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Re-Examining the Effect of Maternal Employment on Child Overweight: The Case of School-Age Children

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Abstract

This paper investigated the effect of maternal employment on childhood overweight in the United States using a sample of school-age children. We used data from the spring 2013 cohort of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 (ECLS-K: 2011). We estimated a recursive bivariate probit model using exogenous variation in the youngest sibling's eligibility for kindergarten as an instrument for maternal employment. As a robustness check, instrumental variable regression using 2SLS estimation technique and IV probit regression were also used. The findings suggest that the effect of maternal employment on child overweight is not significant. The results showed that rather than maternal employment, socioeconomic status, schooling environment, life style behaviors including physical exercise and sedentary behavior were significant factors contributing to child overweight. More specifically, higher socioeconomic status and doing physical exercise more frequently were negatively related to child overweight, while sedentary behavior and free/reduced price school meals were positively related to child overweight.

Keywords Child overweight · Maternal employment · Socioeconomic status · Life-style behavior

Introduction

The problem of rising child overweight poses a serious concern in many industrialized countries including the United States. Currently, it is estimated that one in seven children is overweight or obese in most European Union Countries (Gwozdz et al. 2013). Similarly, more than one third of children and adolescents in the United States are overweight or obese (Ogden et al. 2014). The problem of child overweight is not limited only to undesirable looks, it has serious health implications as well. Previous studies showed that child overweight was associated with illnesses including cardiovascular disease, hypertension, type 2 diabetes, stroke, musculo-skeletal disorders and mental health problems (Gwozdz et al. 2013). In addition, childhood overweight has an impact on long-term psychological conditions such as depression and low self-esteem as well as labor market outcomes including discrimination and lower wages (Daniels 2006; Mocan and Tekin 2009).

The reasons behind the rise in child overweight are manifold, but the main ones include sedentary lifestyle, technological advancement, and expansion of fast food restaurants (Chou et al. 2008; Cutler et al. 2003; Philipson and Posner 2003). Interestingly it appears that, the rise in female labor force participation coincided with the rise in child overweight. According to a report from the U.S. Department of Labor, the labor force participation rate of mothers with children younger than 18 years old rose from 47% in 1975 to 71% in 2006 (Bureau of Labor Statistics 2007). By 2016, the labor force participation rate of mothers with youngest children between the ages of 6 to 17 was close to 75% (Bureau of Labor Statistics 2018). This has led some researchers to investigate the potential relationship between the two events to see if maternal employment is also the reason behind the increase in child overweight.

The effect of maternal employment on child overweight is not straight forward. The first channel suggests that mothers who work have less time for cooking at home and are thereby more likely to buy ready to eat meals which are more condensed with fat (Fertig et al. 2009). Moreover, working

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mothers face a time constraint which makes it difficult for them to oversee their children's activities. Consequently, these children have more autonomy on what to eat and what to do in the absence of their parents. In most cases, such children spend more time in sedentary activities like watching TV and eating unhealthy food all of which contribute toward weight gains. The second channel suggests a negative relation between maternal employment and child overweight. The reasoning behind this approach is that working mothers bring in additional income which can be used to purchase better quality food. In addition, these mothers can afford to have their children placed in organized activities that minimize weight gain. The findings of Gordon-Larsen et al. (2003), Zhang and Wang (2004a, b) for instance, indicated a negative relation between socioeconomic status and obesity which is in line with this conjecture.

There are various studies that analyzed the association between child overweight and maternal employment in the past. Araneo (2008) using data from the Fragile Families and Child Wellbeing Study, found that for children of highly educated mothers who worked full-time, there was a higher probability of being overweight. Anderson et al. (2003) used matched mother–child data from the National Longitudinal Survey of Youth (NLSY) and the results suggested that a child was more likely to be overweight if the mother worked more hours per week over the child's life, and this effect was more pronounced for children from higher socioeconomic backgrounds. Hawkins et al. (2008) studied 13,113 children born in the UK between 2000 and 2002 using data from the Millennium Cohort Study. The result of this study suggested that the more hours the mother worked per week, the higher the probability that the child was overweight, but this finding held only for those children whose families were from higher income levels. Using data from the Child Development Supplement of the Panel Study of Income Dynamics, Fertig et al. (2009) explored the channels through which maternal employment affects child obesity. Their findings indicated that more hours of working by mothers resulted in higher children's BMI through the mechanism of skipping meals, less time spent on reading/talking/listening to music, and more time spent watching TV by children.

Recently, other studies showed that the association between maternal employment and child obesity is mostly driven by child care choices. Greve (2011) used the Danish Longitudinal Survey of Children (DALSC) to examine the effect of maternal employment on child obesity. The results of subgroup analysis by type of care showed that maternal employment reduced children's overweight status for those children in formal daycare, while for those in informal daycare (family daycare), maternal employment had no significant effect. The findings of McDonnell and Doyle (2014) suggested that only full-time maternal employment combined with informal childcare resulted in a higher children BMI while part-time employment combined with formal childcare reduced the likelihood of children being overweight. Formal child care coupled with full-time maternal employment resulted in higher child BMI, but only for those children from higher socioeconomic backgrounds. The findings from Hong (2015) revealed that formal child care reduced the probability of child obesity for working mothers, while for those children under relative care, the probability of gaining weight increased.

The findings of Gwozdz et al. (2013) using data from the IDEFICS study (Identification and Prevention of Dietary and Lifestyle Induced Health Effects in Children and Infants), showed no significant association between maternal employment and childhood obesity. Watanabe et al. (2011) used a self-administered questionnaire that interviewed parents of children aged 3 to 6 in the Tohoku region of Japan. The findings of this study suggested that both maternal employment and the presence of grandparents who care for children were associated positively with child obesity. Anderson (2012) used the Early Childhood Longitudinal Survey-Kindergarten Class of 1998–1999 (ECLS-K) to examine the relationship among maternal employment, family routines, and obesity. Their findings revealed that more hours worked by the mother resulted in fewer family meals, fewer meals at regular times, fewer rules about television watching, and higher probability of child obesity. In a similar study conducted by Meyer (2016), maternal full-time employment was significantly associated with a higher probability of children being overweight through the mechanisms of promoting unhealthy diet and lifestyle behaviors including drinking soda, eating processed food, and watching TV and video games. A rather interesting finding on the topic of child overweight was that of Costa-Font and Gil (2013). Using pooled data from the 2003–2004 to 2006–2007 editions of the Spanish National Health Survey (SNHS), the authors found a significant positive correlation between parental intergenerational transmission of obesity and lifestyles. However, maternal employment resulted in a higher probability of child obesity for girls only.

Other studies highlight the importance of paternal employment for child overweight status as well. Benson and Mokhtari (2011) examined the effect of parental employment on children's percentile body mass index using data from the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID). Their findings suggested that both mothers and fathers weekly work hours were significant predictors of children's weight outcomes. Specifically, more hours worked by fathers was associated with higher children's percentile BMI. In addition, the results revealed that higher hourly wages of mothers, relative to fathers, as well as shared parent–child activities, like participating in building and repairing projects and reading, were associated with lower percentile BMI. The findings of

You and Davis (2011) showed that both fathers' primary and secondary childcare time were negatively associated with the probability of the child being overweight. In addition, their findings suggested that mothers' primary childcare time was also negatively related with the probability of the child being overweight. The study by Champion et al. (2012) suggested that child obesity was significantly and positively associated with paternal nonstandard work schedules. However, there was no significant correlation between maternal work schedule and child obesity. In addition, non-standard work schedules of both parents was positively related to child obesity.

