Weighty Problems: An Examination of Childhood Weight and School Outcomes

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Abstract

This paper examines the effects of childhood overweight and obesity on the child's school-related outcomes for children in Canada and the U.S. using data from the National Longitudinal Survey of Children and Youth (NLSCY) master files and the National Longitudinal Survey of Youth (NLSY) children files respectively. It also attempts to examine pathways that might mediate the relationships between the child's weight and schooling outcomes. The results obtained suggest that there potentially exist some differences between Canada and the U.S. in terms of how the child's weight affects his or her school performance.

JEL Classification: I12, I18, I21

1. Introduction

Obesity has become one of the most prevalent health conditions in developed countries and is now a major public health issue in North America. In particular, the prevalence of childhood obesity in North America has reached levels that have not been seen before. In 2003-2004, 17.1% of children and adolescents in the U.S. were obese (Ogden *et al.*, 2006). In contrast, only 4% of children between the ages of 6 and 11 and 5% of adolescents between the ages of 12 to 19 in the U.S. were obese back in the 1960s (Ogden *et al.*, 2002a). In Canada, the prevalence of obesity increased from 2% to 10% for boys between the ages of 7 and 13 and from 2% to 9% for girls between the ages of 7 and 13 over the period of 1981 to 1996 (Tremblay *et al.*, 2002). [1]

Given these unprecedented and striking increases in prevalence, childhood obesity has become a major focal point for public health officials. The rise in the number of overweight and obese children is of great concern to public health policy makers because childhood obesity is known to have adverse health effects and these effects might prove to be costly to society in the long run. Childhood obesity is associated with increased likelihoods of developing physical health conditions such as sleep apnea, asthma, fatty liver disease, type II diabetes and either early or delayed puberty (Lobstein *et al.*, 2004). In addition, childhood obesity can also exert a long term toll on physical health as children who are overweight or obese are more likely to grow up

[1] The U.S. figures are based on age and gender specific cutoffs from the Centers for Disease Control and Prevention (CDC). The terminology used in this paper differs from the terminology adopted by the Centers for Disease Control and Prevention (CDC). Due to the perceived stigma attached to the term "obese", the CDC has decided to avoid using "obese" to describe children. Instead, the term "overweight" is used in place of "obese" and "at-risk-of-overweight" is used in place of "overweight". However, the CDC's "overweight" cutoff is usually considered to be comparable to cutoffs used to define childhood obesity in other systems of classification such as the IOTF classification system The Canadian figures are based on age and gender specific cutoffs adopted by the International Obesity Task Force (IOTF). While both sets of guidelines generally reach similar conclusions as to whether a child's weight is higher than the medically recommended weight range, they differ somewhat in terms of defining whether a child is obese. It has been suggested that the IOTF cutoffs give a more conservative view of the extent of childhood obesity compared to the CDC cutoffs (for a discussion, see Lobstein *et al.*, 2004). As such, the Canadian figures presented in Trembley *et al.* (2002) can be thought of as being the lower bounds of the estimates of childhood obesity rates in Canada.

to become overweight or obese adults whose risks for cardiovascular diseases are elevated (Srinivasan *et al.*, 1996).

The majority of studies on the potential consequences of childhood obesity have focused on physical health outcomes. However, very few studies have looked at how childhood obesity might affect other child outcomes beyond physical health outcomes. There is a very real possibility that childhood obesity might actually affect other areas of the child's life. Recent research in the economics literature on adults suggests that obese adults are more likely to experience poorer socio-economic outcomes such as lower wages (Baum and Ford (2004), Cawley (2004)). It is reasonable to imagine that a parallel might exist for children. Since children spend a significant amount of time each day in school (just like adults spend a significant amount of time each day at work), it is possible that the effects of childhood obesity might be felt in the school environment. The idea that being overweight or obese might have negative consequences on the child's education outcomes has received some attention in both the popular and medical press (for a review of the existing literature, see Taras and Potts-Datema (2005)) and might be one of the reasons as to why policy makers should be concerned about childhood obesity. Two possible mechanisms through which childhood overweight and obesity might negatively affect school outcomes are:

1. Being overweight or obese may diminish self-esteem and body image. A lack of self-esteem might have negative effects on the child's school performance.

2. Health problems associated with being overweight or obese may increase absenteeism from school, thus causing the child to do less well in school.

Thus far, there have been relatively few empirical studies that have examined the relationship between childhood weight and school outcomes. Schwimmer *et al.* (2003) presents results that suggest that severely obese children in their U.S. clinical sample missed more days of school than children in their control group. Datar *et al.* (2004) looks at kindergartners in the U.S. Their results suggest that overweight children have lower math and reading scores but that this negative relationship can be attributed to underlying socioeconomic variables (Datar *et al.*, 2004). Sabia (2007) presents results that suggest that there is a negative relationship between body mass index (BMI) and grade point average (GPA) for white females between the ages of 14 to 17. However, he finds little evidence to support the idea that a significant relationship between BMI and GPA exists for males and non-white females in that age group (Sabia, 2007).

The objectives of this paper are to look at whether obesity affects school outcomes for pubescent children in Canada and the United States and also to examine the possible mechanisms behind this relationship. I choose to focus on children in this age group because studies in the medical literature suggest that the negative effects of being overweight or obese on self-esteem and body image are the largest for these older children (for a review, see Wardle and Cooke (2005)). As such, puberty might be the time when obesity has the biggest impact on educational outcomes.

In order to accomplish the objectives of this paper, I make use of data from two longitudinal micro-level data sets for my analysis: the National Longitudinal Survey of Children and Youth (NLSCY) for Canada and the children files of the National Longitudinal Survey of Youth 1979 (NLSY) for the U.S.

The paper is organized as follows. Section 2 provides information on the data used. Section 3 describes the econometric model and mechanisms being studied. Section 4 summarizes the results from the empirical analysis and Section 5 concludes.

2. Data

This paper makes use of data from two different sources to examine the relationship between school outcomes and childhood obesity for pubescent children in Canada and the United States. For the Canadian sample, I use data from the National Longitudinal Survey of Children and Youth (NLSCY) master files. For the American sample, I use data from the public-use children files of the National Longitudinal Survey of Youth 1979 (NLSY). Most importantly for this study, both the NLSCY and the children files of the NLSY contain information on the heights and weights of the children surveyed. In the Canadian NLSCY, the heights and weights of children over the age of 11 are self-reported by the children. However, the heights and weights of children under the age of 11 are reported by the person most knowledgeable about the child (PMK). [2] For the children in the U.S. NLSY, their weights and heights are recorded in two ways: they are either actual measured values measured by the interviewer or they are estimates given by the mother. As such, indicator variables for whether the height is based on the mother's estimate and for whether the weight is based on the mother's estimate are included as covariates in the regressions for the American sample to account for this discrepancy.

The availability of the heights and weights of the children enables me to calculate the BMI (Body Mass Index) of the child. Through the BMI, I can determine whether a child is considered to be underweight, overweight or obese by comparing the BMI of the child to the age and gender specific cutoffs from the Centers for Disease Control and Prevention (CDC). These cutoffs are percentile values from age and gender specific growth charts developed by the CDC based on data from five reference populations surveyed between 1963 and 1994 (Ogden *et al.* 2002b). [3] Children who have BMIs below the 5th percentile value are classified as being

[2] Age dummies are included as covariates in the regressions.
[3] The growth chart data can be found at: http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/datafiles.htm

underweight. Children who have BMIs between the 85^{th} and 95^{th} percentile values are classified as being overweight. Children who have BMIs higher than the 95^{th} percentile values are classified as being obese.[4] In addition, both surveys also contain data on the birthweight of the child. Several studies (Currie and Hyson (1999), Behrman and Rosenzweig (2004), Black, Devereux and Salvanes (2007)) suggest that children with low birthweights tend to have worse outcomes further down the road. Weight at birth also plays a role in determining future weight. As such, all regressions in this paper control for birthweight.

