NBER WORKING PAPER SERIES

EFFECTS OF THE MINIMUM WAGE ON CHILD HEALTH

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Working Paper 26691
http://www.nber.org/papers/w26691

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
January 2020, Revised December 2020

The study was funded by a Policies-For-Action (P4A) grant from the Robert Wood Johnson Foundation (RWJF). The authors thank Jason Fletcher, David Simon, Hope Corman, and seminar participants at the RWJF P4A research webinar, at the Federal Reserve Bank of Boston (New England Studies Group), University of Chicago, and at Hunter College, City University of New York for providing helpful comments on the paper. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 26691
January 2020, Revised December 2020
JEL No. I1,I14,I28,J20,J3

ABSTRACT

Effects of the minimum wage on labor market outcomes have been extensively debated and analyzed. Less studied, however, are other consequences of the minimum wage that stem from changes in a household's income and labor supply. We examine the effects of the minimum wage on child health. To obtain estimates, we use data from the National Survey of Children's Health in conjunction with a difference-in-differences research design. We find that an increase in the minimum wage throughout childhood is associated with a significant improvement in child health. A particularly interesting finding is that much of the benefits of a higher minimum wage are associated with the period between birth and age five.

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1. Introduction

The effects of the minimum wage on employment, wages, and income in the United States have been extensively investigated. While these consequences of the minimum wage are of obvious importance, the minimum wage may have other impacts that extend beyond the labor market. One potentially important consequence of the minimum wage is its effect on child health stemming from the effect of the minimum wage on family income and time allocation. Some evidence that the minimum wage has such effects comes from research on the effects of the minimum wage on birth weight. Results from studies by Komro, Livingston, Markowitz, and Wagenaar (2016) and Wehby, Dave, and Kaestner (2019) indicate that increases in the minimum wage had beneficial, although modest, effects on birth weight. Whether the beneficial effects of a higher minimum wage extend to post-birth child health is unknown, however, as no prior research has investigated this question.

In this study, we provide the first analysis of the effect of the minimum wage on children's health using nationally representative data and quasi-experimental methods. An important contribution of our study is that we assess whether the effects of the minimum wage differ by when such changes occur during the child's life. In other words, we investigate if there are certain stages of childhood that are more or less sensitive to changes in household circumstances (e.g., income) associated with changes in minimum wages.

Our analysis uses data from three waves of the National Survey of Children's Health in conjunction with a continuous-treatment, difference-in-differences research design that compares the health of children in the same state "exposed" to different minimum wages over different periods of childhood. Results indicate that a higher minimum wage in childhood leads to statistically significant improvements in health. For children aged 6 to

12, our estimates indicate that a $1 increase in the minimum wage on average over the child's life (for example, a$1 increase each year) is associated with approximately a 10% increase in the probability that the child is in excellent health; a 29% decrease in the probability of being in poor health, as measured by three indicators of whether a child's health requires greater use of medication and medical care than peers and reduces the child's ability to engage in normal activities; and a 26% decrease in missed school days due to illness or injury. Among children ages 13 to 17, we also find positive and significant effects of an increase in the minimum wage over the child's life course on their health, although estimates are less precise and confidence intervals wider due to more limited variation in the minimum wage for these birth cohorts (see Figure 1). For these children, a $1 increase in the minimum wage in each year of the child's life is associated with an 11% increase in the probability that the child is in excellent health; a 57% decrease in the probability of being in poor health, as measured by three indicators noted earlier; and a 42% decrease in missed school days due to illness or injury. Notably, for both cohorts of children, a large share of the cumulative effect of the minimum wage on child health is from changes in the minimum wage during the first five years of life, which suggests that resources during this period are particularly important to children's health.

An important contribution of our study is to the literature on the effects of income on child health. While there is a well-documented association between family income and child health,[1] there is much less evidence that this association represents a causal effect (Cooper

[1] Some recent studies that document the income gradient for health throughout childhood are: Case et al. (2002); Currie and Stabile (2003); Currie et al. (2007), Codliffe and Link (2008); Murasko (2008); and Allin and Stabile (2012). However, there is a voluminous literature documenting a positive association between income (poverty) and child outcomes. Some reviews include: Mayer (1997); Aber et al. (1998). Mayer (2002); Duncan et al. (2014); McEwan and Stewart (2014); Pilas et al. (2014).

and Stewart, 2013; Cooper and Stewart, 2017). In their comprehensive review, Cooper and Stewart (2017) reported that among 15 quasi-experimental studies of the effect of income on child health, findings were decidedly mixed: eight reported evidence of no association between income and child health and 13 reported evidence of a positive association.[2] Moreover, almost all the positive associations pertain to birthweight or child height and weight.[3] There were very few studies of the effect of income on general health or measures of health other than height and weight, and in these, results generally indicated no relationship between income and child health.

The paucity of causal evidence about the role of family income in determining child health has important implications for both theory and policy. From a theoretical point-of-view, child health is likely to be a normal good and, therefore, higher income should be positively associated with child health. However, the magnitude of the effect of family income on child health depends on the relative importance of other drivers of child health, some of which are less amenable to greater investments (e.g., preventive care) from more income, such as genetic factors and exogenous health shocks (e.g., trauma). Evidence consistent with this possibility is found in Currie and Stabile (2003) who showed that lower income children in Canada have a greater number of chronic conditions than high-income Canadian children, but that these conditions have similar long-run effects on health across income groups. While the study was not a causal analysis, the results suggest that income is primarily associated with the presence of chronic conditions and not the consequences of health shocks. From a policy perspective, the lack of causal evidence linking family income

[2] The studies examined multiple outcomes and that is why the total is more than 15.
[3] These findings are consistent with the evidence on the effect of the minimum wage on birth weight (Komro et al., 2016; Wehby et al., 2019).

to child health weakens the case for income support programs, although these programs may be justified on the basis of other evidence.[4]

Our analysis contributes to this literature because the minimum wage affects income. Thus, our finding that a higher minimum wage is associated with better child health may be interpreted as indirect evidence of a causal effect of income on child health. While effects on employment have often taken center stage in the debate over the efficacy of the minimum wage, it is widely acknowledged that an increase in the minimum wage will substantially increase wages for many low-skilled workers (Belman, Wolfson, & Nawakitphaitoon, 2015). We acknowledge that there may be dis-employment effects of the minimum wage that could moderate the positive income gains of minimum wage increases, and these labor supply effects may also directly affect child health. However, we do not find any evidence of this in our analysis and other evidence suggests small to no dis-employment effects of the minimum wage.[5] Therefore, it is reasonable to assume that the primary effect of the minimum wage on health that we observe is through income.[6]

2. Related Literature

2.a. Effects of the Minimum Wage on Employment and Earnings

There is a large literature examining the effects of the minimum wage on employment and earnings. We will not review that literature here, as there are many good reviews (Belman & Wolfson, 2014; Congressional Budget Office, 2014, 2019; Neumark, 2019). While debate on the issue continues, conclusions from almost all reviews of the

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[4] There is substantial evidence that higher family income is a cause of better child developmental outcomes related to cognition such as measures based on school test scores (see Cooper sand Stewart (2013) for a thorough review).
[5] The data we use do not have exact income information to conduct an analysis of the effect of the minimum wage on family income. We discuss this more later in the article.
[6] In this sense, our study is similar to studies of the effect of the EITC on child health (Hoynes et al. 2015; Braga et al. 2019).

evidence coalesce around a consensus that, on average, there seem to be small effects of the minimum wage on employment, and, for those most likely adversely affected, somewhat larger dis-employment effects.[7] In contrast to the mixed evidence on the employment effects of the minimum wage, there is consistent evidence that a higher minimum wage raises wages (Aaronson, Agarwal, & French, 2012; Belman et al., 2015; David, Manning, & Smith, 2016; Dube, 2018). A recent Congressional Budget Office (2019) analysis concluded that an increase in the minimum wage to $12 would increase wages for as many as 11 million workers.[8]

Overall, the evidence on the labor market effects of the minimum wage, at least over the range of increases occurring in the last 20 to 30 years, indicates that a higher minimum wage will raise wages and income among many low-skilled persons, though some of these gains may be partly offset by modest dis-employment effects.[9] The important implication of this literature for child health is that an increase in the minimum wage and, in turn, family income may have improved child health. However, we cannot definitively rule out other pathways (e.g., labor supply) that link the minimum wage to child health.

[7] The "new" minimum wage literature, comprising studies over the past two decades since Card and Krueger (1995), has mostly found small to no effects of moderate increases in the minimum wage on employment (though see Neumark and Wascher (2007) and Neumark (2019) for a critique of some of the methods underlying these conclusions). Belman and Wolfson (2014) provide a survey of this literature and a meta-analysis, with the median and modal employment elasticity ranging between 0 and -0.1. However, there may be larger dis-employment effects for certain groups and the potential for large increases in the minimum wage, or increases beyond some threshold, to lead to larger dis-employment effects (Gorry & Jackson, 2017).

[8] We note that research on the effects of the minimum wage on poverty lack power to detect small to moderate effect sizes. For example, estimates in Burkhauser and Sabia (2007) cannot reject an elasticity of poverty with respect to minimum wage <0.25 in absolute value). Similarly, Neumark and Wascher (2002) cannot reject a change in poverty <5 percentage points (absolute value) with respect to a $1 (20%) increase in minimum wage, which is a large effect given that that over half of families in poverty in the sample do not have anyone who works, and therefore are unlikely to be affected by minimum wage.