The findings of most previous studies seem to suggest that maternal employment is detrimental to child health outcomes as most of these studies document a positive relationship between maternal employment and childhood overweight. However, most of these studies focused on either pre-school children only or samples consisting of both pre-school and school-age children. However, there is some evidence that the effect of maternal employment on child overweight differs by the age of the child (Cawley and Liu 2012). Various studies documented that the early years of the child's life are fundamental to the child's subsequent physical and mental health as well as cognitive development because these are critical periods for the differentiation of nerve function and brain development (Mustard 2007). In addition, non-maternal care during the child's first year of life has a profound effect on a child's emotional development because of the importance of this period for attachment formation (National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network 2005). This implies that maternal employment might be more important in early childhood than at a later stage when the child is enrolled in school. This is because preschool children (usually children younger than 5 years of age) are more dependent on the care of others and have less autonomy on what they eat and what they do. School-age children on the other hand, have some degree of autonomy in their choice of meals and activities, and are less dependent on the care of others. In addition, school-age children spend most of their time at school regardless of whether their mothers work or not, implying that the schooling environment and other family-related socioeconomic factors might be more important determinants of their weight status than the employment status of their mothers. This is in line with Harris' (1995) finding that the one factor that has a lasting effect on children's personalities is the environment they share with their peers.

There are several studies that document the importance of timing of maternal employment with respect to the child's age; the findings are inconclusive. Scholder (2008) noted that it is maternal employment in mid-childhood as opposed to earlier or later years that positively and significantly affects children's overweight status at later stages in life. Miller (2011) found that maternal employment for children aged 9 to 11 and 12 to 14 was significantly and positively related to overweight status during the same period whereas, for children aged 6 to 8, it resulted in a reduction in the rate of obesity. On the other hand, the findings of Brown et al. (2010) suggested that more hours worked by the mother led to a higher probability of overweight for children aged 4 to 5 years but no such effect was observed 2 years later.

There are only a few studies that focused on the effect of maternal employment on the obesity of school-age children (Datar et al. 2014; Hubbard 2008; Morrissey et al. 2011) and these studies did not control for schooling environment. In addition, most of the previous studies that employed instrumental variable techniques to account for the endogeneity of maternal employment did so by using local labor market conditions such as state level unemployment rate (Anderson et al. 2003; Datar et al. 2014; Gwozdz et al. 2013), average hours of work among women by industry (Greve 2011), and state welfare benefit level and welfare reform (Anderson et al. 2003). However, these instruments were found to be weak predictors of maternal employment in the first stage. This paper attempts to address this gap in previous studies by investigating the effect of maternal employment on child overweight, focusing the analysis on school-age children who are understudied, and controlling for the schooling environment which might be an important factor in such analysis. In addition, this study used exogenous variation in youngest sibling's eligibility for kindergarten as an instrument for maternal employment. Previously, Morrill (2011) used exogenous variation in youngest sibling's eligibility for kindergarten as an instrument for maternal employment to examine the effect of maternal employment on the health of school-age children. The health measures used in that study were overnight hospitalizations, asthma episodes, and injuries/poisonings for children between the ages of 7 to 17; the proposed instrument was found to have good predictive power. By adopting Morill's approach to instrumentation, this paper is, to the best of our knowledge, the first to use exogenous variation in youngest sibling's eligibility for kindergarten as an instrument in the analysis of the effect of maternal employment on child overweight.

The purpose of this paper was to re-examine the relationship between maternal employment and child overweight for school-age children. According to the American Obesity Association (AOA), a child is classified as "overweight" if his or her BMI is at or above the 85th percentile and below the 95th percentile. A child is classified as "obese" if his or her BMI is at or above the 95th percentile. In this paper, we used the term "overweight" to refer to those children who were either overweight or obese, that is, those children at or above the 85th percentile. The null hypothesis to be tested is that maternal employment has no effect on the weight outcome of school-age children. An innovation of this re-examination is that we used exogenous variations in the focal child's youngest sibling's eligibility for kindergarten as an instrument for maternal employment and included factors associated with schooling environment which might be associated with childhood overweight for school-age children.

This study used data from the spring 2013 wave of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 (ECLS-K: 2011). This data contains a nationally representative sample of second grade students in the United States. For the purpose of this analysis, we used a bivariate probit model using youngest sibling's eligibility for kindergarten as an instrument for maternal employment. We also used 2SLS and IV probit regressions as robustness checks. The results from all models suggested that there is no significant association between maternal employment and child overweight. In addition, higher socioeconomic status and frequent physical exercise were negatively related to child overweight, while sedentary behavior and free/reduced price school meals were found to be positively related to child overweight. The theoretical framework section provides the theoretical background for the effect of maternal employment on child weight outcome. The empirical model and estimation strategy section presents the data and empirical techniques used for analyzing the relationship between maternal employment and child overweight status. The results and discussion section presents the results and discussion; and the conclusion and policy implications section presents the conclusion and policy implications of this study.

Theoretical Framework

In order to understand how maternal employment affects children's weight outcome, we can start with a theory of household utility function similar to Blau et al. (1996) where the mother's utility is a function of her consumption of a composite good, X, time spent in leisure, L, her child's health, H, and mother-specific factors captured by the vector Θ. We can represent the mother's utility function as U(X, L, H; Θ). The mother has T hours available to spend working for pay, E, providing childcare, Cm, or pursuing leisure, L, such that

$$T = L + E + C_m \tag{1}$$

The child's health outcome is a function of expenditures on goods, G, maternal childcare, Cm, non-maternal childcare (market child care), C, and the child-specific factors captured by the vector ω. The child's health outcome function can be expressed as

$$H = H\left(G, C_m, C; \omega\right) \tag{2}$$

where $.\partial H/\partial C_m \neq \partial H/\partial C$ implying that the mother's care and non-maternal child care are not perfect substitutes.

For simplicity, we can assume that any time spent working requires that the mother utilize market childcare so that E = C. The mother's budget constraint can then be written as

$$\left(v - p^C\right)E + Y = p^G G + X; \tag{3}$$

where v is the mother's wage rate, Y is non-wage income (i.e., an endowment or income from spouse or partner), p^G is the price of health goods, and p^C is the price of childcare. The composite consumption good is the numeraire good. We can then write the mother's utility maximization problem as

$$\max_{X, L, H, Cm, G, E} U(X, L, H; \Theta) \tag{4}$$

$$\text{subject to } (1),\ (2),\ \text{and } (3). \tag{5}$$

Substituting the constraints into the objective function yields

$$\max_{Cm, G, E} U\left(v\left[E - p^C\right] + Y - p^G G, T - E - C_m, H\left(G, C_m, E; \omega\right); \Theta\right) \tag{6}$$

Solving Eq. (6) yields the optimal maternal childcare time, expenditures on health goods, and maternal work hours:

$$\begin{aligned} C_m^* &= C_m(v, Y, P, \omega, \Theta) \\ G^* &= G(v, Y, P, \omega, \Theta) \\ E^* &= E(v, Y, P, \omega, \Theta) \end{aligned} \tag{7}$$

where P = [p^C, p^G] is a vector of prices. Substituting the relations from (7) into (2) gives

$$H = H\left(G*, C*_m, E*\right) = H(v, Y, P, \omega, \Theta) \tag{8}$$

Equation (8) shows that health outcome depends on the mother's wage rate, v, other income, Y, prices of childcare and health goods, P, as well as child and mother-specific characteristics, ω and Θ .

We want to estimate the effect of maternal employment (E) on child health outcome (H). In order to do this, we can estimate Eqs. (7) and (8) as a system of equation, since they are all jointly determined.

Specifically, we can estimate the system

$$\begin{aligned} H_i &= \propto_1 + \beta_1 C_{m,i} + \beta_2 G_i + \beta_3 E_i + \omega_i \gamma' + \varepsilon_{1,i} \\ C_{(m,i)} &= \propto_2 + \phi_{(2,i)} \delta_2' + \varepsilon_{(2,i)} \\ G_i &= \propto_3 + \phi_{3,i} \delta_3' + \varepsilon_{3,i} \\ E_i &= \propto_4 + \phi_{4,i} \delta_4' + \varepsilon_{4,i} \end{aligned} \tag{9}$$

where = ϕ_i[v, Y, P, ω, Θ] is a vector of the parameters from the utility maximization problem (5) and the δ terms are parameter vectors.

