal Study of Adolescent Health (Add Health). The Add Health is a school-

based, longitudinal study of the health-related behaviors of adolescents and their outcomes in young adulthood. Beginning with an in-school questionnaire administered to a nationally representative sample of students in grades 7 through 12 in 1994-95 (Wave 1), the study follows up with a series of in-home interviews of students approximately one year (Wave 2) and then six years later (Wave 3). Other sources of data include questionnaires for parents, siblings, fellow students, and school administrators. By design, the Add Health survey included a sample stratified by region, urbanicity, school type, ethnic mix, and size.⁴

Over 20,000 students completed the Wave 1 in-home survey in 1994-95, and over 14,000 students have been followed longitudinally. The survey collected information from over 5,000 individuals who had a sibling or twin who was also surveyed. Birth weight, which is retrospectively reported by the respondent's parent in a separate survey collected at Wave 1⁵, is available for 12,400 individuals in the follow up sample and 3,500 of the sibling/twin subsample.

Descriptive statistics are provided in Tables 1 (full sample) and 2 (sibling sample). Descriptive statistics separated by twin or sibling status are provided in Table 2A in the appendix. Table 1 shows the average birth weight for this sample is over 3,250 grams and that 11 percent of the sample is classified as low birth weight, which is defined as birth weight less than 2,500 grams. Royer (2009) shows that for California births of singleton females between 1960-1982, the average birth weight was 3,298 grams, and the proportion of low birth weight was 5 percent. A small proportion, 2%, was classified as very low birth weight (<1,500 grams) in the Add Health sample—Royer (2009) also

⁴ See Udry 2003 for full description of the Add Health data set.

⁵ The surveyed parent reported the child's birth weight in pounds and ounces. These measures were combined and converted into grams (1 ounce = 28.3495 grams)

shows a small proportion of very low birth weight babies (<0.03% for female singletons and 3.3% of female twin births). This low proportion in the Add Health survey could partially be explained by selective mortality, since the survey was collected only for children who were alive and in grades 7-12 in 1994-5. Black et al. (2007) shows that infant mortality from low birth weight likely bias estimates on adult outcomes downward.

Table 2 shows that the proportion of twins who have low birth weight is 48%, which also closely matches the 45-49% figures from Royer (2009). Table 1 also shows that these respondents, who were on average 22 years old at Wave 3, have completed 13.2 years of schooling on average and 83% report receiving a high school diploma. The survey also includes many potential medium term health and educational outcomes of low birth weight. In this sample, 20% report repeating any grade by Wave 1⁶.

Oreopolous et al. (2008) use a different measure of whether an individual is on grade-level—whether he/she reached grade 12 by age 17—due to limitations with their administrative data.⁷ They report nearly 70% meet this definition. Importantly, this paper will be able to provide the first empirical evidence of whether the grade repetition occurred early (K-5th grade) or later (6th-12th grades) to further examine the timing of the effects of low birth weight. Thirteen percent of the sample report early grade repetition while only 6 percent report later grade repetition. Other measures of interest include whether the child has a learning disability at wave 1 (12%)⁸, AD/HD (8%)⁹, or receives

⁶ Recall that the respondents are in grades 7-12 at the time of the report, so a small number may repeat a grade following their response to the survey.

⁷ This measure also conflates grade repetition with being “redshirted”.

⁸ This question is asked of the parent respondent: “Does (he/she) have a specific learning disability, such as difficulties with attention, dyslexia, or some other reading, spelling, writing, or math disability?”

⁹ This ADHD measure is a retrospective measure filled in by the individual themselves during Wave 3 when respondents were 18-28 years of age. The survey asks respondents to think back to when they were between 5 and 12 and report how often they performed a set of behaviors (e.g. squirmed in their seat, had difficulty sustaining attention in tasks). One item asked in the retrospective ADHD section of wave III

special education services at wave 1 (9%). Following Black et al. (2007), this paper also examine adolescent height and young adult height¹⁰, and following Oreopolous et al. (2008), examines some measures of health care utilization as an adult, including using an emergency room (58%) or a hospitalization (26%) in the previous five years.

The empirical analysis follows much of the literature by using a series of OLS specifications that attempt to capture unobserved heterogeneity at the environmental and/or family levels by using the design of the survey, which includes multiple individuals from the same school and individuals in the same family.¹¹

First, baseline regressions are estimated:

$$y_{isf} = \alpha + bw_{isf}\beta + x_{isf}\delta + \varepsilon_{isf} \quad (1)$$

where outcome y of respondent i in school s from family f is a function of birth weight bw , with or without controlling for a set of individual and family level characteristics (x), including age, race, gender, birth order, number of siblings, family income, parental education, age, and health, and grade-level (cohort) fixed effects. Next, environmental factors are controlled by using school-level fixed effects along with a rich set of control variables:

$$y_{isf} = \alpha + bw_{isf}\beta + x_{isf}\delta + \mu_s + \varepsilon_{isf} \quad (2)$$

Finally, family fixed effects are controlled and the z vector is a subset of individual level characteristics that varies within families, such as age, gender, and birth order:

(“You were spiteful or vindictive”) is not a DSM-IV ADHD symptom and was excluded from analyses; while 1 DSM-IV impulsivity symptom (“Often interrupts or intrudes on others”) was not included in the retrospective ADHD section. Thus, the analyses included responses to 9 inattentive and 8 hyperactive/impulsive symptoms. Following Kollins et al. (2005) as well as community based samples (Murphy and Barley 1996), a symptom was considered present if it was experienced “often” or “very often.” See Fletcher and Wolfe (2008) for further details of the ADHD measure.

¹⁰ Height is self reported at wave 1 (adolescent) but measured at wave 3 (young adult).

¹¹ While the sample is from a nationally representative survey, weights are not used for the empirical models because weights are not available for the sibling sub-sample.

$$y_{if} = \alpha + bw_{if}\beta + z_{if}\delta + \mu_f + \varepsilon_{if} \quad (3)$$

Results

Table 3 presents unadjusted, adjusted, and school fixed effects specifications for medium term educational outcomes, including learning disability status, AD/HD status, receipt of special education services, and grade repetition. Full regression results are presented in Table 3A in the appendix. Results show that the unadjusted difference in the likelihood of having a learning disability between low birth weight babies and normal weight babies is 5 percentage points, which shrinks to 3.8 percentage points after controls and school fixed effects are used, though this still represents a nearly 33% increase in the likelihood of this outcome. The next set of results show no evidence of differences in AD/HD status by low birth weight status. For special education receipt, the unadjusted difference is 4.9 percentage points, which shrinks to 3.9 points with controls and school fixed effects—a nearly 50% increase .

Following Oreopoulos et al. (2008), I also examine grade repetition outcomes. As discussed earlier, Oreopoulos et al. has a rough measure available (whether the individual reached grade 12 by age 17). The authors show that low birth weight reduces this measure by 8-20 percentage points using sibling and twin differences. Another limitation with these results is that it is unknown when the grade repetition occurs, so that it is unclear whether the effects of low birth weight occur over the short or long term. The results in this paper show an unadjusted increase in grade repetition of 9 percentage points, which is reduced to a 4 percentage point reduction after controls are used—recall that the proportion of individuals who report a grade repetition for the sample is 20%. In

the next set of results, grade repetition is separated into early (grades K-5) and late (grades 6-12). The results indicate that the entire effect of low birth weight on grade repetition occurs in the early grades, with an adjusted estimate of 3.6 percentage points off of a base of 13%.

In Table 4, I present estimates of the effects of low birth weight on the same medium term educational outcomes but using the sibling subsample, school fixed effects, and family fixed effects. Overall, the results are very similar to Table 3, though often larger.¹² One exception is that special education receipt is no longer statistically significant when family fixed effects are controlled, though the magnitudes are very similar to previous estimates using school fixed effects (4.3 vs. 4.9 points). Thus, overall the evidence is strong that there are important intermediate-term educational and health disadvantages from being low birth weight, which are robust to controls for family level heterogeneity.

