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Maternal Employment and Overweight Children

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ABSTRACT

This paper seeks to determine whether a causal relationship exists between maternal employment and childhood overweight. We use matched mother/child data from the National Longitudinal Survey of Youth and employ econometric techniques to control for observable and unobservable differences across individuals and families that may influence both children's weight and their mothers' work patterns. Our results indicate that a child is more likely to be overweight if his/her mother worked more hours per week over the child's life. Analyses by subgroups show that it is higher socioeconomic status mothers whose work intensity is particularly deleterious for their children's overweight status.

I. INTRODUCTION

Childhood overweight may be one of the most significant health issues facing American children today.[1] Over the past three decades, it has grown so dramatically that observers routinely describe the trend as an epidemic. In the 1963 to1970 period, 4 percent of children between the ages of 6 and 11 were defined to be overweight; that level had more than tripled by 1999, reaching 13 percent (Centers for Disease Control, 2001).

This general trend masks important differences in the incidence of childhood weight problems by socioeconomic status. For example, only 1.7 percent of black boys were recorded as being overweight in the 1963 to 1965 period, but that rate has grown almost 10 times to reach 15.1 percent in 1988-1994 (National Center for Health Statistics, 1998). By 1988-1994, 18.8 percent of Mexican-American boys and 17.4 percent of black girls were overweight compared to 11.7 percent of white girls. As we show subsequently, rates of childhood overweight are much higher for the poor and for those with less educated parents as well.

Researchers and public health officials are currently at a loss to explain the rapid rise in childhood obesity. At some basic physiological level, the cause of this increase in overweight among children is clear: weight gain is attributable to taking in more energy than one expends. What is unclear is what has upset this balance between energy intake and expenditure over the last three decades. For example, while genetics clearly play a role in determining overweight, it is hard to imagine that such dramatic and rapid changes have taken place in our genetic makeup that this factor alone could be the culprit.

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[1] The Surgeon General David Satcher said, “This crisis is stealing youth, innocence, and health from our children, and yet as a nation we have been badly remiss in addressing it.” (Mashberg, 1999).

Thus, it is important to consider other causes of overweight, including the environmental factors that may affect either the intake or expenditure of energy. In this regard, analysts have tended to point to factors like the availability and consumption of calorie-rich fast foods along with increased television viewing and decreased exercise. These explanations beg the question of why these behaviors have changed, however, since fast food and television have both been available for decades.

Popular opinion routinely draws a direct link between mothers working and poor outcomes for children. Typical comments express concern about the effects of child care, for instance warning that "parents who casually warehouse their kids could use a healthy does of anxiety (Feder, 1999)." According to the Washington Post, "two-thirds of the people surveyed said that although it may be necessary for a mother to work, it would be better for her family if she could stay home and care for the house and children (Grimsley and Melton, 1998)." Popular news reports on the topic of childhood obesity are similarly peppered with comments from health practitioners who either implicitly or explicitly attribute changes in children's diet and exercise to the increased likelihood that both parents work outside the home. For example, a 1999 *Boston Herald* article cited a pediatric nutrition specialist who "noted in particular that dual-career couples are spending less time monitoring their latchkey children, who consequently snack after school, using their often liberal allowances on candy, ice cream, or soda pop (Mashberg, 1999)." Popular nutrition author Dr. Andrew Weil in an interview on CNN attributed the increased reliance on prepared and processed foods to the fact that "typically, people say they don't have time to cook." The interviewer attributed this time constraint to the prevalence of dual-career families (Weil, 2002).

Those who believe that dual-career families may be contributing to changes in children's diet and exercise habits have a compelling prima facie case. The rise in women working outside the home coincides with the rise in childhood weight problems. From 1970 to 1999, the fraction of married women with children under six who participate in the labor force doubled, rising from 30 percent to 62 percent. Married women with children ages 6 to 17 dramatically increased their labor force participation as well, rising from 49 percent to 77 percent over this period (U.S. Bureau of the Census, 2000).

There are several potential mechanisms through which children's eating patterns and level of physical activity may be affected by having parents who work outside the home. Children may eat differently if child care providers are more likely to give them food that is highly caloric and of poor nutritional value. Further, parents who work outside the home may serve more high-calorie prepared or fast foods, and unsupervised children may make poor nutritional choices when preparing their own after-school snacks. Similarly, unsupervised children may spend a great deal of time indoors, perhaps due to their parents' safety concerns, watching television or playing video games rather than engaging in more active outdoor pursuits.

Alternatively, the increase in working mothers may have no adverse effect on childhood weight problems. First, any correlation between working mothers and overweight children may be spurious, if, for example, mothers who work are those who would be less attentive to their children's nutrition and exercise in any case. On the other hand, there may be a negative impact of maternal work on childhood overweight if households where the mother works have more money with which to purchase more healthful meals, and children of these households participate in after-school sports, thereby increasing their activity levels. Finally, increases in maternal work may be a small component of the myriad environmental changes affecting children's health. The United States might have faced the current epidemic in childhood overweight, even if women's labor force activity had not dramatically increased.

The purpose of this paper is to explore whether the observed coincident rise in maternal employment and childhood overweight represents a causal relationship between these two phenomena. We focus on the role of maternal employment rather than parental employment more generally for three reasons. First, it is mothers' labor supply that has changed dramatically over recent decades. Second, despite the dramatic increase in women's paid market employment, they still bear the bulk of responsibility for child rearing. Third, data limitations in the analysis reported below only enable us to link the employment histories of mothers and children.