However, expenditure on health goods (G) is not directly observed. Therefore, the empirical analysis follows the estimation of the reduced form of the demand function for child health instead of direct estimation of Eq. (9). This reduced demand function for child health can be expressed as

$$H_i = f\left(E_i, X_i, \varepsilon\right) \tag{10}$$

where X is a vector of child and parental characteristics and $\mathcal{E}$ is the error term. The coefficient on E_i from Eq. (10) determines the net effect of maternal employment on child overweight status.

Empirical Model and Estimation Strategy

Model Specification

The estimation equation typically used in previous studies is given in Eq. (11) which shows the effect of maternal employment on child's weight status:

$$Child\ Overweight_i = \beta_0 + \beta_1 Empt_i + \beta_2 X_i + \varepsilon_i \tag{11}$$

The dependent variable is binary which takes a value of 1 if the child is overweight and 0 otherwise. The focus variable is mother's employment ('*Empt*') which is an indicator variable taking a value of 1 if the mother is employed and 0 otherwise. X is a vector of relevant child and parent specific characteristics and $\mathcal{E}_i$ is the error term.

The problem with the above model is that there are some unobserved child and mother specific characteristics that affect child's health outcome and are also correlated with mothers' employment decision, making the coefficient on maternal employment biased. For instance, it might be the case that high-ability mothers are more health conscious and are more likely to have healthy children and work more hours than low ability mothers (Greve 2011). It might also be the case that mothers who have children with poor health might be constrained and less likely to work and not surprisingly the children also are more likely to have poor health (Hubbard 2008). This means that maternal employment status is an endogenous variable in Eq. (11), and failure to account for this unobserved heterogeneity would make the coefficient on maternal employment inconsistent.

In order to reduce any potential bias arising from the endogeneity of maternal employment, we used instrumental variables estimation. Specifically, a two stage least squares (2SLS) procedure was used where maternal employment is instrumented by youngest sibling's eligibility for kindergarten in the first stage. This is shown in Eq. (12) where the instrumental variable youngest sibling eligibility for kindergarten is represented by Z_i and X_i is a vector of the other exogenous explanatory variables. In the second stage, child health outcome is regressed on maternal employment using the predicted value of maternal employment from the first stage estimation. The second stage estimation is shown in Eq. (13):

$$Empt_i = \alpha_0 + \alpha_1 Z_i + X_i + \mu_i \tag{12}$$

$$Child\ Overweight_i = \beta_0 + \beta_1 \widehat{Empt_i} + \beta_2 X_i + \varepsilon_i \tag{13}$$

There is some concern with linear model estimation when both the dependent and the endogenous regressor are binary, rendering the coefficient estimates from 2SLS less efficient. One major potential problem of linear models is that the fitted probabilities can fall below zero or above one, which is theoretically impossible (Lewbel et al. 2012). However, Angrist (2001) argued that 2SLS with binary endogenous regressor often produce efficient estimates that differ very little from non-linear model estimates and hence there is no need to impose strict distributional assumptions. On the other hand, Wooldridge (2011) stated that in the case of binary dependent variable models with a dichotomous endogenous variable, non-linear models like bivariate probit model with Maximum Likelihood Estimation (MLE) would give consistent estimates. This model is shown in Eqs. (14) and (15). However, the bivariate probit model with maximum likelihood estimation requires that the error terms (ε_1, μ_2) are independent of Z and X_1 and distributed bivariate normal. If these assumptions do not hold, then the estimates from bivariate probit model would be inconsistent.

$$Y_1 = 1[\mathcal{D}_1 X_1 + \mathcal{D}_2 Y_2 + \varepsilon_1 > 0] \tag{14}$$

$$Y_2 = 1[\beta_1 X_1 + \beta_2 Z + u_2 > 0] \tag{15}$$

where $Y_1^* = \beta_1 X_1 + \beta_2 Y_2 + \varepsilon_1$ and $Y_2^* = \beta_1 X_1 + \beta_2 Z + u_2$ are the underlying latent variables. Y_1 is the overweight equation and Y_2 is the equation for maternal employment. The instrument Z is included in the maternal employment equation but not in the child overweight status equation, which is the exclusion restriction.

In this paper we presented the results from estimating the bivariate probit model as the main result. As a robustness check, we also presented the estimates from 2SLS using youngest sibling's eligibility for kindergarten as an instrument for maternal employment.

The success of instrumental variable estimation relies on the validity of the instrument. It is commonly known that in order for an instrument to be valid, two conditions must hold. First, the instrument must be highly correlated with the endogenous variable and second, the instrument is correlated with the outcome of interest only through the endogenous regressor. That is, the instrument must not be directly related to the dependent variable. Youngest sibling's eligibility for kindergarten was chosen as an instrument here for the reasoning that there is a substantial reduction in the opportunity cost of a woman's time (making them more likely to work) once the youngest child becomes eligible for kindergarten, and in the United States, kindergarten is provided free of charge by public schools for all children aged 5 and older (Morrill 2011).

The exogenous variation in this instrument comes from variation in the exact timing of fertility (Morrill 2011). We can use an example to describe the exogenous variation similar to the one given by Morrill (2011). Consider the difference in overweight status between two 7 year old boys, one whose mother works because his youngest sibling is 5.5 years old and therefore eligible for kindergarten, and another whose mother does not work because his youngest sibling is 4 years old and not eligible for kindergarten. The satisfaction of exogeneity requirement relies on the assumption that the exact timing of the two births that is, 4 years ago and 5.5 years ago was random conditional on family characteristics, which seems to be a reasonable assumption. The analysis was restricted to those children who had at least one younger sibling so that the focal child's own eligibility for kindergarten would not bias the result.

Data and Description of Variables

Data

The data for this study come from the Early Childhood Longitudinal Study, Kindergarten Class of 2010–2011 (ECLS-K: 2011). This is an on-going survey tracking the same children from Kindergarten to 5th grade. The children in the ECLS-K: 2011 comprise a nationally representative sample from both public and private schools who were in kindergarten in the year 2010–2011. The original data set consists of 18,174 children who participated or whose parents were interviewed in at least one of the two kindergarten data collections (i.e. fall 2010 or spring 2011). The survey period is on a semester basis, i.e. fall and spring of each academic year. The most recent data currently available is from the spring 2013 academic year when children were in second grade. This study was a cross-sectional analysis using data from the spring 2013 cohort. The reason for focusing on the sample from the second grade cohort was to have a large enough sample of children who had younger siblings who could be eligible or ineligible for kindergarten which gives sufficient variation in the instrument used. For instance, the youngest sibling's eligibility for kindergarten cannot be used as an instrument if the sample of children is from the kindergarten cohort because if the focal child is in kindergarten, it is very likely that the youngest sibling will not be eligible for kindergarten, thus eliminating variation in the instrumental variable. The sample included 1,990 grade 2 children aged 7 to 9 whose mothers were the primary respondents to the survey.

Description of Variables

The outcome variable was the probability that the child was overweight which takes a value of 1 if the child was overweight and 0 otherwise. As a robustness check, percentile BMI was also used as a continuous dependent variable. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Unlike the case of adults, the BMI scale itself cannot be used in the determination of overweight status for children because it is highly dependent on the child's age and sex. Therefore, the 2000 BMI-for-age growth chart issued by the Centers for Disease Control and Prevention (CDC) was used to determine each child's overweight status based on age and sex. The main focus variable in the analysis was maternal employment which took on a value of 1 if the mother was employed and 0 otherwise. Mothers' weekly work hours was also used as a continuous predictor to see if the effect of maternal employment at the intensive margin would yield a different result.