[9] Schmitt (2013) provides a good discussion of other adjustment mechanisms that may absorb the effects of a higher minimum wage, thereby relieving the pressure on the employment margin. There also may be changes in the intensive margin of hours of work.

2.b. Previous Evidence of the Effects of the Minimum Wage on Child Health

Studies examining the relationship between the minimum wage and health are sparse, and the few studies that have been conducted have largely focused on the health of adults and workers. Here, we focus on studies related to children. Two recent studies explore how the minimum wage impacts infant health. Both Komro et al. (2016) and Wehby et al. (2019) find evidence that a higher minimum wage is associated with small increases in birth weight. And Wehby et al. (2019) show that the increase in birth weight is driven by an improvement in the fetal growth rate and gestational age, consistent with improved nutrition and maternal behaviors during pregnancy.

Averett, Smith, and Wang (2017) examine the effects of the minimum wage on working teenagers using the Current Population Surveys from 1996 to 2014. Analyses are stratified by race/ethnicity and gender. The authors report that the minimum wage is positively associated with self-reported health among white females and negatively related to self-rated health for Hispanic males. For other racial/ethnic and gender groups the minimum wage was not significantly associated with health.[10]

There have also been a couple of studies of the effect of the Earned Income Tax Credit (EITC) on child health, which, like the minimum wage also affects income and labor supply of low-income families, although the labor supply effects of the EITC are much larger than they are for the minimum wage. Results from these studies find positive effects of the EITC on infant health (Hoynes, Miller, & Simon, 2015) and improved general health and reduction in obesity among young adults (Braga, Blavin, & Gangopadhyaya, 2019).[11]

[10] The disparate set of findings in this study are difficult to reconcile with a behavioral model because almost all groups experienced an increase in earnings. To generate both negative and positive effects, minimum wage related increase in earnings must have had very different effects on behavior.

[11] See Dench and Joyce (2019) for countervailing evidence of the effect of the EITC on infant health.

2.c. Contributions

The literature on the effects of the minimum wage on non-labor market domains is still emerging, and the relatively little research that has assessed effects on health mostly pertains to adult populations (see, Lenhart, 2016; Lenhart, 2017; Reeves, McKee et al., 2017). No study has examined how minimum wage changes impact child health. This is an important research question because of the known disadvantages in terms of health, education, and socio-emotional development of children in low-income families who are most likely to gain from an increase in minimum wages. If the minimum wage has significant, positive effects on child health, then it would be an important, and currently unrecognized, benefit of a higher minimum wage and important evidence in support of such a policy. We provide the first analysis of how minimum wage changes during childhood impact health outcomes for children.

A particularly important contribution of our research is that we examine whether the timing of the minimum wage increase matters (Cunha and Heckman 2007; Braga et al. 2019). Health is a cumulative outcome and the effect of past investments likely matters to current child health. Therefore, our assessment of how changes in the minimum wage at different points over the child's life course affect current child health provides evidence that is central to the human capital theory and important to policymakers.

3. Mechanisms Linking Minimum Wage to Child Health

3.a. Overview

As noted, there is substantial evidence that an increase in the minimum wage increases wages of low-skilled employed persons and may have a small disemployment effect (extensive margin). It is also apparent from prior evidence that the minimum wage increased income and had relatively little effect on the intensive margin of hours of work.[12] Thus, the primary effect of an increase in the minimum wage is to raise income, although there may be some changes in time allocation (e.g., employment and hours of work).

Greater family income can affect child health through multiple channels. The most direct pathway is the increase in consumption of goods and services, such as better nutrition, a better physical environment, and more use of health care that are beneficial to the child.[13] More income can also affect residential and employment stability because of a greater ability to smooth consumption through both savings and access to credit. Finally, greater earnings are likely to reduce financial stress, which may lead to improved mental health of all family members and reduce unhealthy behaviors that are caused by stress, for example, tobacco and alcohol use of adults.

Evidence on the causal effects of income on various mechanisms (mediating factors) linking income to child health is sparse (Stewart and Cooper, 2017). There is limited evidence that greater income is associated with better nutrition (Gennetian and Miller, 2002; Riccio et al., 2010; Milligan and Stabile, 2011) and more consistent evidence that greater income is associated with improved maternal mental health (Gennetian and Miller, 2002; Evans and Garthwaite, 2010; Milligan and Stabile, 2011). Income is also likely causally related to the use of medical care, although income is unlikely to have a significant causal effect on the use of health care among a population with health insurance, particularly Medicaid that has almost no cost-sharing. The lack of evidence on the mediating effects of

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[12] Studies of the effect of minimum wage on hours of work (intensive margin) include: Stewart and Swaffield (2008); Metcalf (2008); Couch and Wittenburg (2001); Neumark and Wascher (2007); Neumark and Wascher (2008); Belman, Wolfson, and Nawakitphaitoon (2015); Neumark, Schweitzer, and Wascher (2004); Zavodny (2000); Skedinger (2015); Dolton, Bondibene, and Wadsworth (2010).

[13] Alternatively, an increase in income may increase unhealthy consumption, but this would be primarily among adults (e.g. smoking, alcohol) and its link to child health would be second order.

income on child health is, first, due to the paucity of experimental and quasi-experimental studies examining the effect of income on child health. Second, data availability often hinders such analyses because of the absence of good measures of the mediating factors, such as nutrition, physical environment, and residential mobility.

A second issue we want to highlight is the possibility that there may be periods in the child's life during which the (income) effects of the minimum wage are particularly important (Cunha and Heckman, 2007). To do so, we use a human capital model of child health and focus on the child health production function central to this model (Grossman, 1972; Todd & Wolpin, 2003). The production function relates child health to cumulative investments in children. The production function embeds the effects of the minimum wage because one likely consequence of a higher minimum wage is greater income, which will increase investments in child health. The production function measures the effects of these investments.

3.b. A Model of Child Health Production

One version of a child health (H) production function is the following, which we present for a child age seven, but the model can be adapted to any age:

$$(1)\ H_7 = H_0(1-\delta_0)\ldots(1-\delta_6) + \alpha_0 I_0(1-\delta_1)\ldots(1-\delta_6)+\ldots+\alpha_6 I_6$$

In equation (1), the health of a child age seven (H_7) depends on her initial health (H_0) and all investments (I) in health from birth (age 0) to age seven. The productivity (effects) of investments is measured by the coefficients α_i. The depreciation of the child's health is denoted by δ_i. Depreciation is time-varying and, for children, may be quite small. Note that the productivity of investments will differ by age and this reflects the possibility that child health may be particularly affected by investments at certain ages.

Consider the prenatal period, Investment in medical care and maternal nutrition may be particularly important because of the dramatic biological changes that occur during the 9-month prenatal period. Similarly, well-child visits during the first three years of life, which is a period of very rapid and continuous physical and neurodevelopmental growth, may be especially important in identifying and remedying risks and promoting health than later visits. We also note that, while we indicate only one type of investment (I) in equation (1), in reality, there are many, such as nutrition, medical care, and exercise.

The minimum wage raises wages and income (net of dis-employment), and this increase in income is likely to increase investment (below, we show that MW is the only determinant of investment for simplicity; *I(MW)*).[14] If so, then the effect of the minimum wage on child health at age seven is given by:

$$(2)\ H_7 = H_0(1-\delta_0)\ldots(1-\delta_6) + \alpha_0 I_0(MW_0)(1-\delta_1)\ldots(1-\delta_6)+\ldots+\alpha_{(6)} I_6(MW_6)$$

$$(3)\ \frac{\partial H_7}{\partial MW} = \frac{\partial H_0}{\partial MW_{-1}}(1-\delta_0)\ldots(1-\delta_6) + \alpha_0 \frac{\partial I_0}{\partial MW_0}(1-\delta_1)\ldots(1-\delta_6)+\ldots+\alpha_6 \frac{\partial I_6}{\partial MW_6}$$

As indicated in equation (3), minimum wages throughout the child's life (including prenatal period here indicated by age subscript -1 may affect health at a particular age, in this case, age seven. It is also the case that a change in the minimum wage at different stages of a child's life may have different effects and not just because of the greater or less depreciation of the investments at that age, but because of differences in the productivity of investments at different ages ($\alpha_i \neq \alpha_j$). Finally, the minimum wage may have different effects at different stages of a child's life because it may have a different effect on the quantity of investments at different stages of life ($\frac{\partial I_t}{\partial MW_t} \neq \frac{\partial I_{(t-1)}}{\partial MW_{(t-1)}}$). For example, parents may focus more on

[14] There may be a decrease in time inputs in child health production if the minimum wage causes some people to work more hours, but evidence (see footnote 7) suggests that this is unlikely to be significant.

nutritional investments during pregnancy and earlier in the child's life, but more on educational or physical activity investments later in childhood.

The last point merits elaboration. Equation (1) is a production function and not a behavioral model—it is best viewed as an accounting relationship. However, it embeds the choices of a behavioral model as manifested by the quantity of investment at each age. Like any economic model, the quantity of investment at each age will depend on the costs and benefits of the investment. The benefits of investment at any age will depend on the productivity of those investments (α_i) and the value (utility) of improved child health. This reasoning suggests that an increase in the minimum wage at ages when the productivity of investment is relatively high will result in a greater change in investment ($\frac{\partial I_t}{\partial MW_t} > \frac{\partial I_{(t-1)}}{\partial MW_{(t-1)}}\ if\ \alpha_t > \alpha_{(t-1)}$) than when the productivity of investment is relatively lower, ceteris paribus. This complementarity between the quantity and productivity of investment underscores why there may be particular times in the child's life when the minimum wage will have particularly large effects. Holding constant the productivity of current investment, the investment will also be higher when the value of additions to child health are relatively larger. The value of greater child health may differ because of differences in the level of health (i.e., diminishing marginal utility of child health), for example, because of higher initial health or because of prior investments.