The NLSCY is a longitudinal dataset that surveys children and their families across Canada. Data for Cycle 1 was collected by Statistics Canada in 1994 for a sample of children between the ages of 0 and 11. Data collection for follow up surveys has been subsequently conducted once every two years. This paper makes use of data from the first five cycles of the NLSCY, covering the period of 1994 to 2002. I restrict my sample to children who were between the ages of 10 and 14 in each cycle. This age restriction yields an initial sample size of 15367 observations. Many of the children surveyed also have siblings who were included in the sample. The sampling process designed by Statistics Canada restricts the maximum number of children participating in the survey to two per household. The NLSCY contains detailed information on many aspects of the child's development, ranging from demographic information to health and schooling outcomes. The person most knowledgeable about the child (PMK) provides most of the information for the survey but children aged 10 and above do provide answers to some of the questions in the questionnaire.

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[4] The terminology used in this paper differs from the terminology adopted by the Centres for Disease Control and Prevention (CDC). Due to the perceived stigma attached to the term "obese", the CDC has decided to avoid using "obese" to describe children. Instead, the CDC has adopted a terminology in which children whose BMIs are between the 85^{th} and 95^{th} percentiles are described as being "at-risk-of-overweight" and children whose BMIs are greater than the 95^{th} percentiles are described as being "overweight". However, the 95^{th} percentile cutoff is usually compared to cutoffs used to define childhood obesity in other systems of classification such as the IOTF classification system, while the 85^{th} percentile cutoff is usually compared to cutoffs used to define childhood overweight.

The NLSCY collects data on academic outcomes for the children. A mathematics test based on the Canadian Achievement Tests is administered to children as part of the survey in each of the cycles of the NLSCY.[5] As such, mathematics test scores are available for children in my sample and these test scores represent one measure of academic functioning in my analysis. School grade information is also available for children in the NLSCY and from this, I construct an indicator for whether the child is in right school grade (or better) expected for his or her age as another measure of school functioning.

The NLSCY also provides information on various health aspects of the child. I construct an indicator variable of whether the child is in bad health at the time of the survey based on the PMK's description of the child's current overall health status. In addition, the PMK is also asked how frequently the child was in good health in the pre-survey year. From this information, I construct an indicator variable that reflects whether the child was usually in good health in the pre-survey year. Data on the number of days of school missed by the child in the past school year is also collected from the teacher who taught the child. Based on this data, an indicator variable for whether the child missed 10 or more days of school in the past school year is constructed. The NLSCY also contains measures of psychosocial aspects of the child's health. The self-image score is constructed based on responses to questions given by the child in the child self-survey portion of the NLSCY.

For the vast majority of the children in the NLSCY, the PMK is the biological mother. If information about the biological mother is available in the survey either in the form of data on the PMK or data on the spouse of the PMK, this information is used to create variables about the mother's characteristics. When information about the biological mother is not available for an

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[5] Originally, children between the ages of 8 and 15 in the NLSCY were also given reading tests in addition to the math tests. However, the reading test was discontinued starting in Cycle 4. As such, I focus only on the mathematics test scores for the Canadian sample in this paper.

observation, information available in the survey about the next closest female parent figure is used to create the mother's variables. Variables describing the mother's work status, educational attainment, health status, immigration status and age are included as covariates in the analysis.

Socioeconomic and demographic variables for the family such as family income, the number of non-parental adults in the household, the number of children in the household and indicator variables for whether the household is a single parent household and for whether the area of residence is rural are included as covariates for children in the Canadian sample. In addition, dummy variables based on the child's age, gender, immigration status and race are also included as covariates for children in the Canadian sample in the regressions.

The National Longitudinal Survey of Youth 1979 (NLSY) was started in 1979 as a survey of American youths between the ages of 14 and 21. Starting in 1986, the NLSY administrators started collecting data on children born to mothers who were part of the NLSY 1979 cohort. Follow-up surveys on these children have been conducted once every two years since then. The original NLSY 1979 sampling design included over-samples of Black, Hispanic and financially disadvantaged youths, in addition to the main cross-sectional sample which was intended to be nationally representative. In my analysis, I look only at children of women who were part of the main nationally representative NLSY 1979 cross-sectional sample. The children of women who were part of the over-samples are not included as part of my sample. This paper makes of data collected on the children of the NLSY 1979 cross-sectional sample female cohort over the period of 1986 to 2002. The sample is restricted to children between the ages of 10 to 14 in each wave of data. These sample restrictions yield an initial sample size of 8061 observations.

The NLSY contains information on academic outcomes for the children in the sample. Peabody Individual Achievement Tests (PIATs) for mathematics and reading comprehension are administered as part of the survey for school-age children. The mathematics and reading comprehension test scores are used as two of the measures for school functioning in my analysis. I also construct an indicator variable for whether the child is in the right grade (or better) expected for his or her age as a separate measure for school functioning for my analysis.

Compared to the NLSCY, the health and school attendance data available for the child is more limited for children in the NLSY. In order to capture information on the child's overall health and school participation for children in the American sample, I construct an indicator variable for whether the child has a health limitation that limits the amount of schoolwork he or she can do and an indicator variable for whether the child has a health limitation that limits school attendance. Based on responses given by the child to questions on how the child perceive himself or herself, the NLSY assigns the child a score on the self-worth scale. In this paper, I use the self-worth score as a measure of the child's psychosocial health.

As in the Canadian sample, I control for mother's work status, educational attainment, health status, immigration status and age as covariates in the regressions. In addition, the NLSY contains information on the mother's weight and height and I use this information to control for whether the mother is overweight or obese in the regressions for the American sample.[6] I also control for family income, number of adults in the household, number of children in the household, number of adults with post-secondary education in the household, for whether the household is a single-parent household and for whether the area of residence is in a rural area in the regressions for the NLSY sample. In addition, dummy variables based on the child's age,

[6] Dropping the mother's weight status from the regressions for the U.S. sample yields results similar to the ones presented in this paper.

gender and race[7] are also included as covariates for children in the NLSY sample in the regressions.

3. Econometric Model

The main focus of this paper is to examine whether the child's weight status affects his performance at school. As such, the primary equations of interest look directly at this relationship:

$$TestScore_{it} = \alpha_0 + \alpha_1 underweight_{it} + \alpha_2 overweight_{it} + \alpha_3 obese_{it} + \alpha_4 birthweight_i + \alpha_5 X_{it} + \alpha_6 F_t + \theta_t + \pi_p + \upsilon_{it} \quad (1)$$

$$RightGrade_{it} = \beta_0 + \beta_1 underweight_{it} + \beta_2 overweight_{it} + \beta_3 obese_{it} + \beta_4 birthweight_i + \beta_5 X_{it} + \beta_6 F_t + \theta_t + \pi_p + \varepsilon_{it} \quad (2)$$

$TestScore_{it}$ represents the child's standardized math test score for children in Canada and the child's standardized math and reading comprehension test scores for children in the U.S.[8], $RightGrade_{it}$ is an dummy variable that takes on a value of 1 if the child is in the school grade (or higher school grade) expected for his or her age, $underweight_{it}$ is an indicator variable which takes on a value of 1 if the child is underweight and a value of 0 otherwise, $overweight_{it}$ is an indicator variable which takes on a value of 1 if the child is overweight (not including obese) and a value of 0 otherwise, $obese_{it}$ is an indicator variable which takes on a value of 1 if the child is

[7] There are three race categories for children in the U.S. NLSY: Black, Hispanic and Other. For children in the Canadian NLSCY, the race information is more precise and there are more race categories (e.g. White, Black, Native American, Indian, Chinese etc.).