In Table 5, I show results of longer term educational outcomes, including years of schooling completed, receipt of high school diploma, and test scores measured at wave 1 and wave 3.¹³ These types of outcomes have been studied extensively in the literature, with Black et al (2007) showing relatively large effects of birth weight on adult IQ for Norwegian men (though the IQ scale range is 1-9) but Oreopolous et al. (2008) finding small effects on a language arts test at grade 12 for a Canadian sample, and Royer (2009)

¹² Since the full and sibling samples are potentially different and moving to the sibling subsample changes the composition of the analysis sample, I test whether the baseline adjusted results are different between the full and sibling samples. I can only reject equality for learning disabilities (at the 8% level).

¹³ The Add Health Picture Vocabulary Test (AHPVT) is a computerized, abridged version of the Peabody Picture Vocabulary Test-Revised (PPVT-R). The AHPVT is a test of hearing vocabulary, designed for persons aged 2 1/2 to 40 years old who can see and hear reasonably well and who understand standard English to some degree. The test scores are standardized by age. Some psychologists interpret PVT scores as a measure of verbal IQ. Information on the test is provided online at <http://www.cpc.unc.edu/projects/addhealth/files/w3cdbk/w3doc.zip>.

finding small effects on years of schooling for US female twins. One limitation with the current study is that the respondents are surveyed conditional on appearing in grades 7-12 in 1994-5, so some individuals with low birth weight may have already dropped out of school.¹⁴ A second limitation with the years of schooling measure is that some individuals have not yet completed their schooling at wave 3. Importantly, in the adjusted analyses, grade-level (cohort) fixed effects at wave 1 are controlled, which should partially alleviate these potential problems.

Like many previous studies, the results suggest small or no effects of low birth weight on high school graduation or years of schooling. The results for test scores at adolescence and young adulthood suggest modest reductions for low birth weight babies (less than a 1/15 standard deviation reduction in the school fixed effects models). When we examine the results in Table 6, which shows the family fixed effects specifications, the estimates are similar in size but less precisely measured.

These findings suggest that the early to medium term educational disadvantages produced by low birth weight status do not seem to result in large educational disadvantages in young adulthood, as measured by years of schooling, receipt of a high school diploma and even achievement on a test of verbal IQ.

Finally, in Tables 7 and 8, height and health utilization outcomes are examined in order to follow Black et al. (2007) and Oreopolous et al. (2008), respectively. Black et al. (2007) found that a 10% increase in birth weight is linked with a 0.75 increase in height (in centimeters). Results in Table 7 suggest that low birth weight babies are approximately 0.8 inches (2 centimeters) shorter in adolescence but only 0.5 inches (1.2

¹⁴ Results in Appendix Table 8A suggest that low birth weight status is not different for individuals across grade levels at wave 1 of the survey, though.

centimeters) shorter by early adulthood. Using a log(birth weight) specification to follow Black et al. (2007) produces very similar results (available upon request), ranging from 0.7 to 0.9 centimeters in height associated with a 10% increase in birth weight.

Results in Table 8 examine two measures of health care utilization: (1) any visit to the emergency room in the previous 5 years and (2) any hospitalization in the previous 5 years. Like results in Oreopolous et al. (2008), I find no evidence that low birth weight babies have higher health care utilization for these measures.

Conclusions

This paper is one of the first papers to examine medium term effects of low birth weight on educational and health outcomes. Using a national sample of adolescents followed into early adulthood and a large subsample of siblings, I am able to follow much of the current research on the effects of low birth weight on life outcomes by using family fixed effects and tracking respondents over time. Long term outcomes such as years of schooling, high school graduation, and test scores largely match previous estimates in the literature, which suggest that long term educational and labor market effects of low birth weight status are likely small. However, this paper does show important medium term disadvantages for low birth weight babies, such as increases in learning disabilities, receipt of special education services, and early grade repetition. However, these early disadvantages appear to largely disappear by young adulthood.

Limitations with the data include few children with very low birth weights, potential measurement error from retrospective parental reports of birth weight, and selection into the survey of individuals in school in grades 7-12 in 1994-5. Black et al.

(2007) show larger effects on adult height and IQ as well as infant mortality for children with birth weights below 1200 grams. Since the Add Health sample has noisy information for birth weights below 1300 grams, this paper is not able to adequately examine this important health indicator. The sample is also conditional on being in school during 1994-95. Although grade (cohort) fixed effects are controlled in the analysis, it could be the case that low birth weight babies have already dropped out of school so that the results on years of schooling and high school diploma receipt are too conservative.¹⁵ However, the long term results are very small in magnitude, so the sample selection bias would need to be severe to overturn the current estimates.

These limitations should be balanced with the many advantages of the data, including following a large national sample of adolescents, including a large subsample of siblings. The survey is also able to overcome the limitations with previous research that has relied on administrative data and the relatively small number of outcomes (and individual characteristics) available in administrative data. Thus, this paper provides a first look into the medium term educational and health consequences of low birth weight. The results are largely robust to the inclusion of school fixed effects as well as family fixed effects. Overall, the results suggest that several important medium term educational disadvantages, such as learning disabilities, receipt of special education, and grade repetition, are associated with low birth weight and are not driven by family level unobservables but do not seem to accumulate into large long-term disadvantage.

¹⁵Results presented in Appendix Table 8A suggest little evidence of differences across grade level in the reporting of low birth weight.

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Tables

Table 1
Descriptive Statistics for Add Health Full Sample

Variable	Wave	Obs	Mean	Std Dev	Min	Max
Low Birth Weight (<2500 grams)	Pre-1	12425	0.11	0.32	0	1
Very Low Birth Weight (<1500 grams)	Pre-1	12425	0.02	0.15	0	1
Birth Weight (grams)	Pre-1	12425	3267	641	1361	5443
Repeat Grade K-5	1	12404	0.13	0.34	0	1
Repeat Grade 6-12	1	12404	0.06	0.24	0	1
Learning Disability	1	12276	0.12	0.32	0	1
Years of Education	3	12413	13.22	1.96	6	22
College	3	12413	0.55	0.50	0	1
HS Diploma	3	12414	0.83	0.38	0	1
Repeat Grade K-12	1	12409	0.20	0.40	0	1
Special Education	1	12369	0.09	0.28	0	1
PVT Score	1	11892	101.19	14.34	14	146
PVT Score	3	12011	101.27	15.74	9	123
Height (feet)	1	12295	5.51	0.34	4	6.8
Height (feet)	3	12047	5.58	0.34	4	7.6
ADHD	3	12415	0.08	0.28	0	1
Age	3	12425	21.82	1.75	18	28
Male	All	12425	0.47	0.50	0	1
Black	All	12425	0.21	0.41	0	1
Hispanic	All	12425	0.15	0.35	0	1
Other Race	All	12425	0.06	0.24	0	1
Birth Order	All	12425	1.81	1.14	1	14
Number of Siblings	All	12425	1.58	1.38	0	13
Singleton	All	12425	0.21	0.40	0	1
Family Income	1	12425	46.15	41.82	0	900
Maternal Education	1	12425	13.27	2.23	0	17
Married Parents	1	12425	0.73	0.44	0	1
Parental Age	1	12425	41.84	6.18	20	89
Parental Health	1	12425	2.40	1.02	1	5
Grade = 8	1	12152	0.15	0.36	0	1
Grade = 9	1	12152	0.19	0.39	0	1
Grade = 10	1	12152	0.19	0.40	0	1
Grade = 11	1	12152	0.18	0.39	0	1
Grade = 12	1	12152	0.14	0.34	0	1
Missing Information	1	12425	0.21	0.41	0	1