3.c. Implications

There are two insights for an empirical analysis of this discussion of the child health production function. The first is that analyses of the effect of the minimum wage on child health need to be concerned with the timing of minimum wage changes throughout the child's life. The minimum wage may not have the same effect at all ages and past minimum wages can affect child health along with the contemporaneous minimum wage. Second, the minimum wage may also have different effects on the quantity of investment at different ages, and because past investments affect the level of current investments through the stock of health, past minimum wages may affect current investments.[15] We return to these issues in the empirical methods section below.

4. Methods

4.a. Data

We employ data from 2003, 2007, and 2011/12 waves of the National Survey of Child's Health (NSCH). The NSCH is in some ways well suited to study the effect of the minimum wage on child health. The NSCH has a relatively large sample size, includes detailed information on the family, and spans a sample period during which many state-level changes in the minimum wage occurred.

The NSCH is a nationally representative, cross-sectional telephone survey of children aged 0-17 years in the U.S. For each wave, a sample was selected by a random-digit-dial (RDD) of landline telephone numbers and cell phone numbers, from the 50 states and D.C. A key strength of the NSCH is that samples, in addition to being nationally-representative, are also representative within each state. In order to ensure adequate state-specific sample sizes, even for the smaller states, the NSCH sampled an equal number of children from each state for each wave. Weights reflecting the probability of selection and response are

[15] One possibility is that a higher minimum wage in one period that leads to a higher health stock at later ages may cause parents to invest less at older ages (for example due to diminishing marginal utility of health). Alternatively, a higher minimum wage in one period that leads to a higher health stock at later ages may cause parents to invest more at older ages if a higher prior health stock raises the returns to current investments (complementarity).

provided. The NSCH collected information on children's health through parental or caregiver interviews.[16]

In order to focus on children most likely affected by the minimum wage, we select a sample of children in low-educated families. A family is defined as low-educated when the highest level of education attained by anyone in the household is high school or less. We limit the sample to children aged 6 to 17 years. We do so for two reasons. First, one of the primary outcomes we examine, missed school days due to illness/injury, is only measured for children age 6 and older. Second, there is a trend of health "worsening" by age until about age 6, which clearly does not reflect biological declines, but almost surely parents becoming more aware of children's health problems during early childhood (see Appendix Figure 1). [17]

We estimate effects separately for children aged 6-12, which is considered developmentally as the middle childhood phase (US Department of Health Human Services, 2010), and for adolescent children (aged 13-17). This is consistent with the theoretical production function approach we use and the conceptual model that the effects of investments are age-specific. Sample sizes prevent more detailed stratification by age. We also limit the sample to children whose survey respondent was a parent (not another caregiver) to reduce measurement error (parents were respondents for 90% of surveyed

[16] The survey was initially conducted by the National Center for Health Statistics. Beginning in 2016, the NSCH became an annual survey conducted by the Census Bureau using a different sampling approach and weighting. The Census Bureau recommends against combining the earlier waves of the NSCH with the 2016 and later waves (U.S. Census Bureau, 2017). For this reason, we do not include the more recent data, currently available for 2016 and 2017.

[17] The objective is to measure child health and how the minimum wage affects health. The growth in the prevalence of illness in early childhood likely stems from the increasing probability of diagnosis with age. The minimum wage may affect this probability and therefore, the effects of the minimum wage would be measuring the effect on the probability of diagnosis and on health directly. We are interested in the latter effect. This issue is less likely at older ages but may persist somewhat.

children). In addition, we exclude children who are home-schooled since parents may learn about their children's health from school health assessments and teacher observation (1.8% of children are homeschooled). Combining the three waves of the NSCH, the sample includes over 45,000 children aged 6-17 years.

Ideally, we would estimate equation (2), the health production function, and to do so we would use measures of the stock of health at a particular age. One limitation of the NSCH (and most data sets) is that there are few such measures like this. Also, several health indicators capture specific illnesses that may have a large genetic influence and unclear links to family investments and income changes (e.g., autism, attention-deficit/hyperactivity disorder). After reviewing available information, we chose four measures of child health that we consider broad enough to capture the child's health stock. The first is the child's general health rated by the parent on a five-category scale (excellent to poor), which we examine as an ordinal variable (from 1 to 5) and as two binary indicators, one for excellent or very good health versus less (good, fair, and poor), and another for poor or fair health versus better (good, very good, and excellent). The second is a measure of what we call poor health that is constructed from responses to the following three questions: 1- Does the child need medication because of a medical or health condition?; 2- Does the child use more medical care than other children of the same age?; and 3- Is the child limited in ability to do things because of a medical or health condition?. We use a dichotomous version of this variable that equals one if the respondent replies affirmatively to any of the three questions. There are also versions of these questions that add a qualifier indicating that the cause is a chronic condition. The third measure of child health we examine is Body Mass Index (BMI), which is only available for children ages 10 and older; therefore, we only include this measure for the second age group of 13 to 17. The NSCH provides BMI grouped into categories based on distribution percentiles. We use a dichotomous version indicating whether BMI is greater than 85th (overweight) or 95th (obesity) percentiles of the BMI distribution. The last measure of child health examined is the number of missed school days in the past 12 months due to illness or injury. The general health and missing school outcomes are moderately correlated.[18]

Compelling measures of investment in child health in the NSCH are few. As noted earlier, the minimum wage is likely to affect child health through better nutrition, less stress, a healthier living environment, and greater use of medical care. Few measures relating to these mechanisms are available in the data. We selected several possible candidates. First, we examined outcomes directly or indirectly related to employment and income: whether anyone in the household is employed, whether the family is impoverished (<100% Federal Poverty Level), whether the family received food stamps, and whether the child was covered by health insurance. We also examined whether a child had a preventive health care visit or had any unmet health care needs. However, it merits noting that despite limiting the sample to low-educated households, the sample of children is relatively well-insured—approximately 85% of the sample is covered by health insurance with about half covered by Medicaid. In addition, 75% of the sample had a preventive health care visit and only about 7% of the sample had unmet health care needs. These figures suggest that there is a somewhat limited scope for the minimum wage to affect child health through greater use of medical care. Though, more granular measures of care, such as the quality and

[18] The weighted mean of missed school days declines from 10.6 days among children with poor-rated health to 3.1 days among children with excellent-rated health, and the correlation coefficient between the five-category health status measure and missed school days is -0.20 ($p<0.01$).

continuity of care, which are not observed in the data, may still be a possible path of influence. Finally, we examined maternal mental health.

Information on the monthly minimum wage at the state and federal level were obtained from publicly available data by Vaghul and Zipperer (2016), compiled from multiple sources including state legislation and resolutions, the Bureau of Labor Statistics, and state agencies and labor departments. The effective minimum wage of a state is the higher of state legislated minimum wage or federal minimum wage.

3.b. Empirical Model of Child Health

As discussed earlier, an increase in income over a child's lifetime, as a result of a higher minimum wage, may affect child health through changes in investments in health. And the timing of changes in the minimum wage during childhood may matter. Changes in the minimum wage during pregnancy and in early childhood may have different effects than changes at later ages. Therefore, it is important to distinguish between the effects of minimum wage changes early in life from more recent changes. We incorporate this notion into our empirical model.

Ideally, we would like to estimate equation (1), but investments in child health are not available in the data. Instead, we estimate the effect of the minimum wage on child health using a reduced-form specification separately for children aged 6-12 and adolescents 13-17. For ages 6-12 years, the specification is as follows:

$$(4)\ \mathrm{H}_{\mathrm{iskt}} = \boldsymbol{\alpha}_{\mathbf{s}} + \boldsymbol{\gamma}_{\mathbf{t}} + \beta_1\,\mathrm{MW\_P}_{\mathrm{iskt}} + \beta_2\overline{\mathrm{MW\_0\_5}}_{\mathrm{iskt}} + \beta_3\overline{\mathrm{MW\_6\_s}}_{\mathrm{iskt}} + \mathbf{E}_{\mathbf{skt}}\boldsymbol{\gamma} + \mathbf{X}_{\mathbf{iskt}}\boldsymbol{\Phi} + \boldsymbol{\mu}_{\mathbf{iskt}}\,.$$

$\mathrm{H}_{\mathrm{iskt}}$ denotes the health outcome of child *i*, at age *k*, in state *s* at survey year *t*. $\mathrm{MW\_P}_{\mathrm{iskt}}$ is the real minimum wage (adjusted for inflation and converted to 2016 dollars) in the pregnancy year,[19] which we include as a separate period given the fundamentally different types of investments in pregnancy and their importance for child health, as well as prior evidence of effects of the minimum wage during pregnancy on infant health (Wehby et al, 2019). $\overline{\text{MW\_0\_5}}_{\text{iskt}}$ is the real minimum wage averaged over birth year and each year up to age 5, and computed as follows:

$$(5)\ \overline{MW\_0\_5} = \frac{1}{6}\sum_{k=0}^{5} MW_{sk} \quad .$$

For each calendar year, the effective real minimum wage is averaged over 12 months before averaging across years. $\overline{\text{MW\_6\_s}}_{\text{iskt}}$ is the real minimum wage at survey year t for children aged 6 years or minimum wage averaged over the years from age 6 until the child's age (k) at survey year for children older than 6 as follows:

$$(6)\ \overline{\text{MW\_6\_s}} = \frac{\sum_{\text{k=Age 6}}^{\text{survey year}} \text{MW}_{\text{sk}}}{(\text{survey year}-\text{year at age 6})+1} \quad .$$