[8] The math test score for the Canadian children is scored out of a total score of 15 in Cycles 1 and 2. The math test score for the Canadian children is scored out of a total score of 20 in Cycles 3 to 5. The standardized math test score for the Canadian children is obtained by first subtracting the average math test score of all children who took the test in that particular cycle of the NLSCY from the child's math test score in the corresponding cycle and then dividing this difference by the overall standard deviation of all math test scores collected in that particular cycle. The math and reading test scores for the American children are scored out of total scores of 100. The standardized math (reading comprehension) test score for the American children is similarly obtained by first subtracting the average math (reading comprehension) test score of all children who took the test in that particular survey year of the NLSY from the child's math (reading comprehension) test score in the corresponding survey year and then dividing this difference by the overall standard deviation of all math (reading comprehension) test scores collected in that particular survey year. As such, the sample means of the standardized scores are close to 0 and the sample standard deviations of the standardized scores are close to 1.

obese and a value of 0 otherwise[9], $birthweight_i$ is the child's weight at birth, X_{it} consist of child characteristics, F_t are family characteristics, π_p represents area of residence dummies[10] and θ_t represents year dummies.

The main econometric issue involved in the estimation of equations (1) and (2) is that it is likely that $E(underweight_{it}, \upsilon_{it}) \neq 0$, $E(overweight_{it}, \upsilon_{it}) \neq 0$, $E(obese_{it}, \upsilon_{it}) \neq 0$ and $E(underweight_{it}, \varepsilon_{it}) \neq 0$, $E(overweight_{it}, \varepsilon_{it}) \neq 0$, $E(obese_{it}, \varepsilon_{it}) \neq 0$ respectively. It is conceivable that estimates of equations (1) and (2) obtained by OLS are potentially subject to bias as there might be unobserved factors which affect both the child's school outcomes and the child's weight. For example, it is possible that parents who are less involved with the child's progress at school are negligent parents who either feed the child unhealthy high-fat diets that cause the child to become overweight or obese or feed the child inadequate diets that cause the child to become underweight. If so, we might incorrectly conclude that deviations from the medically healthy weight range have negative consequences for the child's academic performance. In this case, the OLS estimates of the coefficients on the weight indicator variables will have a negative bias. Reverse causation might be another issue: it is possible that poor performance in school might actually cause the child to gain or lose weight. This would also lead to a negative bias in the OLS estimates. An ideal experiment that would resolve the endogeneity issue would be one in which an exogenous shock affects the child's weight but does not directly impact upon the child's academic performance. Ideally, one would conduct an experiment where children are randomly assigned to groups that are fed different diets and undergo different physical exercise regimes in order to exogenously induce different weight outcomes. In reality,

[9] The omitted weight category in the regressions is the medically healthy weight category.

[10] For children in the Canadian NLSCY sample, the area of residence dummies are province dummies as I have data on the province of residence for this children. For children in the U.S. NLSY sample, the area of residence dummies are region (i.e. North, South, West, East) dummies.

this is an experiment that is very difficult to implement on a large scale as there are significant monitoring and implementation costs involved. In addition, it would be difficult to get ethics approval to conduct such an experiment. A more realistic option would be to look at natural policy experiments. One possible natural experiment that might come close to fitting the bill might be the banning of “junk” food in schools. However, at the current time, given that many of these bans have either only been implemented for short periods of time or are still in the process of being debated among policy makers and given that datasets containing data on academic outcomes and the weights and heights of children for specific geographic areas that have implemented anti-obesity measures are often hard to find, there is insufficient information to conduct such an analysis at the moment.

There are several approaches that are commonly used to account for unobserved factors that might cause the OLS estimates to be biased. One approach would be to try to include a comprehensive set of controls as covariates. For the regressions, I include a comprehensive set of socioeconomic and demographic variables in order to account for variables that might affect both the scholastic outcomes and the child’s weight. Another approach would be to make use of variation within families. Children in the NLSCY and the NLSY often have siblings who were also surveyed. As such, I estimate family fixed effects models in order to account for unobserved heterogeneity at the family level. A potential shortcoming of this approach is that unobserved factors might not be common across observations from the same family. Another concern is that the identification of the family fixed effects model is from families where there is intra-family variation in weight outcomes and this raises the issue of whether there is sufficient intra-family variation in weight outcomes in the samples used in this paper to make the family fixed effects estimates meaningful. From my analysis, there does appear to be a fair amount of within-family variation in weight for both the Canadian and American samples. The within-family standard deviations for the various weight category indicator variables (i.e. the underweight, overweight and obese indicator variables) are around 2/3 of the overall sample standard deviations of the same weight category indicator variables for the Canadian sample. For the U.S. sample, the within-family standard deviations for the various weight category indicator variables are around 3/4 of the overall U.S. sample standard deviations of the same variables. [11]

One of the other objectives of this paper is to examine the potential mechanisms that might mediate the relationship between the child's academic performance and his or her weight. As noted in the introduction section of this paper, it has been postulated that being overweight or obese might negatively impact on the child's education outcomes and that this might be mediated through self-esteem and health pathways. As such, to evaluate these proposed pathways, I look at the relationships between the child's academic outcomes and the child's health measures and also the relationships between the child's health measures and the child's weight:

$$TestScore_{it} = \phi_0 + \phi_1 Health_{it} + \phi_2 birthweight_i + \phi_3 X_{it} + \phi_4 F_t + \theta_t + \pi_p + \varsigma_{it} \quad (3)$$

$$RightGrade_{it} = \varphi_0 + \varphi_1 Health_{it} + \varphi_2 birthweight_i + \varphi_3 X_{it} + \varphi_4 F_t + \theta_t + \pi_p + \vartheta_{it} \quad (4)$$

$$Health_{it} = \delta_0 + \delta_1 underweight_{it} + \delta_2 overweight_{it} + \delta_3 obese_{it} + \delta_4 birthweight_i + \delta_5 X_{it} + \delta_6 F_t + \theta_t + \pi_p + \zeta_{it} \quad (5)$$

where $Health_{it}$ represent the various measures of overall health and psychosocial functioning.

For children in the Canadian sample, the various health-related outcomes examined are: (1) a poor health indicator variable that takes on a value of 1 if the PMK describes the child as being currently not in good health, (2) a usually in good health indicator variable that takes on a

[11] Another approach would be to adopt an Instrumental Variable (IV) strategy. To do so, we would need an instrumental variable that predicts the child's weight but is uncorrelated with the error terms. I attempted to instrument for the child's BMI for children in the Canadian sample with the density of fast food restaurants in the census subdivision and with the proportion of fast food restaurants out of the total number of restaurants in the census subdivision. However, the instruments did not have sufficient predictive power in the first stage regressions.

value of 1 if the PMK describes the child as being in good health more the half the time in the past year, (3) a school absenteeism indicator variable that takes on a value of 1 if the child is reported as having missed 10 or more days of school in the past school year by his or her teacher and (4) the child's self image score (scored out of a total of 16 points).