Table 2
Descriptive Statistics for Add Health
Family Sample

Variable	Wave	Obs	Mean	Std Dev	Min	Max
Low Birth Weight (<2500 grams)	Pre-1	3511	0.21	0.41	0	1
Very Low Birth Weight (<1500 grams)	Pre-1	3511	0.05	0.21	0	1
Birth Weight (pounds)	Pre-1	3511	6.75	1.59	3	12
Birth Weight (grams)	Pre-1	3511	3061	720	1361	5443
Repeat Grade K-5	1	3501	0.17	0.37	0	1
Repeat Grade 6-12	1	3501	0.06	0.25	0	1
Learning Disability	1	3465	0.13	0.34	0	1
Years of Education	3	3507	13.09	2.00	6	22
College	3	3507	0.51	0.50	0	1
Dropout	3	3507	0.14	0.35	0	1
HS Diploma	3	3507	0.81	0.39	0	1
GED	3	3505	0.09	0.28	0	1
Dropout (GED=0)	3	3505	0.11	0.32	0	1
Dropout (GED=1)	3	3507	0.19	0.39	0	1
Idle	3	3360	0.14	0.35	0	1
Repeat Grade K-12	1	3505	0.24	0.42	0	1
Special Education	1	3495	0.09	0.29	0	1
PVT Score	1	3373	99.63	13.71	26	146
PVT Score	3	3403	99.92	15.52	9	123
Height (feet)	1	3478	5.50	0.35	4	6.8
Height (feet)	3	3423	5.58	0.34	4	7.0
ADHD	3	3508	0.09	0.28	0	1
Age	3	3511	21.81	1.75	18	27
Male	All	3511	0.48	0.50	0	1
Black	All	3511	0.23	0.42	0	1
Hispanic	All	3511	0.13	0.34	0	1
Other Race	All	3511	0.06	0.23	0	1
Birth Order	All	3511	1.97	1.20	1	12
Number of Siblings	All	3511	1.88	1.49	0	13
Family Income	1	3511	44.56	40.37	0	800
Maternal Education	1	3511	13.14	2.20	0	17
Married Parents	1	3511	0.71	0.45	0	1
Parental Age	1	3511	41.40	5.89	24	75
Parental Health	1	3511	2.41	1.03	1	5
Grade = 8	1	3403	0.15	0.35	0	1
Grade = 9	1	3403	0.20	0.40	0	1
Grade = 10	1	3403	0.19	0.39	0	1
Grade = 11	1	3403	0.18	0.38	0	1
Grade = 12	1	3403	0.13	0.33	0	1
Missing Information	1	3511	0.22	0.41	0	1

Table 3
Effects of Low Birth Weight on Medium Term Outcomes
Basic and School Fixed Effects

Outcome	Learning Disability	Learning Disability	Learning Disability	ADHD	ADHD	ADHD
Sample	Full	Full	Full	Full	Full	Full
Specification	No Xs	Xs	Xs	No Xs	Xs	Xs
Fixed Effects	None	None	School	None	None	School
Low Birth Weight (<2500 grams)	0.050*** (0.011)	0.046*** (0.011)	0.038*** (0.011)	-0.000 (0.007)	0.005 (0.007)	0.005 (0.007)
Observations	12276	12009	12009	12415	12143	12143
R-squared	0.002	0.050	0.090	0.000	0.016	0.034
Outcome	Special Ed	Special Ed	Special Ed	Repeat Any Grade	Repeat Any Grade	Repeat Any Grade
Sample	Full	Full	Full	Full	Full	Full
Specification	No Xs	Xs	Xs	No Xs	Xs	Xs
Fixed Effects	None	None	School	None	None	School
Low Birth Weight (<2500 grams)	0.049*** (0.010)	0.043*** (0.010)	0.039*** (0.009)	0.091*** (0.015)	0.043*** (0.011)	0.039*** (0.012)
Observations	12369	12100	12100	12409	12141	12141
R-squared	0.003	0.042	0.095	0.005	0.322	0.352
Outcome	Repeat K-5	Repeat K-5	Repeat K-5	Repeat 6-12	Repeat 6-12	Repeat 6-12
Sample	Full	Full	Full	Full	Full	Full
Specification	No Xs	Xs	Xs	No Xs	Xs	Xs
Fixed Effects	None	None	School	None	None	School
Low Birth Weight (<2500 grams)	0.073*** (0.012)	0.041*** (0.011)	0.036*** (0.012)	0.012 (0.009)	-0.006 (0.008)	-0.007 (0.008)
Observations	12404	12131	12131	12404	12131	12131
R-squared	0.005	0.228	0.252	0.000	0.111	0.148

Robust standard errors clustered at the school level. ***1%, **5%, *10%

Xs: age, gender, race, birth order, number of siblings, singleton status, family income, maternal education, married parents, parental age, parental health, grade fixed effects, missing information dummy

Table 4
Effects of Low Birth Weight on Medium Term Outcomes
School and Family Fixed Effects

Outcome	Learning Disability	Learning Disability	Learning Disability	ADHD	ADHD	ADHD
Sample	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family
Low Birth Weight (<2500 grams)	0.066*** (0.016)	0.063*** (0.017)	0.084** (0.041)	0.007 (0.011)	0.007 (0.012)	0.087** (0.036)
Observations	3359	3359	3465	3400	3400	3508
R-squared	0.069	0.126	0.677	0.020	0.062	0.611
P diff full	0.078			0.765		
Outcome	Special Ed	Special Ed	Special Ed	Repeat Any Grade	Repeat Any Grade	Repeat Any Grade
Sample	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family
Low Birth Weight (<2500 grams)	0.046*** (0.012)	0.049*** (0.012)	0.043 (0.038)	0.060*** (0.016)	0.059*** (0.018)	0.081** (0.039)
Observations	3388	3388	3495	3398	3398	3505
R-squared	0.056	0.113	0.690	0.366	0.417	0.752
P diff full	0.740			0.154		
Outcome	Repeat K-5	Repeat K-5	Repeat K-5	Repeat 6-12	Repeat 6-12	Repeat 6-12
Sample	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family
Low Birth Weight (<2500 grams)	0.057*** (0.017)	0.056*** (0.018)	0.073* (0.040)	-0.004 (0.011)	-0.008 (0.011)	0.002 (0.026)
Observations	3393	3393	3501	3393	3393	3501
R-squared	0.270	0.318	0.739	0.115	0.183	0.671
P diff full	0.160			0.800		

Robust standard errors clustered at the school level. ***1%, **5%, *10%

Xs: age, gender, race, birth order, number of siblings, singleton status, family income, maternal education, married parents, parental age, parental health, grade fixed effects, missing information dummy

Table 5
Effects of Low Birth Weight on Long Term Education Outcomes

Outcome	Years of Educ	Years of Educ	Years of Educ	HS Grad	HS Grad	HS Grad
Sample	Full	Full	Full	Full	Full	Full
Specification	No Xs	Xs	Xs	No Xs	Xs	Xs
Fixed Effects	None	None	School	None	None	School
Low Birth Weight (<2500 grams)	-0.152** (0.062)	-0.030 (0.055)	-0.014 (0.050)	-0.020* (0.011)	0.005 (0.011)	0.008 (0.011)
Observations	12413	12144	12144	12414	12141	12141
R-squared	0.001	0.278	0.331	0.000	0.089	0.126
Outcome	PVT Score 1	PVT Score 1	PVT Score 1	PVT Score 3	PVT Score 3	PVT Score 3
Sample	Full	Full	Full	Full	Full	Full
Specification	No Xs	Xs	Xs	No Xs	Xs	Xs
Fixed Effects	None	None	School	None	None	School
Low Birth Weight (<2500 grams)	-2.867*** (0.542)	-0.905** (0.409)	-0.894** (0.343)	-2.637*** (0.759)	-0.691 (0.667)	-0.809* (0.428)
Observations	11892	11645	11645	12011	11757	11757
R-squared	0.004	0.253	0.322	0.003	0.179	0.255

Robust standard errors clustered at the school level. ***1%, **5%, *10%

Xs: age, gender, race, birth order, number of siblings, singleton status, family income, maternal education, married parents, parental age, parental health, grade fixed effects, missing information dummy

Table 6
Effects of Low Birth Weight on Long Term Education Outcomes
School and Family Fixed Effects