Using the National Longitudinal Survey of Youth (NLSY), we first document a simple correlation between maternal employment and overweight. The remainder of the paper attempts to identify whether this simple relationship reflects more than a spurious correlation in which children whose mothers work full-time would still be overweight even if their mothers did not work. To this end, five techniques are employed. First, we estimate standard probit models including a full range of observable characteristics of the mother and child. Second, we estimate "long-difference" models that compare changes in child overweight status at the beginning and end of the panel to changes in maternal work history, thus differencing out any unobserved child-specific fixed effect. We also estimate sibling difference models, both comparing weight outcomes for siblings at the same time and at the same age, thus differencing out any unobserved family-specific fixed effects. Finally, we estimate instrumental variables models.

We also estimate the models by income, maternal education, and race/ethnicity. We analyze subgroups separately since public policy may interact with childhood overweight in different ways for different groups. For example, if maternal work is particularly deleterious for overweight among poor children, one might worry that welfare reform and its attendant work requirements will have unintended adverse consequences for childhood obesity.

Our results lead us to several conclusions. First, mothers who work more intensively, in the form of more hours per week over the child's life, are significantly more likely to have an overweight child. There is no evidence that mothers who work are simply those who are inherently less attentive to their children's health outcomes. In other words, we do not find any support for the notion that these differences are driven by unobservable heterogeneity. Interestingly, the aggregate relationship is entirely driven by the relationship between maternal work and children's weight outcomes among higher socioeconomic status families. These children have the lowest incidence of obesity. For example, if the mother in a top income quartile family works an extra 10 hours per week (on average while working since the child's birth), the child is between 1.3 and 3.8 percentage points more likely to be overweight. Thus for high socioeconomic status families, increases in mothers' average weekly hours of work over the last three decades can explain between 12 and 35 percent (depending on the specification and under certain assumptions) of the increase in the incidence of overweight among children in these families. Finally, while our results indicate that maternal employment has a significant impact on children's overweight for some groups, those who would blame maternal employment for the deterioration in children's health overall need to look elsewhere for the whole story. Particularly for the subpopulations with the highest incidence of childhood obesity, mothers' employment does not appear to be a factor.

II. PREVIOUS RESEARCH

Being overweight as a child has both immediate consequences and long-term implications for individuals, as well as for society as a whole. For example, the increase in childhood overweight has been accompanied by a marked increase in the number of children developing type II diabetes, which has serious health risks (Thompson, 1998). In addition, studies have shown that overweight children are much more likely to become overweight adults than normal weight children (Bouchard, 1997; and Dietz, 1997). Being overweight may have serious health consequences for adults including diabetes, coronary heart disease, atherosclerosis, and colorectal cancer (Power, et al., 1997). Furthermore, being overweight may have social and economic consequences. For example, studies have shown that obesity is negatively related to education and earnings (Averett and Korenman, 1996; Gortmaker, et al., 1993; and Cawley, 2000). Moreover, the health consequences for individuals place additional pressure on the scarce resources of the nation's health care system. Thus, the importance of a better understanding of the determinants of childhood obesity, including the potential role of maternal employment, is clear.

Although little research has directly examined the impact of maternal employment on childhood overweight, past work on other determinants may help inform this issue. Many studies have found a strong correlation between parent and child weight problems, (c.f. Vuille and Mellbin, 1979; Dietz, 1991), although such a correlation could be due to either genetic or behavioral factors. As indicated above, though, while a genetic explanation for overweight is compelling, other factors must play a role as well given the dramatic trends in overweight in the United States over the last few decades.

Thus, researchers have turned to environmental factors (c.f. Locard, et al., 1992; Woolston, 1987; Bar-Or, et al., 1998). The evidence shows a positive correlation between television viewing and overweight among children (c.f. Gortmaker, et al., 1996; and Dietz and Gortmaker, 1985). Findings regarding the relationship between family structure, socioeconomic status, and childhood overweight are more mixed. Sobal and Stunkard (1989) find a weak correlation between low socioeconomic status and obesity for children, but Dietz (1991), Gerald, et al. (1994) and Wolfe, et al. (1994) find a stronger one. Similarly, studies have tended to find a significant relationship between family structure and obesity, although results across studies are not always consistent about the sign of the effect (c.f. Dietz, 1991; Wolfe, et al., 1994; and Gerald, et al., 1994). Researchers have also examined the influence of the types of foods children eat, but the role of parental involvement in this regard is also mixed (c.f. Klesges, et al., 1991; and Birch and Fisher, 1998). Finally, recent work on breastfeeding suggests that infants who are breastfed may be less likely to be overweight later in life than those who are not (von Kries, et al. 1999, Gilman, et al. 2001).

Research specifically examining the link between maternal employment and childhood overweight is very limited. Takahashi, et al. (1999) finds a positive relationship between mothers' employment and children's probability of being overweight, but the data are only for 3-year-old Japanese children. Additionally, Johnson, et al. (1992) study US children age 2-5 in 1987-88 and find no significant effect of maternal employment on nutrient intake.