In this model, β_1 captures the effects of minimum wage changes during pregnancy and β_2 captures effects of minimum wage changes after birth and during early childhood. In contrast, β_3 captures the effects of minimum wage changes later in childhood. Note that the coefficients on the MW variables in each period embed two effects, as per the model of child

[19] The NSCH does not provide data on the child's birth year and month (and it does not provide individual-level data on interview month), which generates measurement error in the pregnancy and birth year for some children and in the average minimum wage over specific ages. The 2003 NSCH survey was completed between January 2003 and July 2004 (87% in 2003 and 13% in 2004), the 2007 NSCH survey was completed between April 2007 and July 2008 (79% in 2007 and 21% in 2008), and the 2011/2012 survey was completed between June 2011 and February 2012 (interview rates by year are not available); therefore, we assign 2003, 2007 and 2011 as the survey year to all participants in each NSCH wave. The NSCH documentation provided information about the number of interviews by month in the 2003 and 2007 NSCH waves. By assuming a 9-month pregnancy and equal probability of birth in each month, we estimate that the pregnancy year and the birth year might be inaccurately assigned for 26% and 35% of children in the 2003 survey, respectively; similarly, pregnancy year and birth year might be inaccurately assigned for 17% and 31% of children in the 2007 survey, respectively. Proportions of interview by month and year were not reported in the documentation of the 2011 NSCH survey, and so we could not estimate these errors. Any such misclassification of the pregnancy year would attenuate the effect sizes; the degree of attenuation, however, is likely to be minimal because of: 1- lagged effects the minimum wage on birth outcomes (Wehby et al. 2019); and 2- high correlation in the minimum wage within states over time.

health production discussed earlier: the effect of the minimum wage on the quantity of investments (and thus health) in that period and the effect of the change in health stock in that period on future investment (i.e. at a later period). The second effect occurs because an increase in health stock at an earlier age raises the stock of health in future periods and, therefore, may affect the quantity and productivity of future investments.

Equation (4) can be interpreted as a reduced form model in which we have substituted for investments with the minimum wage. The model also includes state fixed effects ($\boldsymbol{\alpha}$), and birth year (cohort) fixed effects ($\boldsymbol{\gamma}$). Also included in **E** are state-level time-varying policy measures including state income eligibility thresholds for child coverage in Medicaid, state EITC credits as a percent of federal EITC (including 0 if a state has no EITC program), and cigarette taxes. These measures are calculated for each period and child's age and included in the model in a similar manner to the minimum wage measures. The vector **X** contains child demographic measures including race/ethnicity, gender, and dummies for child age (year by year).

Conditional on other covariates in the model, we assume that the minimum wage is exogenous—uncorrelated with missing investments and initial health shown in equation (1). The exogeneity of the minimum wage is based on the difference-in-differences research design of equation (4) that compares children in the same state who were "exposed" to different minimum wages at specific periods of their childhood while accounting for state, birth cohort, and age at interview effects.[20]

[20] Because of the cross-sectional nature of the data, we do not observe the same child at different points of their life. However, based on the child's age at the survey, we are able to calculate an average minimum wage across years between pregnancy and survey year.

The specification of the minimum wage variable in equation (4) represents one approach to allowing the effects of the minimum wage to differ across the child's life course. In this case, we allow there to be three periods when combining children aged 6 through 12. Our choice represents a compromise between estimating a fully unrestricted specification where we include the minimum wage in each year of the child's life for a given age and simply averaging the minimum wage over the child's life. The former approach is not practical because the minimum wage does not vary on an annual basis and is often constant for several years. This introduces a substantial collinearity problem. Also, it requires estimating separate models for each specific age which is impractical given available sample sizes. The latter approach restricts the effect of the minimum wage to be the same at each age, which is inconsistent with the possibilities highlighted by the conceptual model. In addition to estimating and testing the minimum wage effects in specific periods, we also calculate and test the significance of the sum of the minimum wage effects from all stages.

We also estimate models for adolescents ages 13-17 years. In this case, the model is specified as follows:

$$(7)\ \mathrm{H_{iskt}} = \boldsymbol{\alpha_s} + \boldsymbol{\gamma_t} + \beta_1\,\mathrm{MW\_P_{iskt}} + \beta_2\overline{\mathrm{MW\_0\_5}}_{\mathrm{iskt}} + \beta_3\overline{\mathrm{MW\_6\_12}}_{\mathrm{iskt}} + \beta_4\overline{\mathrm{MW\_13\_s}}_{\mathrm{iskt}} + \mathbf{E_{skt}}\boldsymbol{\gamma} + \mathbf{X_{iskt}}\boldsymbol{\Phi} + \boldsymbol{\mu_{iskt}}$$

$\overline{\mathrm{MW\_6\_12}}_{\mathrm{iskt}}$ is the real minimum wage averaged over ages 6 through 12 as follows:

$$(8)\ \overline{MW\_6\_12} = \frac{\sum_{k=age\ 6}^{Age\ 12} MW_{sk}}{7}\ .$$

$\overline{\mathrm{MW\_13\_s}}_{\mathrm{iskt}}$ is the real minimum wage at survey year t for children aged 13 years or minimum wage averaged from age 13 until child's age (k) at survey year for children older than 13 as follows:

$$(9)\ \overline{\text{MW\_13\_s}} = \frac{\sum_{\text{k=Age 13}}^{\text{survey year}} \text{MW}_{\text{sk}}}{(\text{survey year} - \text{year at age 13}) + 1}.$$

As noted earlier, the NSCH sampled an equal number of children from each state for each wave in order to make the data nationally and state representative. We estimate weighted regression models that apply the NSCH sampling probability weights in order to approximate as best as possible the average partial treatment effect of the minimum wage, and in supplementary analyses also present estimates from unweighted models for comparison. The NSCH provides a final sampling weight that accounts for sample selection and non-response. We estimate all models using OLS and construct standard errors allowing for correlation of observations within the state (i.e., robust-cluster standard errors).

5. Main Results

5.a. Variation in Minimum Wages over Child's Life

Before discussing estimates of the effects of a higher minimum wage on child health, we present descriptive information about the extent of minimum wage changes in our sample period. Specifically, for each measure of the minimum wage (pregnancy, ages 0 to 5, ages 6 to current age, ages 6 to 12, and ages 13 to current age), we calculated the residuals from regressions of each minimum wage measure on all covariates included in the regression models of children's health.

Figure 1 shows the distribution of these residuals by age group. There are two points to note in Figure 1. First, there is significant variation in minimum wages in the sample period. Changes in the (average) minimum wage of $0.5 are not atypical. Second, changes in minimum wages tend to be larger for the younger cohort and larger during later periods in the child's life. Both of these observations reflect the fact that there have been more state changes in minimum wages in the later years (e.g., post 2000) that affect the younger cohort more than the older cohort. As noted in the Introduction, the smaller variation in minimum wages over the life of the older cohort of children results in less precise, but still informative, estimates of the effect of the minimum wage for this cohort.

5.b. Effects of Minimum Wage on Health of Children Aged 6-12

Table 1 reports the effects of the average minimum wage during pregnancy, ages 0-5, and age 6 to current age for children between ages 6 and 12 on parent-rated general child health, the index of poor health and missed school days due to illness or injury, based on equation (4).

Most estimates in Table 1 pertaining to the effect of the minimum wage during pregnancy are small and not statistically significant. The exception is for fair/poor rated health. For this outcome, a $1 increase in the minimum wage during pregnancy is associated with a 1.6 percentage point (24%) decrease in the likelihood of fair/poor rated health.

For minimum wage changes during ages 0-5 years, estimates are more consistently indicative of a beneficial effect. A $1 increase in the minimum wage in each of these five years is associated with a 0.11 (2.7%) improvement in general health (on the five-category scale) and a 6.2 percentage point (8.7%) increase in the probability of very good or excellent rated health. A $1 increase in the minimum wage at each of these ages is also associated with a 3.8 percentage point (14%) decrease in the 3-question index measure of poor health and a 0.57 (15.6%) decrease in missed school days. Note that these are estimated treatment effects associated with an average increase of $1 in the minimum wage over the child's early life course, between the ages of 0 to 5, not that of a one-time increase at a single year of age.

Changes in the minimum wage between ages 6 and the child's current age are generally not statistically significant or clinically important. The exception is the estimate of the effect of the minimum wage at these ages on the 3-question index of poor health; a $1 increase in the average minimum wage during each of these ages is associated with a 3.3 percentage point (12%) decrease.

Finally, we calculated the sum of the coefficients on the minimum wage variables across all ages. These estimates are presented in the last column of Table 1. These estimates measure the cumulative effect of a $1 change in the minimum wage in each year of the child's life: pregnancy, ages 0 to 5, and ages 6 to child's current age, not a one year only increase by $1. A $1 increase in the minimum wage throughout a child's life is associated with a 0.18 unit (4.4%) improvement in general health; a 7 percentage point (10%) increase in the probability of very good or excellent rated health; an 8.3 percentage point (30%) decrease in the 3-question index of poor health; and 0.95 (26%) fewer missed school days. All of these estimates are statistically significant. Finally, if we apply a Holm-Bonferroni correction for multiple testing bias, all significant estimates remain statistically significant.