Outcome	Years of Educ	Years of Educ	Years of Educ	HS Grad	HS Grad	HS Grad
Sample	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family
Low Birth Weight (<2500 grams)	0.047 (0.086)	0.042 (0.086)	-0.088 (0.179)	0.018 (0.016)	0.013 (0.020)	0.005 (0.040)
Observations	3399	3399	3507	3399	3399	3507
R-squared	0.282	0.340	0.798	0.104	0.171	0.735
P diff full	0.230			0.272		
Outcome	PVT Score 1	PVT Score 1	PVT Score 1	PVT Score 3	PVT Score 3	PVT Score 3
Sample	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family
Low Birth Weight (<2500 grams)	-0.916 (0.592)	-0.943* (0.513)	-0.970 (1.237)	-0.416 (0.796)	-0.592 (0.655)	-1.190 (1.627)
Observations	3275	3275	3373	3302	3302	3403
R-squared	0.261	0.343	0.823	0.193	0.294	0.808
P diff full	0.981			0.517		

Robust standard errors clustered at the school level. ***1%, **5%, *10%

Xs: age, gender, race, birth order, number of siblings, singleton status, family income, maternal education, married parents, parental age, parental health, grade fixed effects, missing information dummy

Table 7
Effects of Low Birth Weight on Adolescent and Young Adult Height
School and Family Fixed Effects

Outcome	Height 1	Height 1	Height 1	Height 3	Height 3	Height 3
Sample	Full	Family	Family	Full	Family	Family
Fixed Effects	School	School	Family	School	School	Family
Low Birth Weight (<2500 grams)	-0.088*** (0.009)	-0.105*** (0.014)	-0.068** (0.029)	-0.086*** (0.008)	-0.093*** (0.012)	-0.041 (0.026)
Age	0.027*** (0.006)	0.049*** (0.009)	0.061*** (0.006)	-0.010*** (0.003)	0.001 (0.007)	-0.002 (0.005)
Male	0.347*** (0.013)	0.342*** (0.016)	0.331*** (0.021)	0.480*** (0.005)	0.477*** (0.009)	0.476*** (0.014)
Black	0.014* (0.008)	0.020 (0.022)		0.017** (0.008)	0.031* (0.017)	
Hispanic	-0.088*** (0.010)	-0.096*** (0.021)		-0.104*** (0.009)	-0.100*** (0.018)	
Other Race	-0.155*** (0.019)	-0.176*** (0.039)		-0.170*** (0.022)	-0.199*** (0.045)	
Birth Order	-0.003 (0.003)	-0.004 (0.006)	0.002 (0.012)	-0.002 (0.003)	-0.006 (0.006)	0.005 (0.010)
Number of Siblings	-0.003 (0.003)	-0.007 (0.006)		-0.004 (0.002)	-0.003 (0.005)	
Singleton	0.006 (0.007)	-0.017 (0.018)		-0.005 (0.007)	-0.004 (0.015)	
Family Income	0.000 (0.000)	0.000 (0.000)		0.000 (0.000)	0.000 (0.000)	
Maternal Education	0.004*** (0.001)	0.004* (0.002)		0.005*** (0.001)	0.003 (0.002)	
Married Parents	0.002 (0.007)	0.024 (0.015)		0.003 (0.006)	0.022* (0.012)	
Parental Age	0.002*** (0.000)	0.003*** (0.001)		0.002*** (0.000)	0.003*** (0.001)	
Parental Health	0.001 (0.003)	0.005 (0.005)		0.001 (0.002)	0.002 (0.005)	
Grade = 8	0.121*** (0.012)	0.111*** (0.020)		0.014 (0.008)	0.013 (0.017)	
Grade = 9	0.196*** (0.016)	0.161*** (0.026)		0.014 (0.011)	0.008 (0.023)	
Grade = 10	0.215*** (0.022)	0.166*** (0.036)		0.026* (0.015)	-0.003 (0.027)	
Grade = 11	0.226*** (0.023)	0.157*** (0.040)		0.043*** (0.015)	0.012 (0.032)	
Grade = 12	0.205*** (0.031)	0.130*** (0.047)		0.044** (0.018)	0.002 (0.037)	
Observations	12035	3373	3478	11791	3317	3423
R-squared	0.427	0.454	0.839	0.535	0.561	0.886

Robust standard errors clustered at the school level. ***1%, **5%, *10%.

Additional Controls: Missing Information Dummy and Constant

Table 8
Effects of Low Birth Weight on Health Care Utilization
School and Family Fixed Effects

Outcome	Any ER	Any ER	Any ER	Hospital	Hospital	Hospital
Sample	Full	Family	Family	Full	Family	Family
Fixed Effects	School	School	Family	School	School	Family
Low Birth Weight (<2500 grams)	-0.004 (0.015)	-0.037* (0.019)	0.073 (0.052)	-0.003 (0.013)	-0.014 (0.019)	0.059 (0.061)
Age	0.016** (0.007)	0.030** (0.013)	-0.001 (0.012)	0.024*** (0.005)	0.027*** (0.010)	0.015 (0.010)
Male	-0.006 (0.012)	0.006 (0.020)	0.005 (0.039)	-0.213*** (0.011)	-0.228*** (0.019)	-0.225*** (0.032)
Black	0.022 (0.017)	0.051* (0.029)		0.009 (0.012)	0.000 (0.029)	
Hispanic	0.010 (0.015)	-0.005 (0.039)		0.019 (0.015)	0.020 (0.027)	
Other Race	-0.107*** (0.021)	-0.165*** (0.043)		-0.036** (0.017)	-0.016 (0.036)	
Birth Order	0.011 (0.007)	-0.007 (0.013)	0.005 (0.025)	0.015*** (0.005)	-0.000 (0.009)	-0.006 (0.022)
Singleton	0.038** (0.014)	0.024 (0.028)		0.030** (0.014)	0.040 (0.031)	
Family Income	-0.000 (0.000)	-0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)	
Maternal Education	-0.002 (0.003)	0.002 (0.005)		-0.007*** (0.002)	-0.001 (0.004)	
Married Parents	-0.027** (0.013)	0.001 (0.025)		-0.031*** (0.010)	-0.047** (0.019)	
Parental Age	-0.001 (0.001)	-0.001 (0.002)		-0.004*** (0.001)	-0.003** (0.001)	
Parental Health	0.017*** (0.005)	0.033*** (0.010)		0.010** (0.005)	0.019** (0.008)	
Grade = 8	0.010 (0.019)	0.037 (0.032)		0.016 (0.014)	0.024 (0.025)	
Grade = 9	0.002 (0.024)	-0.056 (0.043)		0.012 (0.022)	0.005 (0.039)	
Grade = 10	-0.042 (0.031)	-0.122** (0.056)		-0.024 (0.028)	-0.031 (0.046)	
Grade = 11	-0.057* (0.034)	-0.106* (0.062)		-0.033 (0.029)	-0.060 (0.051)	
Grade = 12	-0.084** (0.040)	-0.160** (0.078)		-0.051 (0.036)	-0.058 (0.065)	
Observations	11701	3281	3382	11980	3357	3465
R-squared	0.048	0.082	0.653	0.107	0.143	0.647

Robust standard errors clustered at the school level. ***1%, **5%, *10%.
Additional Controls: Missing Information Dummy, number of siblings, and a Constant

Appendix Tables

Table 1A
Descriptive Statistics of Dropped Sample

Variable	Wave	Obs	Mean	Std Dev	Min	Max
Low Birth Weight (<2500 grams)	Pre-1	4123	0.11	0.31	0	1
Very Low Birth Weight (<1500 grams)	Pre-1	4123	0.02	0.15	0	1
Birth Weight (pounds)	Pre-1	4123	7.24	1.41	3	12
Birth Weight (grams)	Pre-1	4123	3285	641	1361	5443
Repeat Grade K-5	1	4119	0.17	0.38	0	1
Repeat Grade 6-12	1	4119	0.09	0.28	0	1
Learning Disability	1	4083	0.16	0.36	0	1
Years of Education	3	0				
College	3	0				
HS Diploma	3	0				
Repeat Grade K-12	1	4107	0.25	0.44	0	1
Special Education	1	4104	0.13	0.33	0	1
PVT Score	1	3932	98.75	15.68	13	137
PVT Score	3	0				
Height (feet)	1	4062	5.54	0.35	4	6.8
Height (feet)	3	0				
ADHD	3	0				
Age	3	0				
Male	All	4123	0.56	0.50	0	1
Black	All	4123	0.23	0.42	0	1
Hispanic	All	4123	0.18	0.38	0	1
Other Race	All	4123	0.05	0.22	0	1
Birth Order	All	4123	1.79	1.15	1	14
Number of Siblings	All	4123	1.56	1.43	0	13
Singleton	All	4123	0.22	0.42	0	1
Family Income	1	4123	42.74	40.82	0	980
Maternal Education	1	4123	13.07	2.12	0	17
Married Parents	1	4123	0.64	0.48	0	1
Parental Age	1	4123	41.43	6.48	20	86
Parental Health	1	4123	2.46	1.03	1	5
Grade = 8	1	3991	0.13	0.34	0	1
Grade = 9	1	3991	0.19	0.39	0	1
Grade = 10	1	3991	0.21	0.41	0	1
Grade = 11	1	3991	0.18	0.38	0	1
Grade = 12	1	3991	0.17	0.37	0	1
Missing Information	1	4123	0.24	0.43	0	1