III. DATA AND DESCRIPTIVE STATISTICS

To conduct our analysis, we mainly use the matched mother-child data from the National Longitudinal Survey of Youth (NLSY), which are described briefly here and in more detail in the Data Appendix. The NLSY first surveyed 12,686 individuals, of whom 6,283 were women, between the ages of 14 and 22 in 1979 and has continued to survey them annually through 1994 and biennually since then. Beginning in 1986, the children of those women have been surveyed biennually as well. At the time we began this project matched data through 1996 had been released, giving us six survey years of data.[2]

The key outcome variable, an indicator for whether the child is overweight, is based on body mass index (BMI). BMI is defined as weight in kilograms divided by height in meters squared (kg/m^2) and is a commonly used measure to define obesity and overweight in adults. The Centers for Disease Control (CDC) has recently endorsed the use of BMI to assess overweight in children, and has produced sex-specific BMI percentile charts for children aged 2 to 20 for this purpose. We follow CDC nomenclature and classify children with a BMI above the 95th percentile of the BMI distribution for their sex-age group as "overweight."[3]

We use the height and weight measures for children between the ages of 3 and 11 in the NLSY to calculate BMI. We truncate the age distribution prior to adolescence, since the younger children are likely to have less choice about the composition of their diet than do adolescents. In addition, this truncation means that children in our sample have not gone through puberty, with its attendant body changes, which may make BMI a less accurate approximation to measures of adiposity. Since the National Health and Nutrition Examination Survey (NHANES) is the source of the CDC's official measures of overweight, we calculate overweight for the same age children in the NHANES and find that our data are comparable.[4]

The second key component to our analysis is the mother's employment history. While current employment status is available, it is less appropriate than a measure of long-term exposure. Current employment may fluctuate, and with it the flows of calories consumed and expended, but it is really the stock of net calories that will determine overweight status. Using the child's lifetime exposure to maternal employment will let us more closely approximate this stock concept. Fortunately, the NLSY provides a virtually complete work history for each mother, allowing us to calculate total weeks worked and total hours worked starting from the date of the child's birth until each survey date. We use these data to construct a measure of average hours worked per week by mothers during the weeks in which they worked at all. We then use this hours per week measure

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[2] Appendix Table 1 presents sample means for all of the variables used in the analysis.

[3] Children above the 85th percentile are referred to as "at-risk of overweight."

[4] In the NHANES III, 10.3 percent are overweight, while in our analysis sample 10.6 are so classified.

along with total weeks worked per year to capture lifetime exposure.[5] Including both of these measures rather than simply a total hours measure helps us to distinguish between those mothers who work at a high intensity, but intermittently, from those who consistently work, but at a lower intensity. Mothers who work at a high intensity may face time constraints during the period in which they are working and may be less able to provide a daily routine that includes nutritious foods and regular exercise.

Table 1 presents simple descriptive statistics for the fraction of children who are overweight by three measures of socioeconomic status and by intensity of mothers' work per week. We have three broad measures of socioeconomic status: quartile of the family income distribution, mother's education, and race/ethnicity. In the first column, we can see that children who are poorer, whose mother's are less educated, and who are members of racial/ethnic minority groups are more likely to be overweight. We have divided mothers' work into three categories capturing intensity of work per week: those who never worked, those who worked fewer than 35 hours per week, and those who worked at least 35 hours per week, on average, since the child's birth. In the first row, we see that the more hours a mother works per week, the more likely her child is to be overweight. The analysis by subgroups, however, shows that this pattern is not universal. The adverse relationship between mother's working and childhood overweight seems to hold only for wealthier families, with better educated, or non-Hispanic mothers.

[5] One potential difficulty in using these two specific maternal employment measures is that it may lead to identification of our models from individuals exhibiting unusual behavior. For instance, holding constant weeks worked and examining changes in hours worked per week, it is possible that women who work for just a few weeks per year but very intensively in those weeks may be identifying these models. Alternatively, variation in weeks worked holding constant hours worked per week could come from individuals who work 40 hours per week, but just for one week per year. To examine this issue, we created ranked categories of weeks worked and hours worked per week, cross-tabulated them, and found very few observations far off the diagonals. In other words, virtually no one has an extreme value of one measure, but not the other.

IV. ECONOMETRIC APPROACHES

Although the descriptive statistics in Table 1 make a compelling prima facie case that there is a relationship between maternal work and childhood overweight, particularly for higher socioeconomic status groups, mothers who work are likely to differ from mothers who do not in both observable and unobservable ways. These omitted variables may bias (either up or down) the relationship between maternal work and childhood overweight across all subgroups. In our analysis, we use five techniques to address these concerns.

First, we estimate standard probit models for whether the child is overweight. The effect of mothers' work is identified by variation across children and over time.[6] While these models can account for observable differences across individuals, there still may be unobservable differences that bias the relationship between a mother's work intensity and her child's weight. For example, if mothers who work more hours are those who are less attentive to their children's health regardless of their work effort, that will induce a spurious positive correlation between hours of work and overweight. Alternatively, suppose permanent family income is related to both child health and maternal work. With only imperfect proxies for permanent income the unobservable components of family income may load onto the maternal work coefficient.