Story et al. (2009) argued that school environment plays a significant role in contributing to child obesity. More specifically, they claimed that less than one third of US schools offer meals that meet the USDA standards for total fat and saturated fat. The study concluded that schools could help reduce child obesity by providing an environment conducive to healthy eating and physical activity. Also, Cawley et al. (2012) found that an additional 50 min per week of physical education in schools reduced BMI z-score by 12% and lowered the probability of obesity by 4 percentage points for 5th grade students. In addition, the findings of Schanzenbach (2009) revealed that those children who received school lunches were 2 percentile points more likely to be overweight than those children who brought their own lunch. Moreover, students were more likely to eat school lunch and be overweight if they were income eligible for reduced price school lunches. In light of these findings, we included two variables that measured school environment related to child obesity. The first variable was a dichotomous variable taking a value of 1 if the school provided physical education for at least half an hour in any given day that this course was given, and 0 otherwise. Another variable related to the school environment was the percentage of children eligible for free or reduced-price meal which takes on a value of 1 if 75% or more of the students were eligible.

Patrick and Nicklas (2005) stated that the change in parental lifestyle including the meal composition and eating habits of rushed families is also an important determinant of child obesity. Busy families usually do not have enough time to eat together as a family and often opt for meals from fast food restaurants. In order to account for eating habits of families, we included a dummy variable taking a value of 1 if the child's family ate dinner together three or more days in a typical week.

There is also evidence from previous literature that sedentary behaviors and less time on physical activity contribute to child obesity (Fertig et al. 2009). In order to capture the activities of children, we included three variables: time spent watching TV, time spent playing video games, and time exercising. The first two variables were dummy variables taking a value of 1 if the child watched TV or played video games for an hour or more in a typical week day. The third variable measured the number of days in a typical week the child exercised that causes rapid breathing for twenty minutes or more.

There is some evidence from previous studies that child obesity also differs by socioeconomic factors including race, mother's education, and income (Akil and Ahmad 2011; Araneo 2008; Stamatakis et al. 2010). The findings from Huffman et al. (2010) indicated that single parents often face role strain while trying to balance their role as a wage earner and as a parent which in turn had a negative impact on the weight of their children. Accordingly, this study used four racial categories; White, Black, Hispanic, and other racial groups. We constructed a dummy for each of these racial categories having 'White' as a reference group in the regression analysis. Information on parents' education level was not asked in the spring 2013 survey. However, a socioeconomic status score imputed using parental education, income level, and occupation prestige score was available in the spring 2012 survey. Since current parental education was not available in the spring 2013 wave and using current income was not recommended due to its strong correlation with current maternal employment, we used the spring 2012 socioeconomic status score as a measure for child's socioeconomic status. Three dummy variables were constructed for the lowest, middle, and top tertiles[1] in the socioeconomic status distribution. Also included in the analysis was a dummy variable for marital status taking a value of 1 if the mother was married or living with a partner and 0 if single (lone parent).

Several previous studies that examined the relationship between maternal employment and child obesity included child care usage as one of the factors associated with child obesity (Greve 2011; Hawkins et al. 2008; McDonnell and Doyle 2014). In line with this, we included three categories of pre-kindergarten child care; parental care, informal care,[2] and center-based care. In addition, the present before- or after-school care arrangements were also included in this analysis. Other child and parent-specific control variables including child age, child sex, biological mother's age at first birth, number of siblings, fathers' weekly work hours and whether the child had high birth weight[3] were also considered.

Results and Discussion

Descriptive Statistics

Table 1 shows that about 55% of the mothers in the sample were employed. Close to 29% of the children in the sample were overweight which is not far from the national figure given by Ogden et al. (2014) that indicated that more than one third of children and adolescents in the United States were overweight. In the sample, 41% of the children were White, close to 35% were Hispanic, about 14% were Black, and the remaining 10% belonged to other racial minorities including Asians, native Alaskan, native Hawaiian and children who were of mixed race. There were substantial differences in child care use in the year before kindergarten and current child care. In the year before children entered kindergarten, about 44% of the children were in center-based care, compared to only 13% once they entered second grade. Intuitively, this seems a reasonable decline in the usage of center-based care as children spend most of their time in school once they enter kindergarten. About 35% of the mothers in the sample were single.[4] About 74% of the children watched TV for an hour or more on a typical weekday and close to 39% played video games for an hour or more on a typical week day. On average, children in the sample did physical exercise that causes fast breathing for at least 20 min, about 4 days a week. On the days physical education class was given in their school, about 66% of the children had that class time for half an hour or more. About 38% of the children attended school where 75% of the children or more were eligible for free/reduced price meal. On average, mothers worked 34 h per week and fathers worked close to 45 h per week. The average child percentile BMI in our sample was 63.

Table 2 shows the proportion of overweight children in the sample by mothers' employment status, race/ethnicity and socioeconomic status. It can be seen from Table 2 that there was little difference in the proportion of overweight

[1] Tertile refers to dividing the sample into three parts.

[2] Informal care includes both relative and non-relative care.

[3] High birth weight is a dummy variable taking a value of 1 if the child had a birth weight of more than 8.8 lbs by the standard cutoff and 0 otherwise.

[4] The category 'single' also includes those who are divorced, separated, widowed, and never married. The category 'married' includes those who are married or in civil union/domestic partnership.

Table 1 Summary statistics, N = 1990

Variable	Percent of sample or mean value (SD)
Mother employed	55.33%
Overweight	28.74%
Days eat dinner together	5.90 (1.64)
Mom's age at first birth	22.31 (4.18)
Days child exercises	4.50 (2.28)
Child age in months	97.73 (4.39)
Number of siblings	2.69 (1.37)
Male	51.56%
Race	
White	41.41%
Black	14.12%
Hispanic	34.67%
Other	9.8%
Primary type of pre-kindergarten care	
Parental	24.32%
Informal	17.29%
Center-based	44.27%
Primary type of before-or after-school care	
None	60.06%
Informal	26.98%
Center-based	12.96%
Single	35.23%
Child had high birth weight	5.68%
Played video game for an hour or more	38.74%
Watched TV for an hour or more	74.12%
Physical Education in school for half an hour or more	66.03%
75% or more students eligible for free/reduced price meal	38.04%
Mothers' hours of work	33.53 (13.24)
Fathers' hours of work	44.52 (11.69)
Percentile BMI	62.91 (28.83)

Standard deviation is in parenthesis

children by maternal employment status. About 29% of children from working mothers were overweight, and among children whose mothers were not employed, 28.5% were overweight. If we considered the proportion of children by socioeconomic status, the lowest tertile had the largest proportion of overweight children (36.4%) whereas only 19% of the top tertile children were overweight. This result is consistent with the findings of Stamatakis et al. (2010) that obesity was more prevalent among children from lower socioeconomic status, compared to children from higher socioeconomic status. The two racial groups that had the largest proportion of overweight children were Hispanics and Blacks. About 36.7% of Hispanic children were overweight and 29.2% of Black children were overweight.

Regression Results

The bivariate probit model results in Table 3 show that the effect of maternal employment on child's overweight status was nonsignificant. The difference between column (1) and column (2) estimates is that column (1) includes only current

Table 2 Percentage of overweight children by maternal employment, socioeconomic status and race

Sub-group	Percentage overweight
All	28.74
By maternal employment	
Mother employed	28.97
Mother not employed	28.46
By socioeconomic status	
Lowest tertile	36.40
Middle tertile	28.92
Top tertile	19.15
By race/ethnicity	
White	23.30
Black	29.18
Hispanic	36.67
Other	23.08

child care usage, while column (2) includes both current and pre-kindergarten child care usage. In both specifications, it can be seen that the effect of maternal employment on child overweight status was not significant. From this result, it can be inferred that the detrimental effects of maternal employment on child weight outcome for pre-school children documented in most previous studies, did not persist to school-age years.

The variables that had a significant effect on child weight outcome were race/ethnicity, birth weight, socioeconomic status, school environment and physical activity by the child including TV watching and exercise. Specifically, if a child had high birth weight, the probability that he/she was overweight went up by 12 to 13 percentage points approximately depending on the specification. On average, those children in the upper tertile of the socioeconomic status distribution were 7 to 8 percentage points less likely to be overweight than those children in the middle tertile of the socioeconomic status distribution. One possible reason might be that children from higher socioeconomic background have better access to healthier foods which are usually more expensive, and more opportunity to do regular physical exercise.