Table 2A
Descriptive Statistics of Family Sample
Twin Sample vs. Sibling Sample

Variable	Wave	Obs	Mean	Std Dev	Obs	Mean	Std Dev
Low Birth Weight (<2500 grams)	Pre-1	947	0.48	0.50	2564	0.11	0.32
Very Low Birth Weight (<1500 grams)	Pre-1	947	0.11	0.31	2564	0.02	0.16
Birth Weight (grams)	Pre-1	947	2541	640	2564	3253	650
Repeat Grade K-5	1	945	0.18	0.39	2556	0.16	0.37
Repeat Grade 6-12	1	945	0.06	0.24	2556	0.07	0.25
Learning Disability	1	933	0.14	0.35	2532	0.13	0.33
Years of Education	3	946	13.26	1.95	2561	13.03	2.01
College	3	946	0.55	0.50	2561	0.49	0.50
HS Diploma	3	947	0.84	0.37	2560	0.80	0.40
Repeat Grade K-12	1	942	0.25	0.43	2563	0.23	0.42
Special Education	1	939	0.10	0.29	2556	0.09	0.29
PVT Score	1	908	98.95	13.74	2465	99.89	13.69
PVT Score	3	917	100.09	14.60	2486	99.86	15.85
Height (feet)	1	934	5.50	0.37	2544	5.51	0.34
Height (feet)	3	928	5.57	0.36	2495	5.58	0.34
ADHD	3	947	0.07	0.26	2561	0.09	0.29
Age	3	947	21.87	1.63	2564	21.79	1.79
Male	All	947	0.51	0.50	2564	0.47	0.50
Black	All	947	0.25	0.44	2564	0.22	0.42
Hispanic	All	947	0.13	0.33	2564	0.13	0.34
Other Race	All	947	0.04	0.20	2564	0.06	0.24
Birth Order	All	947	2.24	1.29	2564	1.87	1.15
Number of Siblings	All	947	2.17	1.42	2564	1.77	1.50
Family Income	1	947	47.61	53.39	2564	43.43	34.27
Maternal Education	1	947	13.20	2.37	2564	13.12	2.13
Married Parents	1	947	0.70	0.45	2564	0.71	0.45
Parental Age	1	947	42.24	6.13	2564	41.09	5.76
Parental Health	1	947	2.36	1.04	2564	2.44	1.02
Grade = 8	1	929	0.14	0.35	2474	0.15	0.36
Grade = 9	1	929	0.22	0.41	2474	0.19	0.39
Grade = 10	1	929	0.20	0.40	2474	0.19	0.39
Grade = 11	1	929	0.19	0.40	2474	0.17	0.38
Grade = 12	1	929	0.11	0.31	2474	0.14	0.34
Missing Information	1	947	0.21	0.41	2564	0.22	0.42

Table 3A
Full Results for Table 3

Outcome	Learning Disability	Learning Disability	Learning Disability	ADHD	ADHD	ADHD	Special Ed	Special Ed	Special Ed
Sample	Full	Full	Full	Full	Full	Full	Full	Full	Full
Fixed Effects	None	None	School	None	None	School	None	None	School
Low Birth Weight	0.050*** (0.011)	0.046*** (0.011)	0.038*** (0.011)	-0.000 (0.007)	0.005 (0.007)	0.005 (0.007)	0.049*** (0.010)	0.043*** (0.010)	0.039*** (0.009)
Age		0.068*** (0.006)	0.071*** (0.006)		0.017*** (0.004)	0.017*** (0.004)		0.054*** (0.006)	0.057*** (0.006)
Male		0.059*** (0.007)	0.058*** (0.007)		0.047*** (0.007)	0.046*** (0.007)		0.037*** (0.006)	0.037*** (0.006)
Black		-0.042*** (0.010)	-0.042*** (0.011)		-0.037*** (0.006)	-0.030*** (0.009)		-0.024*** (0.008)	-0.017* (0.009)
Hispanic		-0.029** (0.011)	-0.037*** (0.011)		-0.026*** (0.008)	-0.022** (0.009)		-0.028*** (0.009)	-0.031*** (0.011)
Other Race		-0.066*** (0.019)	-0.088*** (0.017)		-0.042*** (0.011)	-0.047*** (0.010)		-0.041*** (0.011)	-0.049*** (0.011)
Birth Order		0.008** (0.003)	0.008** (0.003)		0.008** (0.003)	0.008** (0.003)		0.005 (0.004)	0.005 (0.004)
Number of Siblings		-0.007 (0.004)	-0.008* (0.004)		-0.004 (0.003)	-0.005* (0.003)		-0.002 (0.004)	-0.002 (0.004)
Singleton		0.011 (0.009)	0.008 (0.009)		0.018** (0.008)	0.017** (0.008)		0.009 (0.009)	0.007 (0.009)
Family Income		-0.000 (0.000)	-0.000 (0.000)		0.000 (0.000)	0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)
Maternal Education		-0.003 (0.002)	-0.002 (0.002)		-0.001 (0.001)	-0.001 (0.001)		-0.004** (0.002)	-0.003* (0.002)
Married Parents		-0.011 (0.008)	-0.003 (0.008)		-0.009 (0.007)	-0.009 (0.006)		-0.021*** (0.007)	-0.013** (0.006)
Parental Age		0.001 (0.001)	0.001 (0.001)		0.000 (0.000)	0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)
Parental Health		0.015*** (0.003)	0.015*** (0.003)		0.004* (0.003)	0.005* (0.003)		0.008*** (0.003)	0.009*** (0.003)
Grade = 8		-0.064*** (0.012)	-0.066*** (0.012)		-0.021* (0.011)	-0.020* (0.011)		-0.056*** (0.012)	-0.058*** (0.011)
Grade = 9		-0.134*** (0.018)	-0.134*** (0.018)		-0.033** (0.013)	-0.022 (0.017)		-0.119*** (0.019)	-0.124*** (0.019)
Grade = 10		-0.219*** (0.022)	-0.222*** (0.022)		-0.064*** (0.016)	-0.054*** (0.019)		-0.189*** (0.023)	-0.196*** (0.023)
Grade = 11		-0.293*** (0.027)	-0.298*** (0.026)		-0.080*** (0.020)	-0.069*** (0.022)		-0.249*** (0.027)	-0.259*** (0.026)
Grade = 12		-0.380*** (0.034)	-0.390*** (0.032)		-0.104*** (0.023)	-0.094*** (0.024)		-0.311*** (0.033)	-0.325*** (0.032)
Observations	12276	12009	12009	12415	12143	12143	12369	12100	12100
R-squared	0.002	0.050	0.090	0.000	0.016	0.034	0.003	0.042	0.095

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 3A (cont'd)