We have four techniques for addressing unobservable heterogeneity. The first three exploit the longitudinal and family-based nature of the survey. This allows us to "difference out" any permanent unobservable characteristics of individual children over time or within families that might influence both a mother's work intensity and her children's weight. For example, if a mother suffers from *chronic* depression that affects her ability to monitor her children's health and her ability to

[6] Note that in these models, each child may have multiple observations over time, and may have siblings in the sample, who also have multiple observations overtime. Our reported standard errors are corrected for heteroskedasticity and an arbitrary covariance structure over time and within families.

work, these techniques will account for it. Child fixed effects can be eliminated using "long differences," where we take the difference between the first and the last observation for each individual in the sample. Here the effect on the child's probability of being overweight is identified by variation over time in the mother's work behavior within each child's lifetime. Family fixed effects can be eliminated in two alternative ways. We use data on sibling pairs in the sample to create both "point in time" sibling differences and "at the same age" sibling differences. For pairs observed at the same time, identification is provided if the mother changed her work behavior between the births of the two siblings. For pairs at the same age, work intensity varies if the mother changed her work behavior in the years it took the younger sibling to reach the same age as the older sibling at a particular point in time.

Each of these "difference" methods has strengths and weaknesses. A well-known drawback with any difference method is that it may exacerbate attenuation bias due to measurement error (Greene 1993). It is for this reason that we have chosen to estimate child fixed effect models in long-differences rather than first differences.[7] If a mother's work behavior is highly serially correlated, then much of the observed variation in work intensity over short periods of time may be due to measurement error. Long-differences reduce this problem (Griliches and Hausman 1986). Sibling difference methods at the same time also have an advantage in this regard relative to sibling differences at the same age. The former utilizes the mother's work patterns averaged over both siblings' entire lives. The latter throws out some of this information since some of the mother's work behavior during the older sibling's life is discarded while "waiting" for the younger sibling to "catch up."[8] Since another method of reducing problems associated with measurement error is to

[7] The median difference is 6 years (3 surveys) between the first and last observation.

[8] Because we have restricted the NLSY child sample to include those between the ages of 3 and 11 and because the

average data over longer periods (Zimmerman 1992), sibling differences at the same time and long differences offer this advantage.[9]

Beyond that, although all the difference methods control for fixed unobservable characteristics (either over time or within the same family), each has different vulnerabilities to factors that change over time or within the family. If, for instance, a mother *becomes* depressed during our sample period and this affects both her work and her children's health, long differences cannot control for this. Sibling differences at the same age may or may not difference out a shock like this, depending upon when it occurs, but for pairs at the same time the shock to both siblings would be the same (assuming that the shock has the same effect for children of different ages). Alternatively, if one child in the family suffers from chronic health problems, long-differences would control for this, but both forms of sibling difference methods could be biased. Because it is impossible to specify the form of unobservable changes over time or within family, it is impossible to determine which method is preferable, a priori.

Instrumental variables estimation is the fourth method we use to control for unobservable heterogeneity. In theory, this method can account for unobservable heterogeneity, whether it is fixed or variable, and for measurement error bias. Instruments must be related to mothers' work behavior, but have no effect on children's probability of being over weight. Here, we use the variation between states and over time in the unemployment rate, child care regulations, wages of child care workers, welfare benefit levels, and the status of welfare reform in the state.[10] Higher unemployment

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NLSY child assessments are only conducted every other year, only about half as many sibling pairs are available when we compare siblings at the same age.

[9] Children's ages (and thus the number of years of data available to calculate the lifetime exposure to maternal work) vary systematically across these methods. For the "at the same age" estimates, the siblings' average age is 6.6 years. For the "at the same time" estimates, on average the younger sibling is 5.9 years old and the older sibling is 9.2 years old. For the "long difference" estimates, in the second observation, the child is on average 9.2 years old.

[10] First stage regression results are presented in Appendix Table 2. Data on child care regulations were graciously

makes it more difficult for mothers to find work. Child care regulations and higher child care wages may reflect higher costs and less utilization. Women in states with more restrictive welfare rules may be more likely to work. Because the residuals in a model of children's overweight status are unlikely to be related to these geographic variables, our model should be appropriately identified. In practice, instrumental variables estimation has two drawbacks. First, it is often difficult to come up with variables that satisfy the exogeneity requirement. Second, even if one can come up with such variables, they are often only weakly related to the variable of interest, leading to weak second stage results. Keeping the strengths and weaknesses of each of these approaches in mind, we turn to the results.

V. ECONOMETRIC ANALYSES

A. Probit Analysis

The first column of Table 2 presents the result of estimating a simple probit on the probability of child overweight, based on average hours worked per week (if working) and average weeks worked per year, over the child's lifetime.[11] Here we find a positive and significant relationship between the average hours a mother works per week (if working) and childhood overweight. The point estimate indicates that mothers who work 10 hours more per week increase the likelihood that their children will be overweight by 1.2 percentage points.[12] The number of weeks worked are negatively and significantly related to childhood overweight in this specification.

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provided by Joe Hotz and Rebecca Kilburn and were used in Hotz and Kilburn (1996). Because each of our instruments only differs across states and time, the fact that we use so many of them makes it difficult to interpret any one particular coefficient. Multicollinearity will lead to imprecise parameter estimates because so little variation in the data is available to identify any specific coefficient.

[11]Throughout the paper, all models include variables indicating whether the child's height and weight were physically measured or reported by the child's mother. Mothers appear to underestimate the child's height, resulting in those children being more likely to be classified as overweight.