5.c. Effects of Minimum Wage on Health of Children Aged 13-17

In Table 2, we present estimates of the effect of the minimum wage for adolescents aged 13-17. Here we also find evidence of improvement in child health with increases in the minimum wage during childhood. An increase in the minimum wage during pregnancy is associated with a 6 percentage points (21%) decrease in the 3-question index of poor health. Other estimates of the effect of the minimum wage during pregnancy are not statistically significant and relatively small.

An increase in the minimum wage during ages 0 to 5 is associated with improved health of adolescents. A $1 increase in the minimum wage in every year between ages 0 to 5 is associated with an approximately 11% increase in the probability of excellent/very good rated health and a 90% decrease in the probability of poor/fair rated health. A $1 increase in the minimum wage at these ages is also associated with an 8.2 percentage point (42%) decrease in the 3-question index of poor health. These larger effects are consistent with a cumulative and compounded response of the quantity and productivity of investments in child health that are undertaken during early life course, though again, we note that estimates for the older children are less precise and have relatively large confidence intervals. Therefore, the large relative effect reported for fair/poor health needs to be placed in that context.

Few estimates of the effect of the minimum wage during ages 6 to age 12 are statistically significant. There is some evidence that an increase in the minimum wage between ages 6 and 12 decreased the likelihood of the 3-question index poor health (on the order of about 20%), but there are few other notable effects. Similarly, estimates for minimum wage changes between age 13 and current age are small and statistically insignificant. As with the younger group, the largest and most significant effects of the minimum wage were those that occurred during the earliest course of the child's life, between the ages of 0 and 5.

The last column of Table 2 presents the cumulative effect of an average $1 increase in the minimum wage in every year of childhood. These estimates indicate improvements in child health, although only two estimates are statistically significant. A $1 increase in the minimum wage throughout childhood is associated with a 57% decrease in the 3-question index of poor health and a 42% decline in missed school days. As noted before, this is the effect of a $1 increase in the average minimum wage over the child's life course, and not a one-time (or one-year) increase by $1. Other estimates of the cumulative effect of the minimum wage on child health, while not significant, also suggest improved health except for the case of BMI. Here too, a Holm-Bonferroni correction would not affect the statistical significance of our estimates.

6. Sensitivity Analyses

6.a. Including Leads of Minimum Wage

We test the validity of the research design by adding 2-year and 4-year leads of the minimum wage to the models used to obtain estimates in Tables 1 and 2. The leads represent the minimum wage values in future years, specifically at 2 and 4 years from the survey year. If our research design is valid, estimates of the effects of the leads of minimum wages should be zero (statistically speaking) because future minimum wages should not affect past child health. We present estimates from these models in Tables 3 and 4 for children ages 6 to 12 and 13 to 17, respectively. As can be observed, only one of the estimates associated with the lead variables across both tables is statistically significant. In Table 3 (ages 6-12), the 2-year lead of the minimum wage is positively and significantly related to the 3-question index of poor health. It is also the case that estimates of the effects of non-lead measures of minimum wages in Tables 3 and 4 are similar to those in Tables 1 and 2. Overall, the statistical insignificance of all but one of the estimates associated with the lead measures of minimum wages and the robustness of the estimates of interest to the addition of these lead effects suggest that the research design is plausibly valid.

6.b. Effects of Minimum Wage on Child Health in Two-Parent High-Educated Families

As another assessment of the validity of the research design, we examine the effect of the minimum wage on the health of children in two-parent, higher-educated households. These are households where the highest attained education is greater than high school. The information in the NSCH related to educational attainment combines any education above high school in one category and reports the highest attained education in the household (not separately for each parent). Therefore, it is not possible to only include college graduates and so we include households with a parent with educational attainment greater than high school. For this sample, the minimum wage should have smaller or no effects on children's health because these families are largely unaffected by the minimum wage.

Estimates of the effects of the minimum wage using this sample are presented in Tables 5 (ages 6-12) and 6 (ages 13-17). As expected, there are almost no statistically significant estimates in either table and the few estimates that are significant are much smaller than those found for families more likely to be affected. Even for the few instances when an estimate is statistically significant, there is also no consistent pattern across childhood, as was found in the analysis of more affected families. For example, a higher minimum wage during pregnancy is associated with an increase in the probability of poor/fair rated health at ages 13 to 17. However, all other estimates of the effects of the minimum wage during other periods of childhood on this outcome are negative (and very small).

6.c. Adding Demographic and Maternal Health Control Variables

In the model used to obtain estimates in Tables 1 and 2, we only include variables that are clearly exogenous. However, we assess the sensitivity of the estimates to adding several household demographic variables that are measured across all NSCH waves: an indicator that the highest household education is less than high school (versus high school), parental marital status, and the number of children in the household. We also add indicators for maternal general health and mental health ratings (on five-category scales) to account for a potential source of variation in reporting child health. We report the results in Appendix Tables 2 and 3. As shown in those tables, estimates from the model that includes an extended set of covariates are very similar to those reported earlier.

6.d. Unweighted estimates

Given the sampling design of the NSCH, wherein equal numbers of children from each state are sampled for each wave, our preferred estimates discussed above are derived from models that apply the NSCH-provided sampling weights. Weighted estimates approximate the treatment effect for the average child in the U.S., whereas unweighted estimates would approximate the treatment effect in the average state (given equal samples for all states). In the absence of endogenous sampling, the two may differ if there is treatment effect heterogeneity across the treated states (Solon et al. 2016). The unweighted results, which are reported in Appendix Tables 4 and 5, largely show similar patterns though some of the effects (most notably for missed school days) are moderated and become statistically insignificant.

7. Mechanisms

As discussed above, several causal channels underlie the link from the minimum wage to children's health, many of which remain unmeasured in the NSCH data. To assess some possible mechanisms linking the minimum wage to child health, we examined the contemporaneous effect of the minimum wage on whether a child has any insurance coverage, whether anyone in the household is employed, whether the household income was below 100% of the FPL and whether the family received food stamps. These four outcomes relate to the labor market, are the proximate pathways linking the minimum wage to investments in child health, and are the best measures available in the NSCH to assess whether the minimum wage affected labor supply (insurance and employment) and income through labor supply (poverty and food stamps).[21] We also examined two healthcare measures: whether the child had a preventive medical care visit or any unmet health care need. These two outcomes are more closely related to the conceptual model's investments in health, although the sample is relatively well-insured and their health care use will be less dependent on income. We also examined maternal mental health rated on a scale from 1-5 (poor to excellent), which might be an indicator of stress in the household.

Estimates of the effect of the contemporaneous minimum wage on these outcomes are shown in Table 7. The contemporaneous minimum wage is defined as the average minimum wage from age 6 to current age for children ages 6 to 12, and age 13 to the current age for children ages 13 to 17. Most of these estimates are not statistically significant and small in magnitude. In the case of having health insurance and employment, these estimates provide some evidence consistent with the view that the minimum wage does not affect employment and that the effects of the minimum wage on child health observed in Tables 1 and 2 are mainly through income. For adolescents (ages 13 to 17), there is some indication of a significant improvement in maternal mental health associated with a higher minimum wage which may be translated into more productive parenting, and a suggestive decrease in the likelihood that a household is poor.

[21] As noted in footnote 8, there may be little power to detect an effect of the minimum wage on poverty.

8. Conclusions

Increases in the minimum wage have been shown to raise wages and income of low-skilled workers with only small, if any, negative effects on employment. While the effects of minimum wages on these labor market outcomes continue to be a focus of interest surrounding the use of this policy, the minimum wage may have other consequences that are important. In this study, we have assessed the effect of the minimum wage on child health. Ours is the first paper to investigate this issue. We paid particular attention to the fact that child health is the result of investments throughout childhood and that minimum wages throughout childhood may have cumulative effects on child health.

Our findings are noteworthy because they suggest that higher minimum wages throughout childhood have significant effects on child health. Consequently, the debate over the value of minimum wage increases needs to incorporate this evidence, and consider other potential non-labor market effects that the minimum wage may have.

An interesting finding in this study is that much of the beneficial effects of the minimum wage are associated with minimum wage increases during ages 0 to 5. This finding is similar to a recent study for EITC, showing that the effect of EITC during childhood on self-reported general health (reporting excellent or very good health) of young adults is largest during their first five years of life (Braga et al., 2019). It is also the case that increases in the minimum wage during other periods are associated with improvements in health, but are mostly not statistically significant and smaller. However, when we calculate the cumulative effect of a $1 increase in the minimum wage throughout childhood—in every year of a child's life—the beneficial effects of the minimum wage at other ages besides ages

0 to 5 are non-trivial, for example, accounting for 40% to 60% of the cumulative effect of the minimum wage on missed school days due to illness or injury.

Overall, our findings demonstrate that consequences beyond the labor market should be considered when assessing the use of the minimum wage to improve the welfare of low-skilled and low-income families. The increases in income associated with the minimum wage may have wide ranging and meaningful impacts particularly for children in low-income families. Additional research is needed to identify these potential consequences, for example, on school performance.