Outcome	Repeat Any	Repeat Any	Repeat Any	Repeat K-5	Repeat K-5	Repeat K-5	Repeat 6-12	Repeat 6-12	Repeat 6-12
Sample	Full	Full	Full	Full	Full	Full	Full	Full	Full
Fixed Effects	None	None	School	None	None	School	None	None	School
Low Birth Weight	0.091*** (0.015)	0.043*** (0.011)	0.039*** (0.012)	0.073*** (0.012)	0.041*** (0.011)	0.036*** (0.012)	0.012 (0.009)	-0.006 (0.008)	-0.007 (0.008)
Age		0.289*** (0.009)	0.291*** (0.010)		0.210*** (0.009)	0.212*** (0.010)		0.099*** (0.007)	0.098*** (0.007)
Male		0.040*** (0.006)	0.039*** (0.007)		0.014** (0.006)	0.013** (0.006)		0.026*** (0.004)	0.025*** (0.004)
Black		0.071*** (0.014)	0.034*** (0.012)		0.056*** (0.011)	0.041*** (0.010)		0.028** (0.013)	-0.005 (0.010)
Hispanic		0.043*** (0.014)	0.049*** (0.018)		0.012 (0.010)	0.025** (0.012)		0.026* (0.014)	0.021* (0.013)
Other Race		0.008 (0.020)	-0.011 (0.016)		-0.017 (0.015)	-0.014 (0.013)		0.031*** (0.012)	0.010 (0.012)
Birth Order		0.006 (0.004)	0.003 (0.004)		0.005 (0.004)	0.002 (0.004)		0.001 (0.003)	0.001 (0.003)
Number of Siblings		0.001 (0.004)	0.003 (0.004)		0.000 (0.004)	0.003 (0.003)		0.001 (0.002)	0.000 (0.002)
Singleton		0.006 (0.008)	0.008 (0.008)		-0.001 (0.009)	-0.000 (0.009)		0.010 (0.007)	0.011* (0.006)
Family Income		-0.000*** (0.000)	-0.000** (0.000)		-0.000*** (0.000)	-0.000 (0.000)		-0.000*** (0.000)	-0.000 (0.000)
Maternal Education		-0.013*** (0.002)	-0.010*** (0.002)		-0.010*** (0.001)	-0.009*** (0.001)		-0.002* (0.001)	-0.001 (0.001)
Married Parents		-0.032*** (0.010)	-0.028*** (0.009)		-0.013 (0.009)	-0.010 (0.008)		-0.021*** (0.006)	-0.021*** (0.006)
Parental Age		-0.000 (0.001)	-0.000 (0.001)		-0.000 (0.001)	0.000 (0.001)		-0.001** (0.000)	-0.001* (0.000)
Parental Health		0.021*** (0.003)	0.018*** (0.003)		0.016*** (0.004)	0.014*** (0.004)		0.007*** (0.002)	0.005** (0.002)
Grade = 8		-0.264*** (0.014)	-0.262*** (0.014)		-0.200*** (0.014)	-0.199*** (0.015)		-0.090*** (0.010)	-0.088*** (0.010)
Grade = 9		-0.555*** (0.022)	-0.537*** (0.024)		-0.429*** (0.022)	-0.402*** (0.025)		-0.166*** (0.016)	-0.163*** (0.015)
Grade = 10		-0.840*** (0.028)	-0.816*** (0.031)		-0.636*** (0.029)	-0.603*** (0.033)		-0.260*** (0.024)	-0.256*** (0.022)
Grade = 11		-1.143*** (0.036)	-1.124*** (0.039)		-0.857*** (0.036)	-0.826*** (0.041)		-0.369*** (0.031)	-0.368*** (0.028)
Grade = 12		-1.431*** (0.049)	-1.415*** (0.053)		-1.066*** (0.047)	-1.040*** (0.053)		-0.460*** (0.038)	-0.456*** (0.036)
Observations	12409	12141	12141	12404	12131	12131	12404	12131	12131
R-squared	0.005	0.322	0.352	0.005	0.228	0.252	0.000	0.111	0.148

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 5A
Full Results for Table 5

Outcome Sample Fixed Effects	Years of Educ	Years of Educ	Years of Educ	HS Grad	HS Grad	HS Grad
	Full None	Full None	Full School	Full None	Full None	Full School
Low Birth Weight (<2500 grams)	-0.152** (0.062)	-0.030 (0.055)	-0.014 (0.050)	-0.020* (0.011)	0.005 (0.011)	0.008 (0.011)
Age		-0.399*** (0.031)	-0.390*** (0.029)		-0.081*** (0.007)	-0.083*** (0.007)
Male		-0.302*** (0.034)	-0.294*** (0.029)		-0.037*** (0.007)	-0.037*** (0.007)
Black		0.014 (0.107)	0.100 (0.072)		0.004 (0.011)	0.035*** (0.013)
Hispanic		-0.074 (0.061)	-0.029 (0.074)		-0.042*** (0.010)	-0.033** (0.014)
Other Race		0.225 (0.150)	0.395*** (0.076)		0.000 (0.010)	0.012 (0.015)
Birth Order		-0.133*** (0.022)	-0.111*** (0.021)		-0.002 (0.004)	-0.000 (0.004)
Number of Siblings		-0.013 (0.018)	-0.015 (0.018)		-0.002 (0.004)	-0.003 (0.004)
Singleton		-0.295*** (0.050)	-0.254*** (0.049)		-0.010 (0.011)	-0.009 (0.011)
Family Income		0.005*** (0.001)	0.003*** (0.001)		0.000*** (0.000)	0.000** (0.000)
Maternal Education		0.174*** (0.017)	0.140*** (0.015)		0.017*** (0.002)	0.016*** (0.002)
Married Parents		0.335*** (0.037)	0.304*** (0.036)		0.059*** (0.008)	0.050*** (0.009)
Parental Age		0.038*** (0.003)	0.030*** (0.003)		0.002*** (0.001)	0.002*** (0.001)
Parental Health		-0.141*** (0.018)	-0.112*** (0.017)		-0.020*** (0.004)	-0.019*** (0.004)
Grade = 8		0.798*** (0.061)	0.792*** (0.060)		0.087*** (0.016)	0.085*** (0.015)
Grade = 9		1.573*** (0.093)	1.537*** (0.115)		0.169*** (0.020)	0.167*** (0.020)
Grade = 10		2.357*** (0.122)	2.354*** (0.141)		0.270*** (0.026)	0.273*** (0.027)
Grade = 11		3.027*** (0.143)	3.033*** (0.155)		0.396*** (0.031)	0.402*** (0.031)
Grade = 12		3.710*** (0.176)	3.714*** (0.182)		0.510*** (0.037)	0.520*** (0.037)
Observations	12413	12144	12144	12414	12141	12141
R-squared	0.001	0.278	0.331	0.000	0.089	0.126

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 5A (cont'd)

Outcome Sample	PVT Score 1	PVT Score 1	PVT Score 1	PVT Score 3	PVT Score 3	PVT Score 3
	Full	Full	Full	Full	Full	Full
Fixed Effects	None	None	School	None	None	School
Low Birth Weight (<2500 grams)	-2.867*** (0.542)	-0.905** (0.409)	-0.894** (0.343)	-2.637*** (0.759)	-0.691 (0.667)	-0.809* (0.428)
Age		-3.265*** (0.243)	-3.299*** (0.210)		-2.249*** (0.258)	-2.421*** (0.217)
Male		1.822*** (0.278)	1.959*** (0.255)		0.908*** (0.291)	1.056*** (0.261)
Black		-9.354*** (0.834)	-7.179*** (0.465)		-10.703*** (1.475)	-7.729*** (0.922)
Hispanic		-7.295*** (0.705)	-4.697*** (0.549)		-5.704*** (0.887)	-2.510*** (0.821)
Other Race		-6.945*** (1.602)	-4.427*** (0.754)		-6.855*** (2.324)	-2.479*** (0.622)
Birth Order		-1.121*** (0.174)	-0.907*** (0.165)		-0.821*** (0.181)	-0.638*** (0.183)
Number of Siblings		-0.239 (0.161)	-0.264* (0.143)		-0.291 (0.194)	-0.235 (0.213)
Singleton		-0.227 (0.331)	-0.088 (0.311)		-0.204 (0.447)	-0.069 (0.414)
Family Income		0.027*** (0.004)	0.015*** (0.005)		0.019*** (0.003)	0.009*** (0.003)
Maternal Education		1.175*** (0.102)	0.941*** (0.084)		1.095*** (0.092)	0.884*** (0.090)
Married Parents		0.644** (0.273)	0.440* (0.254)		0.622** (0.298)	0.437* (0.259)
Parental Age		0.204*** (0.029)	0.160*** (0.022)		0.173*** (0.031)	0.136*** (0.024)
Parental Health		-0.503*** (0.139)	-0.244** (0.122)		-0.627*** (0.125)	-0.400*** (0.118)
Grade = 8		3.919*** (0.483)	3.942*** (0.454)		3.061*** (0.459)	3.219*** (0.441)
Grade = 9		7.752*** (0.652)	7.533*** (0.771)		6.233*** (0.698)	5.999*** (0.626)
Grade = 10		10.945*** (0.925)	11.131*** (0.868)		8.373*** (1.498)	9.319*** (0.768)
Grade = 11		14.490*** (0.948)	14.971*** (1.056)		10.890*** (1.689)	12.287*** (0.909)
Grade = 12		19.010*** (1.146)	19.335*** (1.215)		15.250*** (1.468)	16.623*** (1.297)
Observations	11892	11645	11645	12011	11757	11757
R-squared	0.004	0.253	0.322	0.003	0.179	0.255