[12]We have also estimated comparable models using an indicator for at-risk of overweight and BMI as a continuous measure as dependent variables and obtained qualitatively similar results.

Given that there are no controls for socioeconomic status, it is likely that weeks worked is picking up some of the positive effect of income on health status.

Column 2 adds controls for a number of demographic variables. Regarding race/ethnicity, if black and Hispanic mothers have fewer employment opportunities than white mothers, and black and Hispanic children are more likely to be overweight for a variety of reasons, excluding race and ethnicity controls will understate the effect of working on children's weight. For similar reasons we control for mother's education (coefficient shown) and AFQT score (coefficient not shown), since a mother's education and ability may affect both her employment patterns and her children's health. A mother may continue to work outside the home with her first child, and choose to reduce her outside work effort with the birth of subsequent children, implying that birth order and number of children in a family may have an effect on children's weight. Thus, we control for whether a child is firstborn and the number of children in the family. Although we do not focus on their coefficients, we control for a number of other variables either because of their likely link to children's weight or to maternal employment patterns.[13] As with the work variables, there is a question of how to interpret these additional coefficients. For instance, maternal education may have a causal impact on childhood overweight, or mothers with more education may have other attributes that are different and reduce the likelihood that their children will be overweight.

The results in Column 2 show that including these control variables reduces the coefficient on average hours worked per week from 1.2 percentage points to 0.8, but it is still statistically significant. However, the number of weeks worked becomes insignificant. Several of the other coefficients are worth noting. Black children are significantly more likely to be overweight than other

[13] These include the child's birth weight, whether the child is female, both the child's and the mother's age in years, controls for education levels of the mother's parents, and controls for whether they were present when the mother was 14. We also include dummy variables for each year of the NLSY.

groups. Mother's education is negatively and significantly related to the probability that her child is overweight – an extra year of education reduces the probability that a child will be overweight by 0.6 percentage points.[14] Children from larger families are also less likely to be overweight, although being the first-born child is not significantly related to the probability of being overweight.

Column 3 includes all the controls in Column 2 as well as additional controls for whether the child was ever breastfed, and the mother's weight status. As discussed earlier, recent evidence (von Kries, et al. 1999, Gilman, et al. 2001) suggests that children who were breastfed are less likely to develop weight problems by the time they are school aged. Mothers with demanding work schedules may be less likely to find the time to breastfeed, and this is a possible pathway through which maternal work may affect childhood overweight. Additionally, mother's weight status may reflect either the impact of genetics on the child's likelihood of being overweight or the effects of the common home environment on the family's weight status.[15]

Although the additional variables included in Column 3 do not change the estimated impact of hours per week or weeks worked much, they are significantly related to childhood overweight. We estimate that children who are breastfed are about 2.3 percentage points less likely to be overweight. Again, the interpretation of this finding is unclear – there may be nutritional value in breast milk that affects children's health later in life, or it may simply be that mothers who breastfeed are more attentive to their children's nutrition throughout the children's lives. Mother's weight is also found to have a large impact on children's weight status. Note that an obese mother (BMI of at

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[14] AFQT score (not shown) also has a negative and significant coefficient.

[15] In a sense, including mother's weight may be "overcontrolling" for the home environment. If working mothers are time constrained and are more likely to rely on calorie-rich prepared and fast foods, then we would expect everyone in the family to be more likely to be overweight when the mother works.

least 30) is also overweight (BMI of at least 25). Therefore, a child whose mother is obese is a full 8.1 percentage points (the sum of the two coefficients) more likely to be overweight.

Column 4 adds controls for average family income since the child's birth and the percent of the child's life that the mother was married. Average family income since the child's birth is a proxy for permanent income, which measures parents' long-term ability to meet their children's needs. Similarly, the percent of the child's life the mother was married is a measure of the long-term resources available to the family. Again, the inclusion of the additional variables in Column 4 does not affect the estimated impact of the maternal employment variables. Moreover, we find no effect of family income or mother's average marital status on childhood overweight. The insignificance of family income appears to be due to the fact that socioeconomic status is well controlled for by race, education, AFQT score and grandparents' education. If we include income without these other variables, as expected, we find that overweight is negatively correlated with income.

So far we have considered the impact of exposure to maternal employment over the child's entire life for children in the 3-11 age range, yet recent research emphasizes the importance of the early childhood environment on subsequent outcomes (see c.f. Nelson, 1999; and Shonkoff and Phillips, 2000). In Table 3, we investigate whether the timing of maternal employment makes a difference for children's overweight status. Table 3 presents two sets of analyses. First, it separates the sample into children age 3-5 and those age 6-11. This allows us to examine whether the effect of mother's work differs between pre-school and elementary school-aged children. If the earlier result was driven by day care quality, one might expect there to be a bigger effect of mothers working more hours per week for pre-school children. Second, Table 3 allows mother's work in the child's first three years of life to have a separate impact from overall work.

The first column simply reprints the results from Table 2, Column 4 for comparison. Columns 2-5 include the same control variables used generating this result. In the second and third columns, we can see that an increase in mothers' hours worked per week has a larger effect on the likelihood of childhood overweight for school-age children, although the difference between the two groups is not statistically significant (p-value=0.42). The fourth column shows that neither hours per week nor weeks worked in the child's first three years of life has a significant impact on the likelihood that a child is overweight when included in the model with no other maternal work measures. In Column 5 we include our overall lifetime exposure measures along with exposure during the first three years of life, and we see that it is only hours per week since the child's birth that matters. Thus, the impact seems cumulative, rather than concentrated in a particular period.