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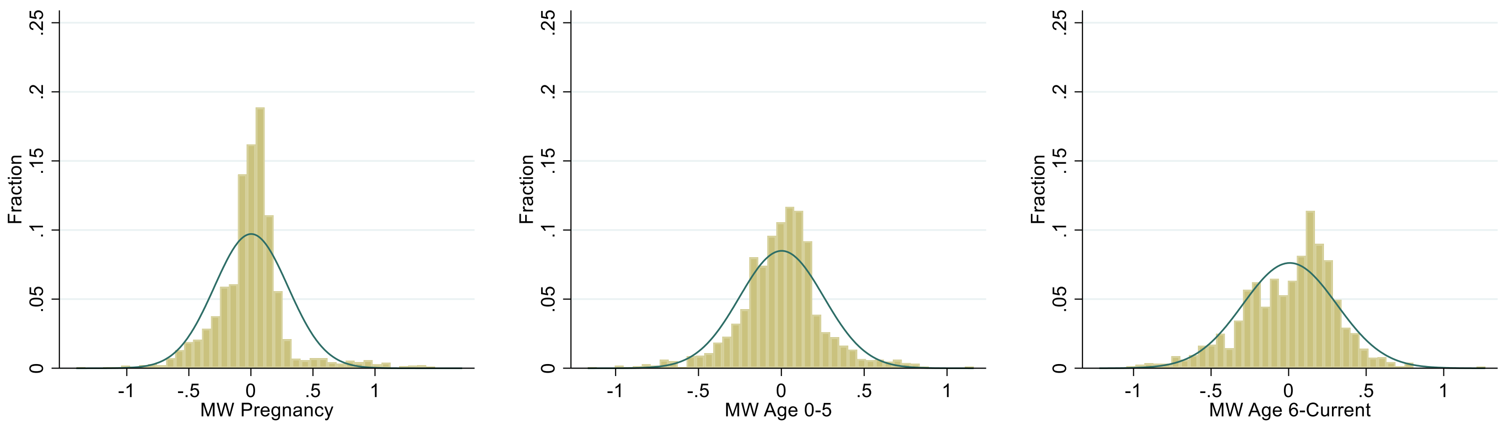
Figure 1. Distribution of Residuals from Regressions of Minimum Wage Measures on Model Covariates

Children Aged 6-12 Years Old



Children Age 13-17 Years Old

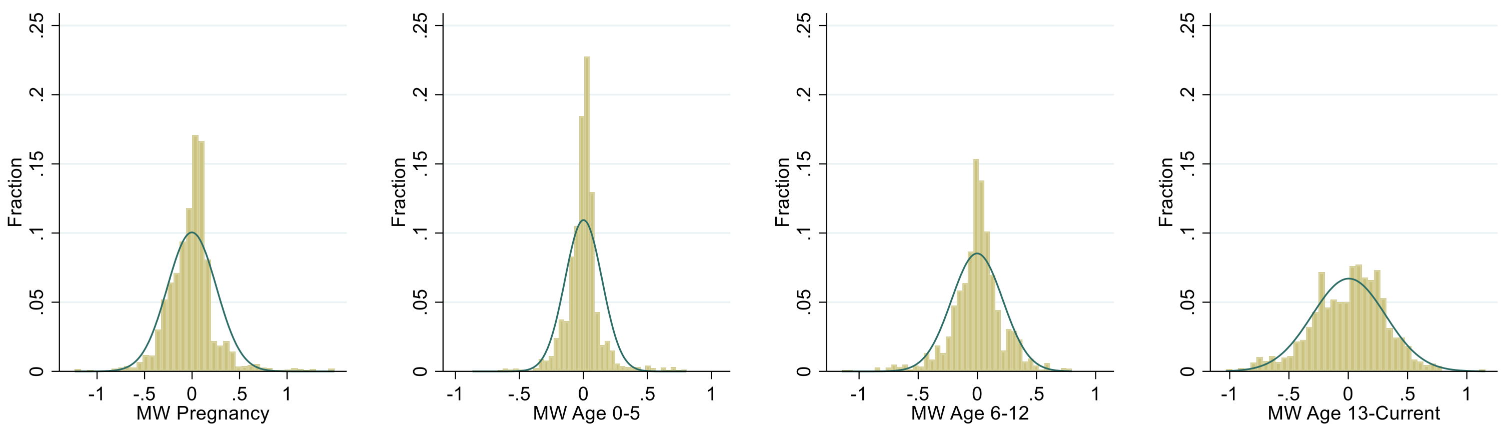


Table 1. Estimates of the Effects of the Minimum Wage on Health of Children Aged 6 to 12 Years

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from age 0 to age 5	Minimum wage from age 6 to current age	*Sum of minimum wage estimates across all ages*
General health rating (1-5 scale poor to excellent)	4.09	0.028	0.11*	0.037	0.18*
		(0.031)	(0.045)	(0.053)	(0.071)
Excellent/very good general health	0.71	-0.0032	0.062**	0.011	0.070**
		(0.014)	(0.022)	(0.019)	(0.022)
Fair/poor general health	0.067	-0.016*	-0.0071	0.0041	-0.019
		(0.0078)	(0.0076)	(0.0079)	(0.012)
Combined measure of poor health[a]	0.28	-0.012	-0.038*	-0.033*	-0.083**
		(0.014)	(0.017)	(0.016)	(0.031)
Combined measure of poor health (chronic conditions)[a]	0.20	-0.015	-0.027	-0.024	-0.066*
		(0.015)	(0.016)	(0.017)	(0.028)
# missed school days past 12 months due to illness or injury	3.68	-0.18	-0.57*	-0.20	-0.95*
		(0.14)	(0.25)	(0.25)	(0.47)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 4 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 19,592 to 21,292 with different outcomes.

[a] The combined measure of poor health is constructed from responses to the following three questions: 1- Does the child need medication because of a medical or health condition?; 2- Does the child use more medical care than other children of the same age?; and 3- Is the child limited in ability to do things because of a medical or health condition?. The indicator is 1 if the respondent replies affirmatively to any of the three questions, 0 otherwise.

[b] This dichotomous variable is equal to 1 if the medical or health conditions in any the 3 questions noted above (in [a]) are reported as chronic .

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Table 2. Estimates of the Effects of the Minimum Wage on Health of Children Aged 13 to 17 Years

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from 0 to age 5	Minimum wage from age 6 to age 12	Minimum wage from age 13 to current age	*Sum of minimum wage estimates across all ages*
General health rating (1-5 scale poor to excellent)	4.10	0.040	0.20**	-0.066	0.026	0.20
		(0.037)	(0.065)	(0.040)	(0.036)	(0.11)
Excellent/very good general health	0.72	0.017	0.077**	-0.022	0.0097	0.082
		(0.018)	(0.022)	(0.020)	(0.016)	(0.046)
Fair/poor general health	0.071	-0.020	-0.064**	0.032	0.00023	-0.052
		(0.012)	(0.020)	(0.023)	(0.0099)	(0.039)
Combined measure of poor health	0.28	-0.060**	-0.057	-0.044	-0.0027	-0.16*
		(0.019)	(0.031)	(0.024)	(0.019)	(0.061)
Combined measure of poor health (chronic conditions)	0.20	-0.017	-0.082*	-0.041*	0.0031	-0.14**
		(0.016)	(0.032)	(0.018)	(0.015)	(0.050)
# missed school days past 12 months due to illness or injury	3.95	-0.31	-0.65	-0.41	-0.28	-1.65*
		(0.30)	(0.46)	(0.23)	(0.21)	(0.79)
Obesity (BMI≥95th percentile)	0.18	-0.025	0.012	0.0052	-0.012	-0.020
		(0.018)	(0.052)	(0.015)	(0.018)	(0.070)
Overweight (BMI≥85th percentile)	0.35	0.035	0.015	-0.029	-0.0094	0.011
		(0.028)	(0.062)	(0.020)	(0.018)	(0.082)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 7 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 16,535 to 18,087 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Table 3. Estimates of the Effects of the Minimum Wage on Health of Children Aged 6 to 12 Years Controlling for Two Leads of Minimum Wage

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from age 0 to age 5	Minimum wage from age 6 to current age	Minimum wage at 2 years from survey	Minimum wage at 4 years from survey	*Sum of minimum wage estimates across all ages*
General health rating (1-5 scale poor to excellent)	4.09	0.016	0.099	0.0047	-0.038	-0.023	0.12
		(0.030)	(0.054)	(0.050)	(0.055)	(0.059)	(0.062)
Excellent/very good general health	0.71	-0.0064	0.059*	0.0017	-0.0089	-0.0077	0.054*
		(0.013)	(0.028)	(0.018)	(0.029)	(0.023)	(0.024)
Fair/poor general health	0.067	-0.012	-0.0012	0.014	0.016	0.0038	0.00065
		(0.0065)	(0.0091)	(0.013)	(0.011)	(0.0095)	(0.019)
Combined measure of poor health	0.28	-0.0076	-0.030	-0.026	0.023	-0.0055	-0.064
		(0.014)	(0.019)	(0.023)	(0.018)	(0.021)	(0.040)
Combined measure of poor health (chronic conditions)	0.20	-0.0074	-0.014	-0.015	0.040*	-0.011	-0.036
		(0.013)	(0.020)	(0.020)	(0.017)	(0.015)	(0.035)
# missed school days past 12 months due to illness or injury	3.68	-0.25	-0.61*	-0.53	-0.028	-0.46	-1.39
		(0.15)	(0.28)	(0.42)	(0.26)	(0.30)	(0.71)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 4 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 19,592 to 21,292 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Table 4. Estimates of the Effects of the Minimum Wage on Health of Children Aged 13 to 17 Years Controlling for Two Leads of Minimum Wage