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 4A
Full Results for Table 4

Outcome	Learning Disability	Learning Disability	Learning Disability	ADHD	ADHD	ADHD	Special Ed	Special Ed	Special Ed
Sample	Family	Family	Family	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family	None	School	Family
Low Birth Weight	0.066*** (0.016)	0.063*** (0.017)	0.084** (0.041)	0.007 (0.011)	0.007 (0.012)	0.087** (0.036)	0.046*** (0.012)	0.049*** (0.012)	0.043 (0.038)
Age	0.073*** (0.012)	0.076*** (0.012)	0.003 (0.007)	0.002 (0.007)	0.001 (0.008)	-0.004 (0.006)	0.057*** (0.010)	0.059*** (0.009)	0.004 (0.007)
Male	0.057*** (0.016)	0.057*** (0.017)	0.099*** (0.031)	0.060*** (0.011)	0.058*** (0.012)	0.049** (0.022)	0.035*** (0.012)	0.036*** (0.012)	0.074*** (0.022)
Black	-0.070*** (0.017)	-0.065*** (0.020)		-0.040*** (0.011)	-0.047*** (0.017)		-0.038*** (0.014)	-0.008 (0.015)	
Hispanic	-0.025 (0.025)	-0.031 (0.026)		-0.016 (0.017)	-0.013 (0.024)		-0.017 (0.020)	-0.008 (0.025)	
Other Race	-0.103*** (0.023)	-0.118*** (0.033)		-0.037 (0.028)	-0.037 (0.034)		-0.065*** (0.018)	-0.061*** (0.022)	
Birth Order	0.007 (0.007)	0.009 (0.007)	0.026* (0.015)	0.005 (0.005)	0.008 (0.005)	0.004 (0.012)	0.005 (0.007)	0.006 (0.006)	0.019 (0.013)
Number of Siblings	-0.005 (0.008)	-0.006 (0.008)		0.001 (0.004)	-0.002 (0.004)		-0.001 (0.006)	-0.001 (0.006)	
Singleton	0.030 (0.023)	0.021 (0.022)		0.026* (0.015)	0.019 (0.015)		0.027 (0.020)	0.016 (0.022)	
Family Income	-0.000** (0.000)	-0.000*** (0.000)		-0.000 (0.000)	-0.000 (0.000)		-0.000** (0.000)	-0.000** (0.000)	
Maternal Education	0.004 (0.004)	0.005 (0.004)		0.001 (0.002)	0.001 (0.003)		0.001 (0.003)	0.001 (0.003)	
Married Parents	-0.011 (0.018)	-0.005 (0.018)		-0.005 (0.012)	-0.010 (0.013)		-0.005 (0.014)	0.003 (0.014)	
Parental Age	0.000 (0.001)	-0.000 (0.001)		0.000 (0.001)	0.000 (0.001)		-0.001 (0.001)	-0.001 (0.001)	
Parental Health	0.026*** (0.006)	0.029*** (0.006)		0.002 (0.005)	0.002 (0.005)		0.013** (0.005)	0.016*** (0.006)	
Grade = 8	-0.088*** (0.024)	-0.087*** (0.027)		-0.012 (0.017)	-0.013 (0.019)		-0.062*** (0.022)	-0.061** (0.024)	
Grade = 9	-0.198*** (0.028)	-0.197*** (0.033)		-0.029 (0.022)	-0.026 (0.028)		-0.159*** (0.025)	-0.159*** (0.031)	
Grade = 10	-0.260*** (0.037)	-0.261*** (0.041)		-0.055** (0.026)	-0.053* (0.032)		-0.210*** (0.034)	-0.208*** (0.039)	
Grade = 11	-0.320*** (0.048)	-0.322*** (0.054)		-0.040 (0.034)	-0.038 (0.039)		-0.281*** (0.040)	-0.282*** (0.046)	
Grade = 12	-0.427*** (0.059)	-0.431*** (0.066)		-0.051 (0.040)	-0.050 (0.045)		-0.341*** (0.050)	-0.338*** (0.055)	
Observations	3359	3359	3465	3400	3400	3508	3388	3388	3495
R-squared	0.069	0.126	0.677	0.020	0.062	0.611	0.056	0.113	0.690
P diff full	0.078			0.765			0.740		

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 4A (cont'd)

Outcome	Repeat Any	Repeat Any	Repeat Any	Repeat K-5	Repeat K-5	Repeat K-5	Repeat 6-12	Repeat 6-12	Repeat 6-12
Sample	Family	Family	Family	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family	None	School	Family
Low Birth Weight	0.060*** (0.016)	0.059*** (0.018)	0.081** (0.039)	0.057*** (0.017)	0.056*** (0.018)	0.073* (0.040)	-0.004 (0.011)	-0.008 (0.011)	0.002 (0.026)
Age	0.311*** (0.015)	0.314*** (0.015)	0.039*** (0.009)	0.234*** (0.015)	0.234*** (0.015)	0.019** (0.009)	0.098*** (0.010)	0.099*** (0.010)	0.024*** (0.007)
Male	0.039*** (0.014)	0.033** (0.014)	0.116*** (0.031)	0.018 (0.013)	0.014 (0.013)	0.082*** (0.026)	0.021*** (0.007)	0.018** (0.007)	0.039** (0.019)
Black	0.111*** (0.018)	0.079*** (0.022)		0.096*** (0.021)	0.086*** (0.025)		0.032* (0.016)	-0.004 (0.014)	
Hispanic	0.069*** (0.025)	0.090*** (0.032)		0.020 (0.022)	0.060** (0.024)		0.036** (0.015)	0.021 (0.018)	
Other Race	-0.024 (0.036)	-0.029 (0.028)		-0.028 (0.028)	0.001 (0.025)		0.016 (0.020)	-0.013 (0.023)	
Birth Order	-0.000 (0.009)	-0.001 (0.009)	0.006 (0.018)	0.010 (0.008)	0.008 (0.008)	0.011 (0.015)	-0.007 (0.005)	-0.005 (0.005)	-0.002 (0.012)
Number of Siblings	0.005 (0.007)	0.007 (0.007)		-0.002 (0.007)	0.001 (0.007)		0.003 (0.004)	0.002 (0.004)	
Singleton	0.019 (0.020)	0.007 (0.021)		0.005 (0.024)	-0.004 (0.025)		0.004 (0.012)	-0.004 (0.013)	
Family Income	-0.001*** (0.000)	-0.000*** (0.000)		-0.000*** (0.000)	-0.000*** (0.000)		-0.000 (0.000)	-0.000 (0.000)	
Maternal Education	-0.008*** (0.003)	-0.004 (0.003)		-0.009*** (0.003)	-0.007** (0.003)		-0.000 (0.002)	0.002 (0.002)	
Married Parents	-0.001 (0.021)	-0.001 (0.021)		0.015 (0.019)	0.014 (0.020)		-0.010 (0.016)	-0.013 (0.016)	
Parental Age	-0.001 (0.001)	-0.001 (0.001)		-0.002 (0.001)	-0.002 (0.001)		-0.000 (0.001)	-0.000 (0.001)	
Parental Health	0.034*** (0.007)	0.030*** (0.007)		0.027*** (0.007)	0.024*** (0.007)		0.006 (0.005)	0.005 (0.005)	
Grade = 8	-0.310*** (0.021)	-0.308*** (0.022)		-0.245*** (0.022)	-0.245*** (0.024)		-0.097*** (0.016)	-0.094*** (0.017)	
Grade = 9	-0.622*** (0.031)	-0.613*** (0.037)		-0.500*** (0.032)	-0.472*** (0.038)		-0.160*** (0.024)	-0.154*** (0.025)	
Grade = 10	-0.917*** (0.039)	-0.898*** (0.049)		-0.730*** (0.041)	-0.689*** (0.049)		-0.254*** (0.033)	-0.248*** (0.035)	
Grade = 11	-1.272*** (0.052)	-1.256*** (0.061)		-0.984*** (0.054)	-0.944*** (0.060)		-0.381*** (0.044)	-0.376*** (0.047)	
Grade = 12	-1.560*** (0.063)	-1.549*** (0.072)		-1.194*** (0.067)	-1.152*** (0.074)		-0.463*** (0.050)	-0.463*** (0.052)	
Observations	3398	3398	3505	3393	3393	3501	3393	3393	3501
R-squared	0.366	0.417	0.752	0.270	0.318	0.739	0.115	0.183	0.671
P diff full	0.154			0.160			0.800		