B. Correcting for Unobservable Heterogeneity

The preceding section shows that mothers who work more intensively, in the form of more hours per week, on average, over their child's life, are more likely to have an overweight child. This result holds when we control for a wide range of observable characteristics. In Table 4, we present results for models that control for unobservable differences across individuals and families that may affect both mother's work intensity and children's weight.

The results from the long-difference model are shown in the first column of Table 4. In this specification, we find that children of mothers who work an additional 10 hours per week while working face a 1.5 percentage point increase in the likelihood of overweight. This estimate is actually larger than that obtained from the probit model and is statistically significantly different from zero at conventional levels. We continue to find weak results regarding the relationship between the number of weeks worked since birth and childhood overweight. It is the intensity of the work effort that seems to be most important. There is no evidence from these estimates, then, that our earlier result was driven primarily by unobserved heterogeneity in fixed characteristics.

The results of sibling differences are reported in Columns 2 ("at the same time") and 3 ("at the same age") of Table 4. Here, point estimates are slightly larger than those obtained from the probit model, but they are somewhat more imprecise. Standard errors are roughly twice the size, and this greater imprecision renders the point estimates insignificant in these specifications. Nevertheless, these estimates again provide no real indication of serious bias from unobserved heterogeneity in the probit specifications.

One of the advantages of sibling differences over individual differences is that they allow us to examine the impact of attributes that do not vary for an individual. Here, for example, we can examine the impact of breastfeeding on overweight, while holding constant any fixed maternal characteristics. The coefficient on breastfeeding is unstable across the specifications in Columns 2 and 3. In neither case is it significantly different from zero, although in Column 3 the point estimate is similar to that in Table 2. As these results suggest that mothers who breastfeed their children may simply be different in many ways from mothers who do not, more research is needed to determine if there is, in fact, a causal impact of breastfeeding on overweight.

Column 4 presents the results of the instrumental variables model. For computational simplicity, we have applied linear probability models to estimate the factors affecting childhood overweight despite the discrete nature of this outcome.[16] The IV method results in point estimates on our maternal employment measures that are similar to those reported in other models, but the standard errors are several times larger. Thus, while the employment effects are not significant, the

[16] We have also estimated a linear probability model in which we do not instrument for maternal employment and found that the parameter estimates in this model are virtually identical to the derivatives from the analogous probit model reported in Column 4 of Table 2.

fact that the pattern of the point estimates is similar to those reported earlier provides another indication that the earlier results were not driven primarily by omitted variable bias. However, our instruments do not allow enough power to reject that the true coefficient is zero.

Overall, then, these results suggest that mothers who are more time constrained due to working more hours per week may have a more difficult time ensuring their children get nutritious meals and regular exercise. If anything, the point estimates from the difference and IV models suggest the probit models may provide an underestimate of the true effect.

C. Estimates for Subgroups

In this section, we present estimates of each of the earlier models by income quartile, mother's education and race/ethnicity, respectively.[17] In Table 5, we divide the sample by income (measured over the child's lifetime) quartiles. Interestingly, the positive effect of more intensive employment is driven almost exclusively by those in the top quartile. In the probit models, the point estimate on hours per week is always positive, but increases with income quartile. Only the estimate for the highest quartile is statistically significant. For this group, the results indicate that a 10-hour increase in average hours worked per week (if working) since the child's birth increases the likelihood that the child will be overweight by 1.3 percentage points. Turning to the estimates that control for unobserved fixed individual or family effects, we see that the impact of having a mother who works more intensively is always greatest for children in the highest income quartile. Consistent with our measurement error discussion above, the estimates for this group are largest for the long difference and "at the same time" estimates. Across all methods, however, the results for the highest income quartile are always positive, at least as big as the probit estimates, and statistically

[17] We exclude the instrumental variables estimates because the estimates become even more imprecise with smaller subgroups.

significant in two out of three cases. For this group, there is no evidence that unobservable heterogeneity drives the relationship between hours worked per week and childhood overweight.

Table 6 reports the results separating the sample by mother's level of education. Here the impact of the intensity of maternal employment is consistently positive and significant for children of more educated mothers. Among these children, probit estimates indicate that if their mothers worked an additional 10 hours per week while working since they were born, they were 1.1 percentage points more likely to be overweight. Again, estimates obtained from long differences and sibling differences support this finding. Children of more highly educated mothers are significantly more likely to be overweight if their mothers work more hours per week in two of the three additional specifications; point estimates are larger for this group in all specifications that control for unobserved heterogeneity. The effect of hours per week for children of mothers who are high school dropouts and graduates are erratic and generally statistically insignificant. The effect of weeks worked is insignificant virtually throughout.

We have also separated the sample by racial/ethnic group and report the results of these estimates in Table 7. In probit models we find that the overall effect of more intensive working appears to be driven by the experience of whites. Point estimates on hours worked per week in models estimated exclusively for whites using long differences and sibling differences are at least as big as the probit estimate, although only the long difference estimates provide sufficient precision to reject the null hypothesis of no effect. Estimates for other groups show no consistent pattern and coefficients on weeks worked are uniformly statistically insignificant.