Unfortunately, the same health measures are not available for children in the U.S. sample. The public use NLSY children files contain less detailed information on the child's health and school attendance than the NLSCY master files. In particular, questions on the child's overall health and on the number of days of school missed by the child were not asked consistently throughout the survey years. As such, the following health-related measures are utilized for children in the American sample: (1) an indicator variable which takes on a value of 1 if the mother reports that the child has a health limitation that limits school attendance, (2) an indicator variable which takes on a value of 1 if the mother reports that the child has a health limitation that limits the child's ability to do school work and (3) the child's self-worth score (scored out of a total of 240 points).

4. Results

4.1 Descriptive Statistics

Table 1 presents descriptive statistics for the main variables used in the analysis for the Canadian NLSCY sample and the U.S. NLSY sample.

In the full Canadian sample, around 9% of the children are underweight, 13% of the children are overweight (not including obese) and 16% of the children are obese. In total, close to 30% of the children in the full Canadian sample are considered to be medically overweight or obese. The Canadian sample is restricted to children between the ages of 10 and 14 in each cycle and the average age is 11.6 years. Around 92% of the children in the full Canadian sample are white. Table 1 also summarizes the main characteristics of the American NLSY sample.[12] In the full American sample, around 6% of the children are underweight, 16.7% of the children are overweight (not including obese) and 12.5% of the children are obese.[13] These figures suggest that close to 30% of the children in the full U.S. sample are considered to be medically overweight or obese. The prevalence of overweight among the mothers of these children is even higher: 46.4% of the mothers in the overall U.S. sample have BMIs greater than 25 and are considered to be overweight or obese. Like the Canadian sample, the U.S. sample is restricted to children between the ages of 10 to 14 in each wave of data. The average age of the child in the overall U.S. sample is 11.76 years. Around 6.7% of the children in the overall U.S. sample are Black and around 2.5% of the children in the overall U.S. sample are Hispanic.

[12] The original NLSY 1979 sampling design included over-samples of Black, Hispanic and financially disadvantaged youths, in addition to the main cross-sectional sample which was intended to be nationally representative. In my analysis, I look only at children of women who were part of the main NLSY 1979 cross-sectional sample. The children of women who were part of the over-samples are not included as part of my sample.

[13] It is perhaps somewhat surprising that there is a higher rate of obesity in the Canadian sample compared to the U.S. sample. One possible explanation is that the BMI values for the majority (around 70%) of the American children are calculated using measured heights and weights, while the BMI values for the Canadian children are calculated using estimated heights and weights. As such, the BMI values for the U.S. sample are generally more accurately measured. For children in the U.S. sample whose BMI values are calculated using estimated heights and/or weights, the obesity rate is around 13%. While this figure is slightly higher than for the obesity rate for the overall U.S. sample, it is still lower than the obesity rate for the overall Canadian sample.

For both the full Canadian sample and the full U.S. sample, the standardized test scores have means that are close to 0 and standard deviations that are close to 1. In general, the mothers in the Canadian sample appear to be more highly educated than the mothers in the U.S. sample. Children in the Canadian sample are also more likely to be in the right (or higher) school grade expected for their ages than children in the U.S. sample.

4.2 Test Score Regression Results for Full Canadian and U.S. Samples

Table 2 summarizes the OLS and family fixed effects estimates for specifications where the dependent variable is the standardized math test score for the full Canadian NLSCY sample and where the dependent variables are the standardized math test score and standardized reading test score for the full U.S. NLSY sample. [14]

Column (1) presents the OLS estimates for the Canadian sample. The results in column (1) suggests that being overweight (not including obese) is associated with a decrease of 0.08 points in the standardized math test score for children in the Canadian sample. Since all of the math and reading test scores used in this paper have been standardized such that they have sample means that are close to 0 and standard deviations close to 1, this represents a decrease of around 8% of one standard deviation in the standardized math test score. The estimated coefficients on the underweight and obese indicators in the OLS specification are positive but are not statistically significant. In keeping with the conclusions from the existing literature on

[14] I also estimated specifications where I used a low birthweight indicator rather than the actual birthweight itself. The results from these specifications suggest that having a birthweight less than 2500 grams is associated with poorer school outcomes. The estimated coefficients on the underweight, overweight and obese indicators are not affected by this change in specification for both the Canadian and the American samples.

birthweight, higher birthweight is associated with an increase in the standardized math score in the OLS specifications. [15]

There is a concern that the OLS estimates might be biased. Suppose that parents who are less involved with the child's progress at school are negligent parents who either feed the child unhealthy high-fat diets that cause the child to become overweight or obese or feed the child inadequate diets that cause the child to become underweight. In this case, the OLS estimates will have a negative bias. In order to control for this possibility, I also estimate family fixed effects models. Column (2) of Table 2 presents the family fixed effects estimates of the specification where the dependent variable is the standardized math score for children in the overall Canadian sample. Similar to the OLS results presented earlier, the family fixed effects results suggest that being overweight (not including obese) is associated with a decrease in the standardized math test score for children in the Canadian sample. The magnitude of this decrease is around 15% of one standard deviation in the standardized math test score and is actually larger than the decrease suggested by the OLS specifications. This is rather surprising since the OLS estimates are expected to have a negative bias. A comparison of the OLS and family fixed effects estimates of the coefficient on the overweight indicator suggests that the bias for the OLS estimate of the coefficient on the overweight indicator is actually positive, contrary to expectations. The estimated coefficients on the underweight and obese indicators are positive but are not statistically significant. However, the family fixed effects estimates of the coefficients on the underweight and obese indicators are larger in magnitude than their OLS counterparts, which is

[15] I also estimated specifications where I interacted the underweight, overweight and obese indicators with household income and maternal education respectively. The estimated coefficients on the interaction terms tend not to be statistically significant. In addition, I also estimated specifications where I interacted the underweight, overweight and obese indicators with the child's gender to investigate if the effects of weight differ between genders. The estimated coefficients on these interaction terms are generally not statistically significant.

in keeping with the *ex-ante* belief that the OLS estimates of the coefficients on the weight dummies have a negative bias. After controlling for fixed family factors, the relationship between the standardized math test score and birthweight is no longer statistically significant.

Column (3) of Table 2 summarizes the OLS estimates for the U.S. sample for specifications where the dependent variable is the standardized math test score. Unlike the results for the Canadian sample, the estimated coefficient on the overweight (not including obese) indicator is not statistically significant for children in the U.S. sample. The OLS results in column (3) also suggest that being underweight is associated with a decrease in the math test score for children in the U.S. sample. The estimated coefficient on the obese indicator is not statistically significant.

Column (4) of Table 2 summarizes the family fixed effects estimates of the standardized math test score regression for children in the U.S. sample. The results suggest that once I control for family fixed factors, being obese is actually associated with an increase in the standardized math test score for children in the U.S. sample. The magnitude of this increase is around 15% of one standard deviation in the standardized math score.

The positive relationship between math test scores and obesity suggested by the family fixed effects specification for the U.S. sample is contrary to the hypothesis that being overweight or obese has negative effects on the child's academic outcomes. However, the family fixed effects estimate of the coefficient on the obese indicator is consistent with the idea that the OLS estimates of the coefficients on the weight indicator variables have a negative bias (recall that the OLS estimate on the obese indicator is not statistically significant for children in the U.S. sample). A potential explanation for the positive relationship might be that obese children might feel the need to compensate for negative perceptions by applying themselves to their studies.

However, I cannot explore this idea further since there is a lack of detailed time usage information in the dataset. The family fixed effects estimates also suggest that higher birthweight is associated with an increase in the child's math test score. The family fixed effects estimates of the coefficients on the underweight and overweight indicators are not statistically significant.