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from 0 to age 5	Minimum wage from age 6 to age 12	Minimum wage from age 13 to current age	Minimum wage at 2 years from survey	Minimum wage at 4 years from survey	*Sum of minimum wage estimates across all ages*
General health rating (1-5 scale poor to excellent)	4.10	0.039	0.20**	-0.048	0.030	0.041	-0.0031	0.22
		(0.036)	(0.066)	(0.046)	(0.039)	(0.037)	(0.053)	(0.11)
Excellent/very good general health	0.72	0.016	0.081***	-0.0059	0.017	0.030	0.0053	0.11
		(0.018)	(0.022)	(0.030)	(0.018)	(0.026)	(0.018)	(0.061)
Fair/poor general health	0.071	-0.020	-0.063**	0.032	-0.0071	0.0068	-0.013	-0.058
		(0.012)	(0.023)	(0.025)	(0.010)	(0.019)	(0.020)	(0.038)
Combined measure of poor health	0.28	-0.058**	-0.060	-0.061**	-0.018	-0.024	-0.019	-0.20***
		(0.019)	(0.032)	(0.022)	(0.021)	(0.023)	(0.027)	(0.052)
Combined measure of poor health (chronic conditions)	0.20	-0.016	-0.084*	-0.056**	-0.014	-0.017	-0.022	-0.17***
		(0.016)	(0.032)	(0.019)	(0.017)	(0.020)	(0.021)	(0.045)
# missed school days past 12 months due to illness or injury	3.95	-0.30	-0.62	-0.40	-0.41	0.16	-0.24	-1.74*
		(0.30)	(0.45)	(0.26)	(0.23)	(0.27)	(0.22)	(0.80)
Obesity (BMI≥95th percentile)	0.18	-0.025	0.0073	-0.0072	-0.0052	-0.036	0.018	-0.030
		(0.018)	(0.048)	(0.018)	(0.027)	(0.018)	(0.023)	(0.057)
Overweight (BMI≥85th percentile)	0.35	0.035	0.015	-0.033	-0.016	-0.00074	-0.0092	0.0016
		(0.029)	(0.064)	(0.022)	(0.031)	(0.027)	(0.035)	(0.073)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 7 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 16,535 to 18,087 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Table 5. Estimates of the Effects of the Minimum Wage on Health of Children Aged 6 to 12 Years using Sample of Married High-educated (Highest Education Above High School) Households

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from age 0 to age 5	Minimum wage from age 6 to current age	*Sum of minimum wage estimates across all ages*
General health rating (1-5 scale poor to excellent)	4.59	-0.018	-0.0080	-0.010	-0.037
		(0.012)	(0.024)	(0.015)	(0.033)
Excellent/very good general health	0.91	-0.012	-0.0042	-0.0015	-0.017
		(0.0072)	(0.0074)	(0.0082)	(0.012)
Fair/poor general health	0.015	-0.0015	0.0069*	-0.00035	0.0050
		(0.0029)	(0.0027)	(0.0031)	(0.0050)
Combined measure of poor health	0.26	0.0012	0.017	0.023	0.042
		(0.0098)	(0.011)	(0.012)	(0.021)
Combined measure of poor health (chronic conditions)	0.21	0.0019	0.0050	0.021*	0.028
		(0.0090)	(0.012)	(0.0098)	(0.021)
# missed school days past 12 months due to illness or injury	3.46	-0.055	0.11	0.13	0.19
		(0.052)	(0.073)	(0.083)	(0.13)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 4 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 58,105 to 61,260 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Table 6. Estimates of the Effects of the Minimum Wage on Health of Children Aged 13 to 17 Years using Sample of Married High-educated (Highest Education Above High School) Households

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from 0 to age 5	Minimum wage from age 6 to age 12	Minimum wage from age 13 to current age	*Sum of minimum wage estimates across all ages*
General health rating (1-5 scale poor to excellent)	4.56	-0.0085	0.015	0.026	0.048	0.081
		(0.022)	(0.041)	(0.022)	(0.027)	(0.081)
Excellent/very good general health	0.91	0.0059	0.0096	0.0038	0.025*	0.044
		(0.0098)	(0.0095)	(0.0077)	(0.010)	(0.024)
Fair/poor general health	0.018	0.019**	-0.0031	-0.0091	-0.013	-0.0059
		(0.0057)	(0.0075)	(0.0063)	(0.0098)	(0.016)
Combined measure of poor health	0.30	-0.010	0.0074	0.010	-0.0043	0.0033
		(0.0071)	(0.023)	(0.017)	(0.015)	(0.042)
Combined measure of poor health (chronic conditions)	0.24	-0.0074	0.011	0.016	0.0047	0.024
		(0.0075)	(0.023)	(0.019)	(0.012)	(0.037)
# missed school days past 12 months due to illness or injury	3.67	0.089	-0.14	-0.057	0.085	-0.024
		(0.10)	(0.28)	(0.19)	(0.17)	(0.48)
Obesity (BMI≥95th percentile)	0.095	0.0082	0.023*	-0.0094	-0.0070	0.015
		(0.0085)	(0.011)	(0.0070)	(0.0088)	(0.019)
Overweight (BMI≥85th percentile)	0.22	0.024	0.015	-0.019	-0.018	0.0029
		(0.017)	(0.019)	(0.016)	(0.011)	(0.049)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 7 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 48,603 to 51,784 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

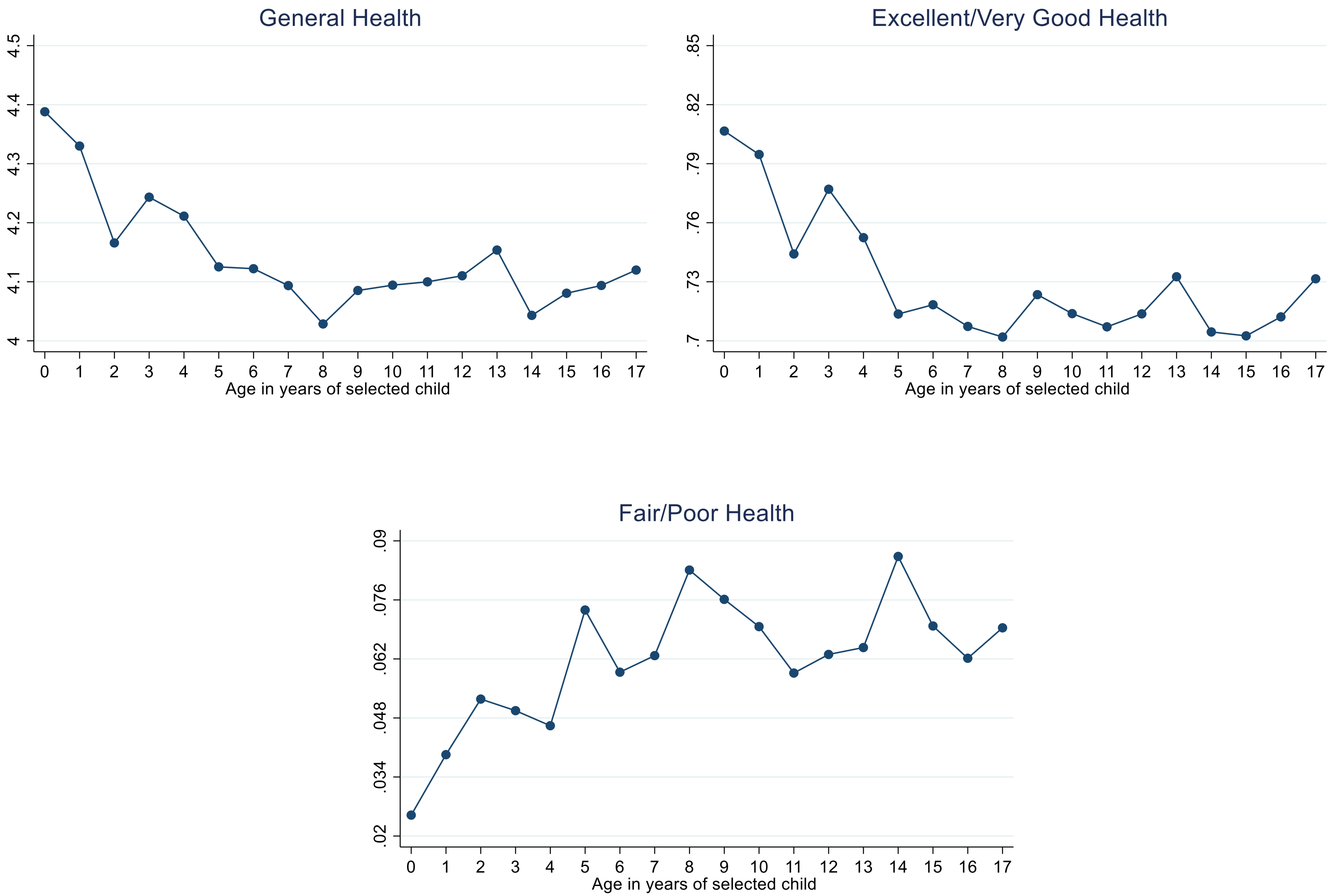
Table 7. Effects of Contemporaneous Minimum Wage on Potential Mediators for Child Health