Table 3 shows that the activities of children also have a significant effect on their weight status. For one additional day per week a child did exercise that causes rapid breathing for 20 min or more, the probability that he/she was overweight went down by approximately 1 percentage point. On the contrary, if a child watched TV for an hour or more on a typical weekday, the probability that he/she was overweight increased by 7 to 8 percentage points depending on the specification. This result supported the findings of Fertig et al. (2009) that more hours of TV watching by children was positively related to their weight status. This is also in line with the conclusions of Akil and Ahmad (2011) that obesity was strongly related to lifestyle behaviors like low levels of physical activity or greater consumption of foods with high concentration of calories. TV watching is a sedentary activity which is usually accompanied by the consumption of unhealthy foods that can contribute to weight gain.

The results from Table 3 suggest that schooling environment also has a significant effect on children's weight status. If a child attended a school where 75% or more of the students were eligible for free/reduced price meal, the likelihood of him/her becoming overweight increased by 5 to 6 percentage points. This is in line with the findings of Schanzenbach (2009) that children who were eligible for free/reduced price school lunch were more likely to be overweight. One possible reason for this might be the one given by Story et al. (2009) that, less than one third of US schools offer meals that meet USDA standards for total fat and saturated fat. Another possible explanation for this might be the fact that if a child attends a school where 75% or more of the students are eligible for free/reduced price meal, it implies that the child is living in a poor neighborhood which again indicates that socioeconomic status is also an important factor in explaining child overweight. Physical education class where children exercise for at least half an hour was not significantly associated with children's overweight status. It can also be inferred from Table 3 that Hispanic children were about 6 percentage points more likely to become overweight than White children, but this was significant only in model (1) and at 10% significance level. Children with single mothers were about 6 percentage points more likely to become overweight than children from dual parent households. This result seems to be in agreement with the findings of Huffman et al. (2010) that single parents face role strain in balancing market work with child rearing which has a negative implication on their children's weight outcome.

Table 3 also shows that child care usage, whether current or pre-kindergarten, is not significantly related to children's weight outcome. This result implies that the effect of pre-kindergarten childcare usage does not persist (or linger on) to school age years. The results of column (1) and column (2) from Table 3 are very similar. The instrument youngest sibling's eligibility for kindergarten was found to be significant at 5% significance level in both specifications implying that our instrumental variable has a good predictive power. The result showed that if the youngest sibling was eligible for kindergarten, the probability that the mother was employed increased by 19 to 20 percentage points.

Robustness Check

In this section, we tested the robustness of our findings by presenting several alternative specifications. Table 4 presents the results from the linear model using 2SLS estimation technique. The results from the 2SLS regression are by and large consistent with the results from the bivariate probit model. The effect of maternal employment on child overweight status is not significant in both column (1) and column (2), which is in line with the findings from the bivariate probit model in Table 3. Similar to the results from the bivariate probit model, the factors that significantly affected child weight outcome are birth weight, socioeconomic status, school environment, and physical activity by the child including TV watching and exercise. The only difference is that race/ethnicity was found to be nonsignificant in this specification.

The first-stage results from Table 4 provide evidence of the validity of the instrument used in the 2SLS regression. The last row for columns (1) and (2) shows that if the child's youngest sibling was eligible for kindergarten, the probability that the mother was employed increased by 6 percentage points. This is in line with the initial argument that as the youngest child becomes eligible for kindergarten, the opportunity cost of the mother's time decreases substantially and she is more likely to be employed. The coefficient estimates in both columns (1) and (2) were statistically significant at 1% level which indicate that the instrument is a good predictor of the endogenous variable. The F-statistic in both specifications is greater than the rule of thumb critical value of 10 which is an added evidence for the validity of the instrument.

Table 5 presents 2SLS estimates from modeling child weight outcome as a continuous measure (percentile BMI) as opposed to a binary indicator (overweight status). We can see that maternal employment is not significantly related to child percentile BMI both in column (1) and column (2).

Table 3 Bivariate probit model estimates for the impact of maternal employment on child weight outcome

Variables	Overweight (1)	Overweight(2)
Mother employed	0.187 (0.171)	0.101 (0.238)
Child age	−0.002 (0.003)	−0.002 (0.003)
Female	−0.023 (0.023)	−0.020 (0.025)
Days eat dinner together	0.006 (0.008)	0.003 (0.009)
Black	−0.001 (0.042)	0.008 (0.045)
Hispanic	0.057† (0.031)	0.038 (0.036)
Other	−0.005 (0.044)	0.042 (0.046)
Number of siblings	−0.010 (0.013)	−0.013 (0.014)
Single	0.058† (0.030)	0.063* (0.032)
Informal (current)	−0.036 (0.079)	−0.010 (0.096)
Center-based (current)	−0.087 (0.053)	−0.033 (0.066)
Mom's age at first birth	0.003 (0.003)	0.004 (0.003)
Child had high birth weight	0.121* (0.049)	0.135** (0.052)
Days child exercises	−0.010* (0.005)	−0.014** (0.005)
Lowest tertile	0.052 (0.035)	0.050 (0.039)
Highest tertile	−0.074* (0.033)	−0.086* (0.035)
Played video game for an hour or more	−0.005 (0.026)	−0.001 (0.029)
Watched TV for an hour or more	0.073** (0.028)	0.080* (0.032)
Physical Education in school	−0.020 (0.026)	−0.016 (0.031)
Free/reduced price meal	0.060* (0.028)	0.056† (0.030)
Center-based care pre-kindergarten		−0.032 (0.031)
Informal care pre-kindergarten		−0.060 (0.052)
Youngest sibling	0.190* (0.076)	0.198* (0.082)

The estimates represent marginal effects. Robust Standard errors are in parentheses. N = 1591 for model (1) and N = 1384 for model (2). The coefficients corresponding the variable 'Youngest Sibling" are from regressing maternal employment on the instrument, youngest sibling eligibility for kindergarten

*$p < 0.05$, **$p < 0.01$, and $^{\dagger}p < 0.10$

Table 4 2SLS estimates for the impact of maternal employment on child weight outcome

Variables	Overweight (1)	Overweight (2)
Mother employed	−0.052(0.385)	−0.048 (0.384)
Child age	−0.002 (0.003)	−0.002 (0.003)
Female	−0.023 (0.023)	−0.017 (0.026)
Days eat dinner together	0.001 (0.011)	0.00002 (0.012)
Black	−0.004 (0.044)	0.004 (0.048)
Hispanic	0.046 (0.038)	0.025 (0.043)
Other	−0.013 (0.042)	0.031 (0.047)
Number of siblings	−0.022 (0.019)	−0.018 (0.017)
Single	0.075* (0.034)	0.075* (0.035)
Informal (current)	0.061 (0.152)	0.045 (0.143)
Center-based (current)	−0.030 (0.102)	−0.001 (0.097)
Mom's age at first birth	0.003 (0.003)	0.005 (0.003)
Child had high birth weight	0.149** (0.058)	0.153** (0.060)
Days child exercises	−0.011* (0.005)	−0.014* (0.006)
Lowest tertile	0.029 (0.057)	0.041 (0.052)
Highest tertile	−0.067* (0.031)	−0.078* (0.032)
Played video game for an hour or more	−0.017 (0.032)	−0.006 (0.033)
Watched TV for an hour or more	0.061† (0.032)	0.069* (0.034)
Physical education in school	−0.009 (0.032)	−0.007 (0.036)
Free/reduced price meal	0.069* (0.030)	0.061† (0.033)
Center-based care pre-kindergarten		−0.025 (0.036)
Informal care pre-kindergarten		−0.038 (0.073)
Youngest sibling	0.060** (0.022)	0.064** (0.024)

Robust Standard errors are in parentheses. N = 1591 for model (1) and N = 1384 for model (2). The first stage F-statistics for model (1) is 35.53 and 31.14 for model (2). Model (1) includes only current before-and- after school child care arrangements, while model (2) includes both current and pre-kindergarten child care arrangements