Reading comprehension test scores are also available for children the U.S. NLSY sample. Columns (5) and (6) of Table 2 present the OLS and family fixed effects estimates for the specification where the dependent variable is the standardized reading comprehension test score for children in the full U.S. sample respectively. None of the OLS estimates on the weight indicators are statistically significant. Column (6) summarizes the family fixed effects estimates. Similar to the family fixed effects estimates for the math test score regression for children in the U.S. sample, the family fixed effects estimates for the reading test score regression suggest that once fixed family factors are accounted for, children in the U.S. sample who are obese actually tend to do better on the reading test. This positive effect has a magnitude that is around 20% of one standard deviation in the standardized reading score. This again suggests that the OLS estimate of the coefficient on the obese indicator for the U.S. sample has the expected negative bias. There is also some evidence to suggest that children in the U.S. sample who are overweight might do better on the reading test. The family fixed effects estimates for the coefficient on the underweight dummy are not statistically significant.

To summarize, there are several key differences between the test score regression results for the Canadian sample and the test score regression results for the U.S. sample. While there appears to be a negative relationship between math test scores and being overweight (not including obese) for the Canadian sample, this is not the case for the American sample. There is however, some indication from the family fixed effects estimates that overweight children in the

American sample might actually do better on the reading test. The relationship between the math test score and weight for obese children in the Canadian sample does not appear to be well defined. In contrast, the family fixed effects estimates for the U.S. sample suggest that obese children tend to do better on the math test and also on the reading test. A potential explanation might be that obese children in the U.S. might feel the need to compensate for negative perceptions of obese individuals by applying themselves to their studies. A comparison of the OLS estimates and the corresponding family fixed effects estimates of the coefficients on the weight dummies for both samples suggest that in general, family fixed effects estimates are less negative than their OLS counterparts. This is in keeping with the *ex-ante* expectation that the OLS estimates have a negative bias. The only exception to this is for the overweight (not including obese) indicator for the Canadian sample in the math test score regressions, where the OLS bias appears to be positive. Differences in time usage might help to explain the differences between the Canadian results and the American results. Unfortunately, there is a lack of detailed information about the child's time usage in the data used.

4.3 Expected School Grade Regression Results for Full Canadian and U.S. Samples

In order to look at the effects of weight on a broader measure of academic functioning, I also estimate regressions where the dependent variable is an indicator variable for whether the child is in the expected (or higher) school grade expected for his or her age. Table 3 summarizes the OLS and family fixed effects estimates for the specification where the dependent variable is the indicator variable for whether the child is in the school grade level (or higher grade level) expected for his or her age for the full Canadian NLSCY sample and for the full U.S. NLSY sample.

Column (1) of Table 3 displays the OLS estimates for the right-grade-for-age regression for the Canadian NLSCY sample. The OLS results suggest that underweight children are more likely to be in the expected (or higher) grade by 3 percentage points while obese children are less likely to be in the expected (or higher) grade. Children who weighed more at birth are more likely to be in the grade expected for their ages. Although being overweight (not including obese) is associated with a decrease in the standardized math test score for children in the Canadian sample, this negative effect does not seem to extend to whether the child is in the right (or higher) grade expected for his or her grade.

Column (2) summarizes the family fixed effects estimates for the specification where the dependent variable is the expected (or higher) grade dummy for the full Canadian sample. After controlling for fixed family factors, the child's current weight status and weight at birth no longer appear to have any effect on whether the child is in the right (or better) grade expected for his or her age.

Column (3) and (4) summarize the OLS and family fixed effects estimates for the U.S. sample respectively. None of the weight-related regressors have statistically significant coefficients.

4.4 Health Pathway Regression Results for Full Canadian and U.S. Samples

Since one of the objectives of this paper is to examine the potential pathways that might underlie the effects of weight on school outcomes, I also look at: (1) the relationships between the child's academic outcomes and the child's health measures and (2) the relationships between the child's health measures and the child's weight.

Table 4a presents estimates of the relationships between the child's academic outcomes and the child's various health-related measures for the full Canadian sample. The OLS results in column (1) suggest that children who are in poor health tend to do less well on the math test. They also suggest children who were absent from school for 10 or more days in the past school year tend to do less well on the math test and that better self-image is associated with higher math test scores. Increased absenteeism is also associated with a decrease in the likelihood that the child is in the expected or higher school grade in the OLS specification where the dependent variable is the expected (or higher) school grade indicator. However, once I control for fixed family factors in the family fixed effects specifications, the estimated coefficients on the health-related variables are no longer statistically significant.

Table 4b summarizes the results for specifications where the dependent variables are the health-related measures for the full Canadian sample. The OLS results in Table 4b suggest that children who are underweight or obese are more likely to be reported to be in current poor health by the PMK and that obese children are also less likely to be reported as being usually in good health in the past year by the PMK (columns (1) and (3)). The OLS results also suggest that overweight and obese children tend to have poorer self-image (column (7)). However, none of the family fixed effects estimates of the coefficients on the weight indicators for the Canadian sample are statistically significant, even though many of these estimates have the same signs as the OLS estimates. The lack of statistical significance in these family fixed effects estimates suggest that the OLS results for specifications where these health measures are the dependent variables might have been driven by unobserved heterogeneity at the family level. This is perhaps not surprising for some of the variables since the poor health indicator and good health indicator are based on reports from the PMK and the self-image score is based on questions answered by the child. Although being absent from school for 10 days or more is associated with poorer school outcomes, weight does not appear to be a factor in determining absenteeism (columns (5) and (6)).

Table 5a examines the relationships between the child's academic outcomes and the child's health-related measures for the full U.S. sample. In the OLS specifications, better self-worth is associated with increases in both the math and the reading test scores, while having a health condition that limits the amount of school work that the child can do is associated with large decreases (around 90% of one standard deviation) in both test scores for children in the full U.S. sample. The family fixed effects estimates also suggest that children who have health limitations that limit the amount of school work they can do tend to perform less well on both the math and the reading comprehension tests. However, the magnitudes of the estimated coefficients on the school work limitation indicator in the family fixed effects specifications are smaller than the corresponding OLS estimates. The family fixed effects estimates on the self-worth score for the test score specifications are positive but are not statistically significant.

The OLS results (column (5)) for the right grade regression indicate that better self-worth is associated with an increase in the probability that the child is in the expected (or higher) school grade while the presence of a health condition that limits the amount of school work that the child can perform is associated with a decrease in the probability that the child is in the right (or higher) school grade expected for his or her age for children in the U.S. sample. However, the corresponding family fixed effects estimates (column (6)) are not statistically significant.

Table 5b summarizes the results for specifications where the dependent variables are the health-related measures for the full American sample. The results suggest that deviations from the normal healthy weight range do not affect whether the child experiences health limitations that either limit school attendance or school work (columns (1) to (4)). Higher birthweight is associated with a decrease in the probability that a child has health limitations that limit the amount of school work that he or she can undertake. The OLS results suggest that children who are overweight or obese might have lower self-worth (column (5)). However, although the corresponding family fixed effects estimates of the coefficients on the overweight and obese indicators continue to be negative, they are no longer statistically significant (column (6)).

To summarize, I find relatively little evidence for the mechanisms examined in this paper. While the OLS estimates suggest that weight might affect certain aspects of the child's health such as the child's self-image or self-worth for children in both countries, the corresponding family fixed effects estimates are not statistically significant. The results appear to indicate that the relationships between academic performance and weight are mediated through pathways not captured by the health-related measures used in this paper.