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 6A
Full Results for Table 6

Outcome	Years of Educ	Years of Educ	Years of Educ	HS Grad	HS Grad	HS Grad
Sample	Family	Family	Family	Family	Family	Family
Fixed Effects	None	School	Family	None	School	Family
Low Birth Weight (<2500 grams)	0.047 (0.086)	0.042 (0.086)	-0.088 (0.179)	0.018 (0.016)	0.013 (0.020)	0.005 (0.040)
Age	-0.387*** (0.048)	-0.400*** (0.048)	0.244*** (0.035)	-0.086*** (0.013)	-0.092*** (0.014)	0.010 (0.009)
Male	-0.274*** (0.055)	-0.253*** (0.055)	-0.422*** (0.128)	-0.036*** (0.013)	-0.032** (0.013)	-0.055** (0.023)
Black	-0.100 (0.105)	-0.020 (0.117)		-0.019 (0.022)	-0.012 (0.031)	
Hispanic	-0.152 (0.096)	-0.057 (0.120)		-0.070*** (0.022)	-0.078*** (0.027)	
Other Race	0.031 (0.155)	0.221 (0.152)		0.001 (0.023)	0.005 (0.029)	
Birth Order	-0.091*** (0.033)	-0.077** (0.034)	-0.100 (0.089)	0.016** (0.007)	0.017** (0.008)	0.017 (0.016)
Number of Siblings	0.018 (0.034)	0.003 (0.035)		-0.002 (0.007)	-0.007 (0.008)	
Singleton	-0.505*** (0.119)	-0.459*** (0.130)		-0.031 (0.026)	-0.032 (0.029)	
Family Income	0.006*** (0.001)	0.005*** (0.001)		0.000 (0.000)	0.000 (0.000)	
Maternal Education	0.167*** (0.025)	0.146*** (0.025)		0.019*** (0.004)	0.016*** (0.004)	
Married Parents	0.156* (0.085)	0.144 (0.088)		0.049*** (0.016)	0.039** (0.016)	
Parental Age	0.032*** (0.006)	0.026*** (0.006)		0.002 (0.001)	0.001 (0.001)	
Parental Health	-0.140*** (0.040)	-0.120*** (0.043)		-0.012 (0.008)	-0.010 (0.009)	
Grade = 8	0.727*** (0.102)	0.710*** (0.101)		0.116*** (0.033)	0.110*** (0.034)	
Grade = 9	1.501*** (0.139)	1.480*** (0.146)		0.212*** (0.036)	0.208*** (0.038)	
Grade = 10	2.319*** (0.173)	2.328*** (0.180)		0.314*** (0.044)	0.321*** (0.048)	
Grade = 11	3.104*** (0.220)	3.102*** (0.225)		0.475*** (0.055)	0.480*** (0.061)	
Grade = 12	3.694*** (0.256)	3.721*** (0.260)		0.578*** (0.069)	0.600*** (0.074)	
Observations	3399	3399	3507	3399	3399	3507
R-squared	0.282	0.340	0.798	0.104	0.171	0.735
P diff full	0.230			0.272		

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 6A (cont'd)

Outcome Sample Fixed Effects	PVT Score	PVT Score	PVT Score	PVT Score	PVT Score	PVT Score
	1	1	1	3	3	3
	Family None	Family School	Family Family	Family None	Family School	Family Family
Low Birth Weight (<2500 grams)	-0.916 (0.592)	-0.943* (0.513)	-0.970 (1.237)	-0.416 (0.796)	-0.592 (0.655)	-1.190 (1.627)
Age	-2.899*** (0.392)	-2.927*** (0.386)	0.482* (0.250)	-2.396*** (0.415)	-2.850*** (0.363)	0.592** (0.291)
Male	1.665*** (0.447)	1.757*** (0.425)	0.201 (0.759)	1.106* (0.627)	1.090* (0.610)	0.206 (0.987)
Black	-9.416*** (0.871)	-6.249*** (0.927)		-10.524*** (1.201)	-6.830*** (1.034)	
Hispanic	-6.740*** (0.955)	-4.470*** (1.120)		-4.680*** (1.156)	-1.403 (1.096)	
Other Race	-6.462*** (2.113)	-3.078*** (1.163)		-8.013** (3.549)	-2.186 (2.131)	
Birth Order	-0.941*** (0.262)	-0.803*** (0.274)	-0.788 (0.479)	-0.623* (0.365)	-0.597* (0.322)	-0.850 (0.571)
Number of Siblings	-0.290 (0.257)	-0.379 (0.241)		-0.202 (0.366)	-0.299 (0.380)	
Singleton	-0.909 (0.792)	-0.180 (0.722)		-0.519 (1.033)	-0.255 (1.039)	
Family Income	0.025*** (0.006)	0.017** (0.007)		0.018*** (0.006)	0.013* (0.007)	
Maternal Education	1.085*** (0.154)	0.909*** (0.151)		0.947*** (0.163)	0.785*** (0.170)	
Married Parents	0.297 (0.569)	0.455 (0.557)		1.119* (0.644)	1.034 (0.663)	
Parental Age	0.147*** (0.041)	0.116*** (0.038)		0.142*** (0.048)	0.130*** (0.042)	
Parental Health	-0.331 (0.209)	-0.077 (0.197)		-0.815** (0.320)	-0.691** (0.317)	
Grade = 8	4.802*** (0.940)	4.558*** (0.930)		4.870*** (0.828)	4.976*** (0.808)	
Grade = 9	7.882*** (1.067)	7.749*** (1.221)		7.481*** (1.065)	7.204*** (0.975)	
Grade = 10	10.501*** (1.378)	10.595*** (1.507)		10.025*** (1.707)	10.477*** (1.325)	
Grade = 11	14.026*** (1.618)	14.303*** (1.789)		13.967*** (1.688)	15.091*** (1.554)	
Grade = 12	17.580*** (2.005)	18.032*** (2.269)		16.810*** (2.082)	18.627*** (1.877)	
Observations	3275	3275	3373	3302	3302	3403
R-squared	0.261	0.343	0.823	0.193	0.294	0.808
P diff full	0.981			0.517		

Robust standard errors clustered at the school level. ***1%, **5%, *10%. Additional Controls: Missing Information Dummy and Constant

Table 8A
Proportions of Normal and Low Birth Weight Respondents by Grade Level
N=12,079

Grade	Normal Weight	Low Birth Weight
7	89.02	10.98
8	88.88	11.12
9	88.43	11.57
10	89.62	10.38
11	88.58	11.42
12	88.16	11.84
Total	88.81	11.19