Overall, then the subgroup analysis shows that a measure of the intensity of mother's work over the child's lifetime has a positive effect on a child's likelihood of being overweight if the child is in a high income family, with a well-educated, or white mother. This is consistent with time constraints affecting these mother's ability to supervise their child's eating and exercise patterns. For these subgroups, a 10-hour increase in average hours worked per week over a child's life is estimated to increase the likelihood that the child is overweight by between one and four percentage points, depending on the specification. Thus, a mother of this type moving from part-time (20 hours per week) work to full-time work (40 hours) is expected to increase the probability that her child is overweight by between 2 and 8 percentage points.

VI. DISCUSSION

Intuitively, one might have thought that higher socioeconomic status mothers would be those for whom working would matter least, because they are the mothers in the best position to purchase high quality child care in their absence. Instead, we find that it is only for this group that mother's work matters, implying that when these mothers spend more time per week with their children, they are doing something that promotes a nutritious diet and exercise for their children.

There are alternative interpretations of this finding. First, it may be difficult to find caregivers who have skills equal to those of these mothers. Absent direct information on childcare provider skills, however, it is impossible to determine if this is the case. Alternatively, it may be the case that lower socioeconomic status women are more time constrained whether or not they work. For these women, shadow prices of nutritious meals and exercise may be high. Changes in work patterns may not sufficiently shift the time constraint for us to observe changes on these margins. For example, if there are few grocery stores and safe places to play near one's house and one faces transportation difficulties, then one may not have time to provide nutritious meals and active play time regardless of whether one works.

To put the magnitude of our findings in context, we consider the extent to which the effect of mothers' work can explain the increased prevalence of overweight among children over the past few decades. First, recall that childhood overweight has increased across all income, race, and education groups. Since maternal work is only related to childhood overweight among relatively advantaged families, and because even when we control for a large number of variables we can only explain around 6 percent of the variation in childhood overweight, there are clearly other factors besides working mothers contributing to this epidemic. Here we examine how much of the increase in childhood overweight can be explained by increases in mothers' average hours per week, for a subgroup where maternal work has an impact. This analysis is necessarily inexact because we must use several different data sets that cover slightly different time periods and use somewhat different data definitions. Since the exercise is simply for illustrative purposes, we conduct the analysis for just one subgroup: the top quartile of the income distribution.

For this exercise, we used data from the March 1976 and March 1995 CPS to estimate the increase in hours worked per week over the past calendar year for women, 16 years or older, who had children under 18 living at home, in family's with incomes in the top quartile of the income distribution. We also use data from the 1971-1975 and the 1988-1994 NHANES to estimate the change in the percentage of these children who are overweight.[18] Average hours worked per week increased from 20.1 in 1975 to 27.2 in 1994 for this group. The results from our analyses above predict that this change (7.1) in average hours per week will lead to an increase in the probability of a child being overweight of between 0.9 to 2.7 percentage points.[19] In 1976, the probability that a child in a top-income-quartile household was overweight was 2.1 percent. By 1994, this had risen to 9.9 percent. Thus, the probability that a child from one of these families was overweight increased by 7.8 percentage points. Based on these calculations, the increase in average hours worked by mothers

[18] We describe the CPS, NHANES I and NHANES III data sources in the Data Appendix. See Appendix Table 3 for sample means of these data.

in high-income families can account for between 11.8 to 34.6 percent of the trend in the prevalence of childhood overweight for children in these families.

VII. SUMMARY AND CONCLUSIONS

The contribution of this work is several fold. First, much of the research on childhood overweight reports simple correlations between overweight and various characteristics of the child or the family. This research is among the first to grapple with issues of causality. It presents robust evidence of a positive and significant impact of maternal work on the probability that a child is overweight. It is not simply that mothers who work are those who would have overweight children regardless of their employment behavior. In addition, contrary to some other childhood outcomes, the effect of maternal work on childhood overweight is not sensitive to whether the mother works during a child's early years of development. Further, this work presents prima facie evidence that the mechanism through which maternal employment affects childhood overweight is constraints on mother's time; it is hours per week, not the number of weeks worked, that affects children's probability of overweight. This result makes sense if it is the day-to-day routines that matter for a mother's ability to supervise her child's nutritional intake and energy expenditure. Working fewer hours per week allows more time for shopping, cooking, and energy expending play dates or organized sports. Finally, we show that it is important to examine explanations for childhood overweight separately for subgroups. Working more hours per week only has a deleterious effect on children in higher socioeconomic status households.

While clearly there is much more to learn about causal factors related to the epidemic of overweight among children in the United States, this project lays the groundwork for future research

[19] The estimated coefficient ranges between 0.013 and 0.038. Since average hours per week are in units of 10, we first multiply the coefficient by 10. Then we multiply this by the change in average hours per week.

into the causes of childhood overweight. Further work is needed in understanding the mechanisms through which mothers' working translates into overweight children. For example, how does child care quality affect children's nutrition and energy expenditure? A deeper understanding of other direct contributors to childhood overweight is also imperative. For example, we need to know more about children's opportunities for vigorous exercise, including physical education in school, after-school programs, and access to parks or other recreational facilities. This work demonstrates that it is critical to examine these contributors separately for different population subgroups. A deeper understanding is important if society is going to develop appropriate policy responses to this important public health issue.