4.5 Results for White Canadian Sub-sample and Non-Black, Non-Hispanic U.S. Sub-Sample

The results presented in the preceding sections suggest that there are several key differences between results for the Canadian sample and the U.S. sample. The main cross-country difference is that while the OLS estimates of the coefficients on the three weight status indicator variables (underweight, overweight and obese) in the academic outcome regressions for the American sample have the expected negative bias, the OLS estimates of the coefficient on the overweight indicator in the math test score regressions for the Canadian sample actually appear to have a positive bias. One of the potential explanations for the Canada-U.S. differences is that Canada and the U.S. differ in racial compositions. In particular, the U.S. has larger proportions of Blacks and Hispanics in the population than Canada. This is of particular interest to my analysis because the "obesity crisis" in the U.S. is perceived by some to be driven primarily by the Black and Hispanic portions of the population. Indeed, Black and Hispanic children in the U.S. are approximately twice as likely to be obese as their white, non-Hispanic counterparts (Ogden *et al.*, 2002a).

In order to examine the idea that racial differences are driving the differences in the results, one would ideally want to look at similar populations in Canada and the U.S. One way to do this would be to look only at white children in both populations. One complication in trying to do this accurately for the data used in this paper is that while the race categories for the Canadian sample are well-defined and white children can be identified from the sample, the race categories for the American sample are available only as “Black”, “Hispanic” and “Others”. In light of this, I make the assumption that the majority of children who are not classified as Black or Hispanic in the American sample are actually white.

I obtain separate OLS and family fixed effects estimates of equations (1) and (2) for children who are classified as white in the Canadian sample and for non-Black and non-Hispanic children in the American sample respectively (results available upon request). The results obtained for white Canadian children are qualitatively similar to the results obtained for the full Canadian sample. The results obtained for the non-Black and non-Hispanic American sub-sample are qualitatively similar to the results obtained for the full American sample. The similarities between the results for the sub-samples and the results for the full samples that the sub-samples are derived from suggest that the differences in racial composition are probably not the main driving forces behind the differences between Canadian and American results.

4.6 Other Possible Explanations

Another possible explanation is that the Canadian BMI values are less accurately measured than the American BMI values. While the BMI values for the majority (around 70%)

of American children in the sample are computed using measured heights and weights, the BMI values for the Canadian children are computed using estimated heights and weights. To investigate this possibility, I obtain separate estimates of the academic outcome specifications for children in the American sample whose BMI values are computed using estimated heights and/or estimated weights. In this sub-sample, 5.3% of the children are classified as being underweight, 18% are classified as being overweight (not including obese) and 13% are classified as being obese. A comparison of the OLS and family fixed effects estimates of the coefficients on the weight dummies in the academic outcome regressions for this sub-sample suggest that there is generally a negative bias in the OLS estimates (results available upon request). This is in keeping with the results for the overall U.S. sample from which this sub-sample is derived. Although the cross-country differences observed do not appear to be primarily due to differences in methods of quantifying height and weight (i.e. measured values vs. estimated values), it is also possible that there are systematic differences between countries in how respondents estimate height or weight.

Another potential explanation is that the differences observed between the two samples are due to differences in the children's time usage. I am unable to examine this possibility since the datasets lack detailed information on time usage.

5. Conclusions

In this paper, I examine the hypothesis that childhood overweight and obesity have negative consequences on school outcomes for children between the ages of 10 and 14 in Canada and in the United States using micro-level data from the NLSCY and the NLSY respectively. I also investigate potential pathways that might facilitate a link between weight and academic outcomes. The results presented in this paper suggest that there are potentially differences between Canada and the U.S. in terms of how the child's weight might affect his or her school performance.

The results obtained for the Canadian NLSCY sample suggest that being overweight (not including obese) is associated with a decrease in the math test score. The OLS estimates of the coefficient on the overweight indicator variable in the math test score regressions for the Canadian NLSCY sample actually have a positive bias. This is somewhat surprising given that the OLS estimates of the coefficients on the weight indicator variables are *ex-ante* expected to have a negative bias in the academic outcome regressions. There is also some evidence to suggest that underweight children in the Canadian NLSCY sample have better academic outcomes. However, the relationship between academic performance and weight is not well-defined for obese children in the Canadian sample. The family fixed effects estimates of the coefficients on the underweight and obese indicators in the school outcome regressions generally tend to be less negative than their OLS counterparts, which is in keeping with the notion that the OLS estimates of the coefficients on the weight indicator variables in the school outcome specifications should have a negative bias. The results also suggest poor health, lower self-image and increased absenteeism from school might be associated with poorer school outcomes for children in the Canadian sample. However, the results also indicate that the relationships between academic performance and weight are mediated through pathways not captured by the health-related measures used in this paper. Although there is some evidence that being overweight or obese is associated with poorer overall and psychosocial health in the OLS estimates, I do not find any significant relationships between health and weight in the family fixed effects estimates for the Canadian sample.

The results obtained for the U.S. NLSY sample indicate that after controlling for fixed family factors, being obese is actually associated with better academic performance. This is contrary to the hypothesis that childhood obesity has negative consequences for school outcomes but is consistent with the *ex-ante* notion that the OLS estimates for the coefficients on the weight dummies have a negative bias in the academic outcome specifications. A comparison of the family fixed effects estimates and the OLS estimates of the coefficients on the weight indicator variables obtained from the academic outcome regressions suggests that for the American sample, the OLS estimates generally have the expected negative bias. Despite the positive relationship between obesity and academic performance, obesity is also associated with poorer self-worth for children in the American sample. This presents a puzzling situation as self-worth is commonly thought to have a positive effect on academic performance (the estimated coefficients for the self-worth score in some of the school outcome regressions reported in this paper actually support this idea). A potential explanation is that obese children feel the need to compensate for negative perceptions by applying themselves to their studies. Unfortunately, I am not able to further explore this possibility due to a lack of detailed data on the child's usage of time. The results also indicate that the relationships between academic performance and weight are mediated through pathways not captured by the health-related measures available for the U.S. sample. I do find that children in the American sample who have health limitations that limit the amount of school work that he or she can do tend to perform less well in school. However, there is a lack of evidence to suggest that health limitations are related to the child's weight in the analysis presented in this paper.

I also attempt to examine whether differences in racial composition constitute the main driving forces behind the differences between the results for the Canadian and American samples.

The results obtained suggest that these differences do not appear to be primarily driven by differences in racial composition between the two countries.

This paper addresses the need to examine the effects of childhood overweight and obesity on outcomes beyond physical health conditions and presents an important look at how childhood overweight and obesity affects children's school-related outcomes. Many questions about the causes and consequences of childhood overweight and obesity remain to be answered. Future research would greatly benefit from detailed large-sample datasets that are designed primarily to study the causes and consequences of childhood overweight and obesity.