	Age 6-12			Age 13-17		
	N	Mean Dep. Variable	Minimum wage from age 6 to current age	N	Mean Dep. Variable	Minimum wage from age 13 to current age
Any insurance Coverage	21254	0.86	-0.020	18068	0.85	-0.011
			(0.023)			(0.022)
Any preventive care use	21065	0.75	0.0042	17922	0.74	-0.0018
			(0.010)			(0.022)
Unmet care needs	21271	0.062	0.0059	18068	0.072	0.015
			(0.0082)			(0.014)
Household income below 100% FPL	19413	0.54	-0.015	16402	0.47	-0.036*
			(0.016)			(0.016)
Any employment in the household	21219	0.79	-0.012	18009	0.79	0.014
			(0.013)			(0.016)
Received food stamp benefit	20330	0.36	0.017	17315	0.27	-0.023
			(0.012)			(0.019)
Maternal mental health (1-5 scale poor to excellent)	20205	3.72	0.056	16977	3.63	0.10*
			(0.040)			(0.039)
Maternal excellent/very good mental health	20205	0.58	0.022	16977	0.55	0.056***
			(0.018)			(0.015)
Maternal fair/poor mental health	20205	0.12	-0.016	16977	0.14	-0.013
			(0.017)			(0.020)

Notes: Estimates represent the effects of minimum wage averaged for certain periods (estimated separately) on linkages between minimum wage and child health. Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; gender; and each race/ethnicity group. Other controls include state EITC credit as a percent of the federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds, year effects, and state fixed effects. Estimates are weighted by the NSCH sampling weights.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Appendix Figure 1. Children's Health Outcomes by Age



Appendix Table 1. Summary Statistics

	Age 6-12	Age 13-17
Child health		
General health rating (1-5 scale poor to excellent)	4.09	4.10
Excellent/very good general health	0.71	0.72
Fair/poor general health	0.067	0.071
Combined measure of poor health	0.28	0.28
Combined measure of poor health (chronic conditions)	0.20	0.20
# missed school days past 12 months due to illness or injury	3.68	3.95
Obesity (BMI≥95th percentile)		0.18
Overweight (BMI≥85th percentile)		
Age	9.08	14.96
Gender		
Male	0.51	0.52
Female	0.49	0.48
Race/ethnicity		
Non-Hispanic white	0.40	0.45
Non-Hispanic black	0.16	0.17
Non-Hispanic others	0.06	0.06
Hispanic	0.38	0.32

Notes: The summary statistics were weighted by NSCH sampling weights.

Appendix Table 2. Estimates of the Effects of the Minimum Wage on Health of Children Aged 6 to 12 Years Adding Household Demographic and Maternal Health Variables

	Mean Dep. variable	Minimum wage during pregnancy	Minimum wage from age 0 to age 5	Minimum wage from age 6 to current age	Sum of minimum wage estimates across all ages
General health rating (1-5 scale poor to excellent)	4.08	0.063**	0.035	0.0099	0.11*
		(0.027)	(0.022)	(0.036)	(0.054)
Excellent/very good general health	0.71	0.0052	0.016	0.00048	0.022
		(0.010)	(0.010)	(0.011)	(0.014)
Fair/poor general health	0.069	-0.020**	-0.00058	0.0017	-0.019**
		(0.0092)	(0.0065)	(0.0052)	(0.0087)
Combined measure of poor health	0.28	-0.037**	-0.043**	-0.019	-0.100***
		(0.018)	(0.017)	(0.017)	(0.027)
Combined measure of poor health (chronic conditions)	0.20	-0.044*	-0.025	-0.0061	-0.074**
		(0.023)	(0.018)	(0.018)	(0.028)
# missed school days past 12 months due to illness or injury	3.70	-0.29*	-0.56**	-0.21	-1.05**
		(0.15)	(0.22)	(0.23)	(0.48)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 4 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 18,531 to 19,926 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Appendix Table 3. Estimates of the Effects of the Minimum Wage on Health of Children Aged 13 to 17 Years Adding Household Demographic and Maternal Health Variables

	Mean Dep. variable	Minimum wage during pregnancy	Minimum wage from 0 to age 5	Minimum wage from age 6 to age 12	Minimum wage from age 13 to current age	Sum of minimum wage estimates across all ages
General health rating (1-5 scale poor to excellent)	4.09	0.030	0.32***	0.053	0.025	0.43***
		(0.027)	(0.080)	(0.052)	(0.032)	(0.15)
Excellent/very good general health	0.71	0.014	0.13***	0.033	0.0083	0.18**
		(0.019)	(0.037)	(0.028)	(0.016)	(0.079)
Fair/poor general health	0.072	-0.0080	-0.12***	0.0100	0.00053	-0.12***
		(0.0075)	(0.036)	(0.013)	(0.0088)	(0.037)
Combined measure of poor health	0.29	-0.057***	-0.029	-0.025*	0.012	-0.099**
		(0.014)	(0.024)	(0.015)	(0.019)	(0.044)
Combined measure of poor health (chronic conditions)	0.20	-0.016	-0.051**	-0.033**	0.011	-0.089**
		(0.015)	(0.023)	(0.013)	(0.016)	(0.035)
# missed school days past 12 months due to illness or injury	3.96	-0.15	-0.48	-0.59***	-0.40**	-1.62**
		(0.20)	(0.43)	(0.21)	(0.20)	(0.71)
Obesity (BMI≥95th percentile)	0.18	-0.018	0.029	0.00046	-0.017	-0.0054
		(0.020)	(0.054)	(0.011)	(0.021)	(0.075)
Overweight (BMI≥85th percentile)	0.35	0.056	0.055	-0.020	-0.023	0.068
		(0.041)	(0.059)	(0.021)	(0.019)	(0.10)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 7 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Estimates are weighted by the NSCH sampling weights. Sample size ranges from 15,470 to 16,915 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Appendix Table 4. Estimates of the Effects of the Minimum Wage on Health of Children Aged 6 to 12 Years without using NSCH Sampling Weights

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from age 0 to age 5	Minimum wage from age 6 to current age	Sum of minimum wage estimates across all ages
General health rating (1-5 scale poor to excellent)	4.18	0.0087	0.057*	0.024	0.090*
		(0.029)	(0.024)	(0.024)	(0.039)
Excellent/very good general health	0.75	-0.0050	0.033**	0.0088	0.037*
		(0.012)	(0.010)	(0.0100)	(0.015)
Fair/poor general health	0.056	-0.0014	-0.0099	0.00034	-0.011
		(0.0047)	(0.0062)	(0.0050)	(0.0085)
Combined measure of poor health	0.29	-0.0052	-0.015	-0.025	-0.046*
		(0.012)	(0.013)	(0.013)	(0.019)
Combined measure of poor health (chronic conditions)	0.22	-0.0092	-0.016	-0.026*	-0.051*
		(0.012)	(0.011)	(0.011)	(0.020)
# missed school days past 12 months due to illness or injury	3.94	0.019	-0.069	-0.0080	-0.059
		(0.14)	(0.15)	(0.12)	(0.22)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 4 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Sample size ranges from 19,592 to 21,292 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.

Appendix Table 5. Estimates of the Effects of the Minimum Wage on Health of Children Aged 13 to 17 Years without using NSCH Sampling Weights

	Mean Dep. Variable	Minimum wage during pregnancy	Minimum wage from 0 to age 5	Minimum wage from age 6 to age 12	Minimum wage from age 13 to current age	Sum of minimum wage estimates across all ages
General health rating (1-5 scale poor to excellent)	4.10	-0.014	-0.024	-0.029	-0.0026	-0.069
		(0.030)	(0.038)	(0.037)	(0.021)	(0.065)
Excellent/very good general health	0.72	-0.015	-0.0067	-0.018	0.0025	-0.037
		(0.015)	(0.016)	(0.019)	(0.0097)	(0.034)
Fair/poor general health	0.071	-0.0031	0.0027	0.0024	0.0040	0.0060
		(0.0066)	(0.013)	(0.0067)	(0.0055)	(0.021)
Combined measure of poor health	0.28	-0.016	0.0012	-0.0034	0.0033	-0.015
		(0.013)	(0.016)	(0.015)	(0.0082)	(0.028)
Combined measure of poor health (chronic conditions)	0.20	0.0034	-0.0052	0.0027	0.0030	0.0040
		(0.014)	(0.019)	(0.013)	(0.0073)	(0.029)
# missed school days past 12 months due to illness or injury	3.95	-0.054	-0.14	-0.27	-0.26*	-0.72
		(0.10)	(0.40)	(0.20)	(0.12)	(0.55)
Obesity (BMI≥95th percentile)	0.18	-0.016	-0.034	0.00056	0.0024	-0.047
		(0.013)	(0.022)	(0.013)	(0.0086)	(0.032)
Overweight (BMI≥85th percentile)	0.34	-0.0060	0.0093	0.00051	0.010	0.014
		(0.012)	(0.030)	(0.018)	(0.012)	(0.044)

Notes: Estimates measure changes in child health outcomes with a one dollar increase in average minimum wage in a given period (estimated using Equation 7 and OLS). Standard errors are adjusted for arbitrary correlation in the errors across observations within each state and reported in parentheses. All specifications include dummy variables for each year of child age; for gender; and for each race/ethnicity group. Other controls include state EITC credit as a percent of federal credit (including 0 for states that do not have ETIC), cigarette taxes, and Medicaid income eligibility thresholds (calculated similar to the minimum wage measures), year of birth fixed effects and state fixed effects. Sample size ranges from 16,535 to 18,087 with different outcomes.

*** p-value ≤ 0.001; ** p-value ≤ 0.01; * p-value≤ 0.05.