*$p < 0.05$, **$p < 0.01$, and †$p < 0.10$

Table 5 2SLS estimation with child percentile BMI as a dependent variable

Variables	pBMI (1)	pBMI (2)
Mother employed	−0.176 (0.246)	−0.153 (0.247)
Child age	−0.003 (0.002)	−0.003 (0.002)
Female	−0.015 (0.015)	−0.011 (0.016)
Days eat dinner together	−0.005 (0.007)	−0.006 (0.008)
Black	0.010 (0.027)	0.011 (0.029)
Hispanic	0.042† (0.023)	0.025 (0.027)
Other	−0.063* (0.030)	−0.039 (0.033)
Number of siblings	−0.015 (0.012)	−0.009 (0.011)
Single	0.049* (0.020)	0.041† (0.021)
Informal (current)	0.103 (0.097)	0.079 (0.092)
Center-based (current)	0.018 (0.066)	0.021 (0.063)
Mom's age at first birth	−0.002 (0.002)	−0.001 (0.002)
Child had high birth weight	0.123** (0.033)	0.125** (0.034)
Days child exercises	−0.004 (0.003)	−0.004 (0.004)
Lowest tertile	−0.002 (0.036)	0.012 (0.033)
Highest tertile	−0.021 (0.021)	−0.035 (0.022)
Played video game for an hour or more	−0.005 (0.020)	0.005 (0.020)
Watched TV for an hour or more	0.027 (0.022)	0.031 (0.023)
Physical Education in school	−0.001 (0.021)	−0.001 (0.024)
Free/reduced price meal	0.027 (0.019)	0.016 (0.021)
Center-based care pre-kindergarten		0.006 (0.022)
Informal care pre-kindergarten		0.036 (0.046)
Youngest Sibling	0.060** (0.022)	0.064** (0.024)

Robust Standard errors are in parentheses. N = 1591 for model (1) and N = 1384 for model (2). The first stage F-statistics for model (1) is 35.53 and 31.14 for model (2). Model (1) includes only current before-and- after school child care arrangements, while model (2) includes both current and pre-kindergarten child care arrangements

*$p < 0.05$, **$p < 0.01$, and †$p < 0.10$

Similar to the results from Tables 3 and 4, having high birth weight was found to be positively and significantly related to child percentile BMI. Being raised by a single mother led to a 0.04 to 0.05 unit increase in BMI percentile. Being Hispanic was positively and significantly related to percentile BMI while there was some evidence that belonging to other racial category was negatively and significantly related to percentile BMI. What is different in this model is that socioeconomic status and physical activity including exercise turned out to be nonsignificant. The first-stage results from this specification also showed that having a youngest sibling eligible for kindergarten was positively and significantly associated with the probability of maternal employment.

There is some concern that modeling the effect of maternal employment at an extensive margin might not give the complete picture as the effect of maternal employment might be more pronounced at the intensive margin as opposed to the extensive margin. To account for this, we included mothers' weekly work hours as the endogenous predictor. This is shown in Table 6. In addition, there is some evidence from previous literature that paternal work hours also play significant role in influencing children's weight outcome as fathers and mothers are joint decision makers in the household (Benson and Mokhtari 2011; You and Davis 2011). To account for this, we included fathers' weekly work hours as an additional control variable. This specification is shown in column (3) and (4) in Table 6. The results showed that the effect of mothers' weekly work hours on child percentile BMI was nonsignificant. In addition, paternal work hours was also nonsignificant in explaining child weight outcome. The first-stage result from this specification proved the validity of our instrument with an F-statistic of greater than 10 and a statistical significance at 1%. Similar to the results from Tables 3, 4, and 5, the variables that were significantly

Table 6 2SLS estimation with child percentile BMI as a dependent variable and mothers' hours of work as predictor

Variables	pBMI	pBMI	pBMI	pBMI
	(1)	(2)	(3)	(4)
Mothers' hours of work	−0.004 (0.006)	−0.004 (0.006)	−0.005 (0.006)	−0.004 (0.006)
Child age	−0.003 (0.002)	−0.003 (0.002)	−0.003 (0.002)	−0.003 (0.002)
Female	−0.014 (0.015)	−0.011 (0.017)	−0.014 (0.015)	−0.011 (0.017)
Days eat dinner together	−0.005 (0.007)	−0.005 (0.006)	−0.005 (0.007)	−0.005 (0.007)
Black	0.017 (0.030)	0.016 (0.031)	0.017 (0.030)	0.015 (0.031)
Hispanic	0.050^{*} (0.020)	0.033 (0.022)	0.050^{*} (0.020)	0.032 (0.022)
Other	$-0.060^{\dagger}$ (0.031)	−0.036 (0.033)	-0.061^{*} (0.031)	-0.037 (0.033)
Number of siblings	−0.014 (0.011)	−0.007 (0.009)	−0.014 (0.011)	−0.007 (0.009)
Single	0.048^{*} (0.020)	$0.039^{\dagger}$ (0.020)	0.048^{*} (0.019)	$0.039^{\dagger}$ (0.020)
Informal (current)	0.111 (0.110)	0.081 (0.096)	0.112 (0.111)	0.081 (0.096)
Center-based (current)	0.031 (0.083)	0.029 (0.075)	0.032 (0.085)	0.030 (0.076)
Mom's age at first birth	−0.002 (0.002)	−0.001 (0.002)	−0.002 (0.002)	−0.001 (0.002)
High birth weight	0.119^{**} (0.031)	0.121^{**} (0.031)	0.120^{**} (0.031)	0.122^{**} (0.031)
Days child exercises	−0.004 (0.003)	−0.004 (0.004)	−0.004 (0.003)	−0.004 (0.004)
Lowest tertile	−0.008 (0.043)	0.008 (0.038)	−0.010 (0.045)	0.006 (0.040)
Highest tertile	−0.024 (0.021)	$-0.039^{\dagger}$ (0.023)	−0.022 (0.021)	−0.037 (0.023)
Video game for ≥ 1 hr	−0.002 (0.017)	0.008 (0.018)	−0.002 (0.017)	0.008 (0.018)
Watched TV for ≥ 1 hr	$0.032^{\dagger}$ (0.019)	$0.038^{\dagger}$ (0.020)	$0.032^{\dagger}$ (0.019)	$0.037^{\dagger}$ (0.020)
Physical Education	−0.005 (0.017)	−0.005 (0.020)	−0.005 (0.017)	−0.005 (0.020)
Reduced price meal	0.029 (0.019)	0.019 (0.020)	0.029 (0.019)	0.020 (0.020)
Fathers' hours of work			0.0004 (0.001)	−0.001 (0.001)
Center care pre-KG		0.005 (0.021)		0.005 (0.022)
Informal care pre-KG		0.036 (0.047)		0.036 (0.047)
Youngest Sibling	2.386^{**} (0.839)	2.709^{**} (0.907)	2.349^{**} (0.836)	2.696^{**} (0.902)

Robust Standard errors are in parentheses. N = 1591 for model (1) and model (3). N = 1384 for model (2) and model (4). The first stage F-statistics for model (1) is 38.49 and 30.77 for model (2). The first stage F-statistics for model (3) is 38.03 and 30.45 for model (4)

$^{*}p < 0.05$, $^{**}p < 0.01$, and $^{\dagger}p < 0.10$

related to child weight outcome were watching TV, high birth weight, marital status, and race/ethnic background.

Table 7 gives the results from IV probit regression where the dependent variable is the probability of child overweight and the endogenous predictor is mothers' weekly work hours. Again, the effect of maternal work hours on child overweight status was not significant. Consistent with the previous specifications, the factors that were significantly associated with child overweight status were marital status, high birth weight, physical activity by the child including exercise and watching TV, socioeconomic status and free/reduced price meal in school. Specifically, having high birth weight, watching TV, attending school where 75% or more students were eligible for free/reduced price meal, and being raised by a single mother, were positively and significantly related to the probability of the child being overweight. On the other hand, frequent physical exercise and coming from a higher socioeconomic status were significantly and negatively related to the probability of child overweight. Having a youngest sibling eligible for kindergarten raised maternal weekly work hours by approximately 2.3 to 2.7 h, and this result was significant at 1% significance level. This shows that our instrument remained highly predictive of maternal employment throughout all specifications.