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Table 1: Descriptive Statistics of the Main Variables (Standard Deviations in Brackets)

	Canada All Kids	**Canada Whites**	**U.S. All Kids**	**U.S. No Blacks & Hispanics**
Underweight	0.0897	0.0885	0.06	0.0597
	[0.2857]	[0.28406]	[0.2375]	[0.2370]
Overweight	0.1312	0.1291	0.1671	0.166
	[0.3376]	[0.3354]	[0.3731]	[0.3722]
Obese	0.1615	0.1593	0.1245	0.1193
	[0.3680]	[0.3660]	[0.3302]	[0.3242]
Birthweight (KG)	3.4036	3.4064	3.7127	3.7378
	[0.5882]	[0.5873]	[0.6359]	[0.6279]
Standardized Math Score	0.0549	0.0498	0.0662	0.12828
	[0.9665]	[0.9585]	[0.9923]	[0.9744]
US: Standardized Reading Score			-0.0893	-0.0284
			[0.9940]	[0.9779]
Child is in Right Grade or Better	0.843	0.8448	0.6737	0.674
	[0.3638]	[0.3621]	[0.4689]	[0.4688]
Canada: Self-Image Score (Out of 16)	12.682	12.754		
	[2.9561]	[2.9002]		
Canada: Child is in Poor Health	0.1165	0.1109		
	[0.3208]	[0.3140]		
Canada: Child Usually in Good Health	0.9764	0.9761		
	[0.1517]	[0.1529]		
Canada: Absent From School>=10 Days	0.1036	0.1043		
	[0.3048]	[0.3057]		
US: Health Condition Limits School Attendance			0.0223	0.0221
			[0.1476]	[0.1469]
US: Health Condition Limits School Work			0.0415	0.0413
			[0.1995]	[0.1991]
US: Self Worth (out of 240)			206.06	206.44
			[33.43]	[33.30]
US: Child is Black			0.0668	
			[0.2496]	
US: Child is Hispanic			0.0252	
			[0.15680]	
US: Mother has BMI>25			0.4635	0.441
			[0.4987]	[0.4965]
US: Mother has BMI>30			0.199	0.1814
			[0.3993]	[0.3854]
Child is Male	0.5109	0.5108	0.5197	0.5191
	[0.4999]	[0.4999]	[0.4996]	[0.4997]
Age of Child (years)	11.57	11.59	11.76	11.75
	[1.345]	[1.349]	[1.420]	[1.422]
Ln(Household Income (in 2002 Dollars))	10.98	11.01	10.61	10.66
	[0.6477]	[0.6417]	[0.8756]	[0.8488]
Mother is a High School Drop-out	15.49%	14.51%	13.77%	12.57%
Mother is High School Graduate	21.74%	22.40%	51.03%	51.46%
Mother has some Post-Secondary Edu	45.28%	46.04%	22.89%	22.92%
Mother has University Degree	17.49%	17.05%	12.32%	13.06%
Number of Observations	14610	13235	7446	5616

Notes: All descriptive statistics are weighted by child sampling weights.

Table 2: Estimates of the Relationship Between Test Scores and Weight for Full Canadian and U.S. Samples

	[1]	[2]	[3]	[4]	[5]	[6]
	Canada	Canada	U.S.	U.S.	U.S.	U.S.
	OLS	Family FE	OLS	Family FE	OLS	Family FE
	Std. Math	Std. Math	Std. Math	Std. Math	Std. Read	Std. Read
Underweight	0.06943	0.14695	-0.16468	-0.00645	-0.08309	-0.00861
	[1.24]	[1.42]	[2.37]*	[0.10]	[1.19]	[0.12]
Overweight	-0.07858	-0.14778	0.00463	0.07005	0.02131	0.09174
	[2.00]*	[2.16]*	[0.10]	[1.47]	[0.47]	[1.92]+
Obese	0.04933	0.05787	-0.02891	0.15133	0.08008	0.20266
	[1.02]	[0.75]	[0.50]	[2.37]*	[1.39]	[3.30]**
Birthweight (KG)	0.04663	0.0315	0.03183	0.12754	0.06242	0.11933
	[1.68]+	[0.31]	[1.06]	[3.29]**	[2.04]*	[2.81]**
Constant	-2.26341	0.30354	-1.39542	1.6345	-0.83062	0.14407
	[5.58]**	[0.13]	[2.87]**	[1.01]	[1.75]+	[0.08]
Observations	9328	9328	4936	4936	4885	4885
R-squared	0.19	0.77	0.13	0.65	0.14	0.65

Robust t statistics in brackets. Year dummies are included in all specifications.

Province (region) dummies included in all Canadian (U.S.) specifications.

The full set of covariates for the Canadian specifications also include the mother's age at birth of child, the natural log of household income, maternal educational attainment, dummy variables for the child's age, the child's gender and the child's race, for whether the mother worked, for the mother being an immigrant, for the mother being in poor health, for single parent household,for the area of residence being rural and controls for the number of non-parental adults and number of children in the household.

The full set of covariates for the U.S. specifications also include the mother's age, the natural log of household income, maternal educational attainment, dummies for the child's age, the child's gender,the child's race and for whether the height or weight is mother-reported, dummies for whether the mother worked, for the mother being overweight or obese, for the mother having health limitations, for the mother being an immigrant and dummies for the family being below the poverty line, for single parent status and for the area of residence being rural and controls for the number of adults and number of children in the household.

Regressions are weighted with child sampling weights. + significant at 10%; * significant at 5%; ** significant at 1%

Table 3: Estimates of the Relationship Between Right School Grade and Weight for Full Canadian and U.S. Samples

	[1] Canada OLS Right Gr.	[2] Canada Family FE Right Gr.	[3] U.S. OLS Right Gr.	[4] U.S. Family FE Right Gr.
Underweight	0.02999	0.00355	0.00848	0.02244
	[1.96]*	[0.17]	[0.26]	[0.61]
Overweight	-0.01835	-0.00346	-0.00589	-0.00114
	[1.31]	[0.22]	[0.27]	[0.04]
Obese	-0.02626	-0.0076	0.01608	0.03741
	[1.61]	[0.40]	[0.65]	[1.21]
Birthweight (KG)	0.02958	-0.00249	0.00719	0.01977
	[2.80]**	[0.09]	[0.50]	[0.92]
Constant	0.23424	5.32428	0.48654	-1.59954
	[1.81]+	[5.25]**	[2.23]*	[1.70]+
Observations	12715	12715	5146	5146
R-squared	0.12	0.78	0.09	0.55

Robust t statistics in brackets. Year dummies are included in all specifications.
Province (region) dummies included in all Canadian (U.S.) specifications.
The full set of covariates for the Canadian specifications also include the mother's age at birth of child, the natural log of household income, maternal educational attainment, dummy variables for the child's age, the child's gender and the child's race, for whether the mother worked, for the mother being an immigrant, for the mother being in poor health, for single parent household,for the area of residence being rural and controls for the number of non-parental adults and number of children in the household.
The full set of covariates for the U.S. specifications also include the mother's age, the natural log of household income, maternal educational attainment, dummies for the child's age, the child's gender,the child's race and for whether the height or weight is mother-reported, dummies for whether the mother worked, for the mother being overweight or obese, for the mother having health limitations, for the mother being an immigrant and dummies for the family being below the poverty line, for single parent status and for the area of residence being rural and controls for the number of adults and number of children in the household.
Regressions are weighted with child sampling weights. + significant at 10%; * significant at 5%; ** significant at 1%

Table 4a: Estimates of the Relationship between School Outcomes and Health Measures for Full Canadian Sample

	[1] Canada OLS Std. Math	[2] Canada Family FE Std. Math	[3] Canada OLS Right Gr.	[4] Canada Family FE Right Gr.
Child is in Poor Health	-0.11424	0.01456	0.01826	0.04824
	[2.14]*	[0.12]	[1.17]	[2.09]*
Child Usually in Good Health	-0.0811	0.06887	0.05418	-0.00799
	[0.68]	[0.35]	[1.51]	[0.19]
Self-Image Score (Out of 16)	0.01604	0.01593	-0.0029	-0.00293
	[2.41]*	[1.28]	[1.38]	[0.81]
Absent From School>=10 Days	-0.26737	-0.17127	-0.03713	-0.00995
	[4.56]**	[1.51]	[2.12]*	[0.34]
Birthweight (KG)	0.06215	0.01408	0.03576	0.01657
	[2.05]*	[0.12]	[3.00]**	[0.54]
Constant	-2.10482	1.35328	0.32056	4.831
	[4.59]**	[0.50]	[2.12]*	[3.37]**
Observations	7682	7682	8597	8597
R-squared	0.2	0.8	0.13	0.84

Robust t statistics in brackets. Year dummies are included in all specifications.
Province dummies included in all Canadian specifications.
The full set of covariates for the Canadian specifications also include the mother's age at birth of child, the natural log of household income, maternal educational attainment, dummy variables for the child's age, the child's gender and the child's race, for whether the mother worked, for the mother being an immigrant, for the mother being in poor health, for single parent household,for the area of residence being rural and controls for the number of non-parental adults and number of children in the household.
Regressions are weighted with child sampling weights. + significant at 10%; * significant at 5%; ** significant at 1%

Table 4b: Estimates of the Relationship Between Health Measures and Weight for Full Canadian Sample

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	Canada	Canada	Canada	Canada	Canada	Canada	Canada	Canada
	OLS	Family FE	OLS	Family FE	OLS	Family FE	OLS	Family FE
	Poor Health	Poor Health	Usual G.Health	Usual G.Health	Absent	Absent	Self Image	Self Image
Underweight	0.03173	0.0326	-0.00557	-0.01575	-0.0084	0.00246	-0.19842	-0.10425
	[1.84]+	[1.37]	[0.91]	[1.54]	[0.49]	[0.06]	[1.48]	[0.52]
Overweight	0.0146	0.00598	-0.00488	-0.00542	0.00292	0.00672	-0.18141	-0.12824
	[1.21]	[0.32]	[0.90]	[0.65]	[0.21]	[0.27]	[1.71]+	[0.77]
Obese	0.03487	0.0256	-0.01795	-0.00483	0.00935	-0.00566	-0.49321	-0.26767
	[2.45]*	[1.27]	[2.55]*	[0.47]	[0.56]	[0.19]	[3.34]**	[1.57]
Birthweight (KG)	-0.00318	0.04354	0.00509	0.0131	0.01238	0.0044	-0.09077	0.09377
	[0.40]	[1.49]	[1.51]	[0.86]	[1.38]	[0.15]	[1.28]	[0.40]
Constant	0.32766	-0.96222	0.77071	0.69883	0.30592	-1.17279	6.2212	11.25266
	[2.90]**	[2.20]*	[13.00]**	[2.59]**	[2.66]**	[1.43]	[6.01]**	[2.44]*
Observations	12718	12718	12718	12718	9413	9413	11633	11633
R-squared	0.08	0.67	0.03	0.55	0.05	0.72	0.28	0.74

Robust t statistics in brackets. Year dummies are included in all specifications.
Province dummies included in all Canadian specifications.
The full set of covariates for the Canadian specifications also include the mother's age at birth of child, the natural log of household income, maternal educational attainment, dummy variables for the child's age, the child's gender and the child's race, for whether the mother worked, for the mother being an immigrant, for the mother being in poor health, for single parent household,for the area of residence being rural and controls for the number of non-parental adults and number of children in the household.
Regressions are weighted with child sampling weights. + significant at 10%; * significant at 5%; ** significant at 1%

Table 5a: Estimates of Relationships Between School Outcomes and Health Measures for Full U.S. Sample

	[1]	[2]	[3]	[4]	[5]	[6]
	U.S.	U.S.	U.S.	U.S.	U.S.	U.S.
	OLS	Family FE	OLS	Family FE	OLS	Family FE
	Std. Math	Std. Math	Std. Read	Std. Read	Right Gr.	Right Gr.
Child's Self-Worth Score (Out of 240)	0.00276	0.00098	0.00281	0.00081	0.0005	-0.00006
	[4.68]**	[1.50]	[4.74]**	[1.23]	[1.73]+	[0.17]
Health Condition that Limits School	0.20146	0.20009	0.18195	0.17148	0.08266	-0.02204
Attendance	[1.38]	[1.27]	[1.27]	[0.97]	[1.12]	[0.25]
Health Condition that Limits School Wor	-0.87587	-0.61878	-0.82896	-0.37919	-0.1369	0.00425
	[7.77]**	[4.49]**	[7.67]**	[2.32]*	[2.27]*	[0.05]
Birthweight (KG)	0.05056	0.12807	0.0441	0.13449	0.00295	0.05774
	[1.47]	[2.61]**	[1.26]	[2.33]*	[0.17]	[2.01]*
Constant	-2.22061	1.17678	-1.51859	0.88765	0.4689	-1.14819
	[3.94]**	[0.57]	[2.64]**	[0.39]	[1.76]+	[0.95]
Observations	3471	3471	3434	3434	3437	3437
R-squared	0.17	0.68	0.17	0.68	0.1	0.61

Robust t statistics in brackets. Year dummies are included in all specifications.

Region dummies included in all U.S. specifications.

The full set of covariates for the U.S. specifications also include the mother's age, the natural log of household income, maternal educational attainment, dummies for the child's age, the child's gender,the child's race and for whether the height or weight is mother-reported, dummies for whether the mother worked, for the mother being overweight or obese, for the mother having health limitations, for the mother being an immigrant and dummies for the family being below the poverty line, for single parent status and for the area of residence being rural and controls for the number of adults and number of children in the household.

Regressions are weighted with child sampling weights. + significant at 10%; * significant at 5%; ** significant at 1%

Table 5b: Estimates of the Relationship Between Health Measures and Weight for Full U.S. Sample

	[1]	[2]	[3]	[4]	[5]	[6]
	U.S.	U.S.	U.S.	U.S.	U.S.	U.S.
	OLS	Family FE	OLS	Family FE	OLS	Family FE
	Lim.School Attend.	Lim. School Attend.	Lim. School Work	Lim. School Work	Self Worth	Self Worth
Underweight	0.00057	-0.00089	0.01619	0.01331	-1.87655	-4.18227
	[0.05]	[0.09]	[1.14]	[0.94]	[0.70]	[1.14]
Overweight	-0.00414	-0.01221	-0.01214	-0.01472	-4.13338	-3.36629
	[0.65]	[1.33]	[1.53]	[1.38]	[2.36]*	[1.39]
Obese	-0.00532	-0.01	0.00439	-0.0047	-12.06355	-5.19847
	[0.69]	[0.90]	[0.36]	[0.34]	[4.78]**	[1.61]
Birthweight (KG)	-0.00712	-0.00427	-0.01045	-0.02048	0.85586	0.53405
	[1.67]+	[0.64]	[1.67]+	[1.78]+	[0.74]	[0.26]
Constant	0.25148	-0.24947	0.21631	-0.32486	168.88202	213.23393
	[2.61]**	[0.73]	[2.11]*	[0.76]	[9.42]**	[2.41]*
Observations	5190	5190	5177	5177	3529	3529
R-squared	0.02	0.49	0.04	0.49	0.07	0.53

Robust t statistics in brackets. Year dummies are included in all specifications.

Region dummies included in all U.S. specifications.

The full set of covariates for the U.S. specifications also include the mother's age, the natural log of household income, maternal educational attainment, dummies for the child's age, the child's gender,the child's race and for whether the height or weight is mother-reported, dummies for whether the mother worked, for the mother being overweight or obese, for the mother having health limitations, for the mother being an immigrant and dummies for the family being below the poverty line, for single parent status and for the area of residence being rural and controls for the number of adults and number of children in the household.

Regressions are weighted with child sampling weights. + significant at 10%; * significant at 5%; ** significant at 1%