The findings from the robustness check revealed that the main result from the bivariate probit model was not sensitive to alternative model specifications. More specifically, maternal employment was not a significant factor explaining the overweight status of school age children. As stated earlier, some studies (Datar et al. 2014; Fertig et al. 2009) claimed

Table 7 IV probit estimation with probability of overweight as a dependent variable

Variables	Overweight (1)	Overweight (2)	Overweight (3)	Overweight (4)
Mothers' hours of work	− 0.003 (0.029)	− 0.003 (0.027)	− 0.003 (0.029)	− 0.004 (0.027)
Child age	− 0.006 (0.008)	− 0.007 (0.009)	− 0.006 (0.008)	− 0.007 (0.009)
Female	− 0.066 (0.070)	− 0.051 (0.080)	− 0.065 (0.070)	− 0.049 (0.079)
Days eat dinner	0.004 (0.033)	0.001 (0.029)	0.005 (0.034)	0.002 (0.030)
Black	0.006 (0.138)	0.036 (0.145)	0.009 (0.137)	0.040 (0.144)
Hispanic	0.146 (0.095)	0.092 (0.104)	0.152 (0.095)	0.098 (0.106)
Other	− 0.020 (0.130)	0.118 (0.139)	− 0.010 (0.130)	0.125 (0.141)
Number of siblings	− 0.061 (0.050)	− 0.055 (0.042)	− 0.061 (0.051)	− 0.055 (0.042)
Single	0.209* (0.087)	0.209* (0.091)	0.212* (0.087)	0.213* (0.091)
Informal (current)	0.165 (0.495)	0.137 (0.436)	0.164 (0.500)	0.139 (0.435)
Center-based (current)	− 0.084 (0.381)	0.014 (0.345)	− 0.088 (0.389)	0.013 (0.348)
Mom's age at first birth	0.009 (0.009)	0.014 (0.009)	0.008 (0.009)	0.014 (0.009)
High birth weight	0.422** (0.144)	0.447** (0.148)	0.420** (0.145)	0.445** (0.149)
Days child exercises	− 0.030† (0.016)	− 0.039* (0.018)	− 0.030†(0.016)	− 0.039* (0.018)
Lowest tertile	0.073 (0.198)	0.104 (0.178)	0.082 (0.209)	0.110 (0.187)
Highest tertile	− 0.227* (0.098)	− 0.269* (0.107)	− 0.240* (0.098)	− 0.280** (0.105)
Video game for ≥ 1 hr	− 0.044 (0.081)	− 0.020 (0.084)	− 0.043 (0.081)	− 0.019 (0.084)
Watched TV for ≥ 1 hr	0.199* (0.089)	0.233* (0.096)	0.202* (0.090)	0.235* (0.097)
Physical Education	− 0.026 (0.079)	− 0.020 (0.093)	− 0.027 (0.080)	− 0.021 (0.094)
Reduced price meal	0.187* (0.085)	0.167† (0.092)	0.184* (0.085)	0.164† (0.092)
Fathers' hours of work			0.003 (0.004)	0.002 (0.004)
Center care pre-KG		− 0.075 (0.103)		− 0.076 (0.104)
Informal care pre-KG		− 0.112 (0.225)		− 0.111 (0.227)
Youngest Sibling	2.386**(0.834)	2.709** (0.899)	2.349**(0.830)	2.696** (0.895)

Robust Standard errors are in parentheses. N = 1591 for model (1), N = 1384 for model (2), N = 1591 for model (3) and N = 1384 for model (4). The coefficients corresponding the variable 'Youngest Sibling" are from regressing mothers' work hours on the instrument, youngest sibling eligibility for kindergarten. The estimates represent marginal effects

*p < 0.05, **p < 0.01, and †p < 0.10

that the mechanisms through which maternal employment affects child obesity are through children's activities and eating habits. The reasoning is that mothers who work have less time available to supervise the activities of their children, and unsupervised children are more likely to spend more time in sedentary activities like watching TV which is usually accompanied with eating unhealthy food. This in turn has a negative impact on their weight. If this is the case, including these potential channels in the regression of child weight outcome on maternal employment might yield incorrect regression estimates. Therefore, we regressed each of these activities on maternal employment to check the association between the two. These results are shown in Tables 9 and 10 in the Appendix. The first row in Columns (1), (2) and (3) in both tables shows the effect of maternal employment on the probability of TV watching by child for an hour or more in a typical weekday, the probability that the child plays video game for an hour or more in a typical weekday and the changes in log count in the number of days the child does exercise that causes rapid breathing for at least 20 min. The results showed that maternal employment, whether at the extensive margin or intensive margin, was not significantly associated with any of the child activities considered in this study. The only exception is found in column (2) of Table 10 where the effect of maternal work hours on the probability that the child played video game for an hour or more was positive and significant, but this was only at 10% significance level. Therefore, these activities can be included in the regression of child weight outcome on maternal employment as independent regressors as specified in Tables 3, 4, 5, 6, 7.

Conclusions and Policy Implications

The purpose of this paper is to re-examine the effect of maternal employment on child overweight status. To this end, this study used bivariate probit models to estimate the effect of maternal employment on child's overweight status. The results showed that the effect of maternal employment on child weight outcome was not significant. To test whether our finding is sensitive to model specification, we used instrumental variable regression using 2SLS having both the probability of child overweight and percentile BMI as the dependent variable. In addition, we modeled IV probit regression to test whether maternal employment at the intensive margin would yield a different result. The instrumental variable used for maternal employment is exogenous variation in youngest sibling's eligibility for kindergarten. The results from the non-linear and linear models are consistent with each other. In particular, the effect of maternal employment on child overweight status is not significant in all specifications. This result remained robust when maternal employment is measured both at the intensive and extensive margin. Therefore, we fail to reject the null hypothesis which states that maternal employment has no effect on child weight outcome for school-age children. Whether this nonsignificant result is due to the positive and negative effects of maternal employment offsetting each other, or whether it is due to the diminishing effect of age could not be determined with certainty based on the available information. However, this finding suggests that the detrimental effects of maternal employment on child weight outcomes that were documented in earlier studies are not necessarily applicable to school-age children, or at least these effects do not persist over to school-age years. This finding supports the argument made by Gwozdz (2016) that child development is more influenced by the environment in which the family lives than by parental employment. In poor neighborhoods, there tends to be more concentration of fast-food restaurants, fewer grocery stores, and limited opportunities for physical activity resulting in sedentary behavior and unhealthy diet which all contribute to weight gain.

This study finds that socioeconomic status, marital status, birth weight, TV watching and physical exercise by children, and school environment are the factors that significantly contribute to child overweight status. In particular, children from higher socioeconomic backgrounds were less likely to be overweight. Children with single mothers were more likely to be overweight compared to children from dual-parent households. In addition, children who watched TV for an hour or more on a typical weekday were more likely to be overweight compared to those who did not. By contrast, with an increase in the number of days children do exercise that causes rapid breathing for 20 min or more during a typical week, the probability that they became overweight declined. Children who had high birth weight were more likely to be overweight compared to children who had normal birth weight. This might be due to genetic factors or other maternal characteristics during pregnancy. In any case, this result suggests that weight problems in infancy persist to school-age years, which implies that early intervention is needed to tackle childhood weight problems to avoid problems at a later stage in life.

This paper also finds some evidence of health disparities across different racial/ethnic groups. Specifically, there was some evidence that Hispanic children were more likely to be overweight than White children and children from other racial minorities were less likely to be overweight than White children. In general, the findings of this paper suggest that rather than maternal employment, it is lifestyle behaviors, socioeconomic background and schooling environment that significantly contribute to child overweight. It is not surprising that current child care usage turned out to be nonsignificant in explaining child weight outcome given that children now spend most of their time in school.

This study has a few limitations. First, the dataset consists of only school-age children, so subgroup analysis between school age and pre-school children could not be conducted to see if the effect of maternal employment differs between the two age groups. Second, it was not possible to use state level unemployment rate and state welfare laws as additional instrumental variables as used in previous studies, because information on children's state of residence was not available. However, this result has an interesting policy implication calling for policies regarding maternity leave to be more generous during the child's early years as most previous studies document the adverse effects of maternal employment on pre-school children. This study found that if a child attended a school where 75% or more of the children were eligible for free/reduced price meal, the likelihood that the child was overweight increased. This calls for more government actions to ensure that school meals meet USDA's quality standards for healthy diet. Based on the findings that children from higher socioeconomic status are less likely to be overweight, and the high prevalence of overweight children in the lowest socioeconomic status distribution, public policies directed towards narrowing the socioeconomic status gap might help reduce the prevalence of overweight children in the United States.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest.

Research involving Human Participants and/or Animals This article does not contain any studies with human participants or animals performed by any of the authors.

Informed Consent This research does not contain any individually identifiable information.

Appendix

See Tables 8, 9, 10.

Table 8 Detailed description of variables

Variables
Maternal employment: 1 = if mother is employed; 0 = if mother is not employed
Mothers' work hours: the number of hours the mother works per week
Fathers' work hours: the number of hours the father works per week
Overweight: the probability that the child is overweight where 1 = overweight, 0 = not overweight
pBMI: Child percentile BMI
Days child does exercise: The number of days in a typical week the child does exercise that causes rapid breathing for 20 min or more
Watch TV: dummy variable where 1 = if the child watches TV for an hour or more during a typical weekday and 0 = otherwise
Play video games: dummy variable where 1 = if the child plays video game for an hour or more during a typical weekday and 0 = otherwise
Days eat dinner together: the number of days the family eats dinner together in a typical week
Mom's age at first birth: Biological mother's age at first birth
Child age: child's age in months
Child sex: dummy variable where 1 = female, 0 = male
Number of siblings: focal child's number of siblings
Socioeconomic status: categorical variable where middle tertile is the reference group Lowest tertile (1 = if in lowest tertile; 0 = otherwise) Middle tertile (1 = if in middle tertile; 0 = otherwise) Upper tertile (1 = if in upper tertile; 0 = otherwise)
Child race Black Hispanic Other (other racial minorities including Asians, people of mixed race, native Hawaiian or Pacific islander) White (reference group)
Child had high birth weight (dummy where 1 = yes, 0 = no)
Single: indicator for marital status where 1 = if mother is single and 0 if mother is married
Child care pre-kindergarten Center-based care Informal care Parental care (reference group)
Current child care use (before and-after school care) Center-based Care Informal care No before-and-after school care in formal or informal setting (reference group)
Physical Education in school: dummy variable taking a value of 1 if the child attends school that gives physical education class where children exercise for half an hour or more in the days this course is given; and 0 otherwise
Free/reduced price meal: dummy variable taking a value of 1 if child attends school where 75% or more of the children are eligible for free/reduced price meal; and 0 otherwise

Table 9 Regression estimates for the association between maternal employment and child activities

	TV watching (1)	Playing video game (2)	Child Exercise (3)
Mother employed	−0.080 (0.303)	0.724 (0.435)	−0.039 (0.426)
Center-based care pre-kindergarten	0.008 (0.030)	−0.056 (0.044)	−0.032 (0.036)
Informal care pre-kindergarten	0.042 (0.057)	−0.132 (0.086)	−0.106 (0.079)
Female	0.000 (0.023)	-0.137^{**} (0.033)	-0.084^{**}(0.029)
Child age	−0.002 (0.003)	0.002 (0.004)	0.000 (0.003)
Days eat dinner together	−0.003 (0.009)	0.007 (0.013)	0.018 (0.012)
Black	0.058 (0.037)	$0.104^{\dagger}$ (0.060)	−0.086 (0.056)
Hispanic	−0.014 (0.037)	0.105^{*} (0.053)	−0.050 (0.050)
Other	$-0.080^{\dagger}$ (0.045)	0.065 (0.060)	−0.081 (0.052)
Informal (current)	0.071 (0.110)	−0.193 (0.158)	0.039 (0.162)
Center-based Care (current)	−0.027 (0.080)	-0.278^{*} (0.117)	0.053 (0.115)
Single	−0.023 (0.028)	−0.039 (0.043)	−0.008 (0.039)
Mom's age at first birth	−0.004 (0.003)	-0.009^{*} (0.004)	0.000 (0.003)
Child had high birth weight	0.031 (0.050)	0.015 (0.070)	0.019 (0.059)
Lowest tertile	−0.003 (0.042)	0.092 (0.064)	−0.095 (0.059)
Highest tertile	-0.141^{**} (0.032)	−0.025 (0.041)	0.031 (0.032)
Physical Education in school	0.010 (0.034)	−0.052 (0.047)	0.026 (0.043)
Free/reduced price meal	0.024 (0.027)	0.054 (0.044)	0.025 (0.039)
Number of siblings	−0.009 (0.015)	0.005 (0.019)	0.017 (0.018)
N	1429	1429	1399

Robust standard errors are in parentheses. (1) and (2) represent coefficient estimates from 2SLS regression where the probability the child watches TV and plays video game for an hour or more during weekday are the dependent variables respectively. (3) represents coefficient estimates from additive log-linear IV poisson regression

*$p < 0.05$, **$p < 0.01$, and $^{\dagger}p < 0.10$

Table 10 Regression estimates for the association between maternal employment and child activities

	Watching TV (1)	Playing video game (2)	Days exercises (3)
Mothers' work hours	−0.002 (0.007)	$0.017^{\dagger}$ (0.010)	−0.001 (0.010)
Center-based care pre-kindergarten	0.007 (0.029)	−0.052 (0.041)	−0.033 (0.035)
Informal care pre-kindergarten	0.042 (0.058)	−0.135 (0.084)	−0.106 (0.078)
Female	0.000 (0.023)	-0.137^{**} (0.031)	-0.084^{**} (0.028)
Child age	−0.001 (0.003)	0.001 (0.003)	0.0003 (0.003)
Days eat dinner together	−0.002 (0.008)	0.003 (0.011)	$0.018^{\dagger}$ (0.011)
Black	0.061 (0.040)	0.073 (0.061)	−0.085 (0.058)
Hispanic	−0.010 (0.030)	0.066 (0.043)	−0.048 (0.039)
Other	$-0.079^{\dagger}$ (0.044)	0.053 (0.055)	−0.080 (0.050)
Informal (current)	0.073 (0.116)	−0.208 (0.160)	0.040 (0.164)
Center-based Care (current)	−0.022 (0.095)	-0.316^{*} (0.133)	0.055 (0.130)
Single	−0.023 (0.027)	−0.034 (0.040)	−0.009 (0.038)
Mom's age at first birth	−0.004 (0.003)	-0.008^{*} (0.004)	0.0002 (0.003)
Child had high birth weight	0.030 (0.048)	0.026 (0.064)	0.018 (0.054)
Lowest tertile	−0.005 (0.048)	0.110 (0.070)	−0.096 (0.065)
Highest tertile	-0.143^{**} (0.034)	−0.008 (0.042)	0.031 (0.034)
Physical Education in school	0.008 (0.029)	−0.031 (0.038)	0.025 (0.036)
Free/reduced price meal	0.026 (0.026)	0.039 (0.040)	0.026 (0.038)
Number of siblings	−0.008 (0.013)	0.0004 (0.016)	0.017 (0.016)
N	1429	1429	1399

Robust standard errors are in parentheses. (1) and (2) represent coefficient estimates from 2SLS regression where the probability the child watches TV and plays video game for an hour or more during weekday are the dependent variables respectively. (3) represents coefficient estimates from additive log-linear IV poisson regression

*$p < 0.05$, **$p < 0.01$, and $^{\dagger}p < 0.10$

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