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Table 1: Rates of Overweight for Children Age 3 to 11 in the NLSY, by Maternal Employment and Socioeconomic Status

	All	Mother Never Worked	Mother Worked < 35 Hours/Week Since Birth	Mother Worked 35 Hours/Week Since Birth
All	10.6	9.4	10.1	12.9
By Income Quartile Since Birth				
1st Quartile	12.4	13.3	11.4	13.0
2nd Quartile	11.1	8.5	11.0	11.5
3rd Quartile	11.7	12.1	11.0	12.2
4th Quartile	8.5	3.2	7.3	10.6
By Maternal Education				
Less than High School Degree	12.8	13.0	14.3	11.3
High School Degree	10.7	8.1	10.2	11.7
Some College or More	9.5	7.9	7.6	11.6
By Race/Ethnicity				
Hispanic	13.3	17.0	13.2	12.5
Black, non-Hispanic	15.0	11.7	14.2	16.0
White, non-Hispanic	9.5	7.6	9.0	10.3

Notes: Hours per week relate to weeks in which some work occurred. Sampling weights are used to provide nationally representative estimates.

Table 2: Probit Estimates of the Impact of Maternal Employment Since Child was Born on Childhood Overweight
(Estimates Represent Derivatives, Robust Standard Errors in Parentheses)

	(1)	(2)	(3)	(4)
Average Hours per Week if Working Since Child's Birth (in units of 10)	0.012 (0.002)	0.008 (0.003)	0.007 (0.002)	0.007 (0.003)
Number of Weeks Worked Since Child's Birth (in units of 52)	-0.003 (0.001)	-0.001 (0.002)	-0.001 (0.002)	-0.001 (0.002)
Black, non-Hispanic		0.051 (0.012)	0.035 (0.005)	0.024 (0.011)
Hispanic		0.016 (0.013)	0.009 (0.007)	0.011 (0.013)
Mother's Highest Grade Completed		-0.006 (0.002)	-0.005 (0.002)	-0.004 (0.002)
Child Was First Born		-0.010 (0.009)	-0.007 (0.004)	-0.008 (0.008)
Number of Children		-0.010 (0.004)	-0.009 (0.004)	-0.010 (0.004)
Child Was Breast Fed			-0.020 (0.008)	-0.018 (0.008)
Mother's BMI 25 (Overweight or Obese)			0.034 (0.008)	0.031 (0.009)
Mother's BMI 30 (Obese)			0.047 (0.011)	0.039 (0.012)
Average Family Income Since Birth (in units of $10,000)				-0.002 (0.002)
Percent of Child's Life Mother was Married				-0.013 (0.011)
Psuedo R-Squared	0.020	0.046	0.059	0.060
Number of Observations	16,650	16,650	16,650	16,650
% of Children Overweight in Sample	10.6	10.6	10.6	10.6
Age of Children in Sample	3 to 11	3 to 11	3 to 11	3 to 11

Notes: The dependent variable is a binary variable equal to 1 if child's BMI is above the 95^{th} percentile for his/her age and sex. The standard errors are robust, clustered on the mother's identification code, as there are multiple children per mother over time. All columns include dummies for mother reported height and weight. Columns 2-4 also include child's birth weight, mother's afqt score, both the child's and mother's age in years, dummy variables for the year of the survey, controls for education levels of the mother's parents, dummy variables indicating whether mother's parents were present when she was 14, and a dummy variable indicating whether the child is female. All estimates are weighted using the child's sampling weight.

Table 3: Probit Estimates of the Impact of Maternal Employment at Different Points in Child's Life on Childhood Overweight
(Estimates Represent Derivatives, Robust Standard Errors in Parentheses)

	(1)	(2)	(3)	(4)	(5)
Average Hours per Week if Working	0.007	0.005	0.008		0.007
Since Child's Birth (in units of 10)	(0.003)	(0.003)	(0.004)		(0.003)
Number of Weeks Worked	-0.001	0.003	-0.001		-0.001
Since Child's Birth (in units of 52)	(0.002)	(0.003)	(0.002)		(0.003)
Average Hours per Week if Working in				0.003	0.0003
Child's First 3 Years of Life (in units of 10)				(0.003)	(0.003)
Number of Weeks Worked in				0.001	0.002
Child's First 3 Years of Life (in units of 52)				(0.004)	(0.005)
Psuedo R-Squared	0.059	0.069	0.073	0.059	0.060
Number of Observations	16,650	6,565	10,085	16,650	16,650
% Overweight in Sample	10.6	10.9	10.4	10.6	10.6
Age of Children in Sample	3 to 11	3 to 5	6 to 11	3 to 11	3 to 11

Notes: All specifications include the same covariates as Column 4 of Table 2. See notes to that table.

Table 4: Alternative Methods to Control for Unobservable Heterogeneity in the Impact of Maternal Employment on Childhood Overweight (Robust Standard Errors in Parentheses)

	Individual Long Difference (1)	Sibling Differences at Same Time (2)	Sibling Differences at Same Age (3)	Instrumental Variables (4)
Average Hours per Week Since Child's Birth (in units of 10)	0.015 (0.007)	0.009 (0.008)	0.008 (0.006)	0.009 (0.024)
Number of Weeks Worked Since Child's Birth (in units of 52)	-0.005 (0.004)	-0.006 (0.005)	0.003 (0.006)	0.004 (0.016)
Mother's Highest Grade Completed	-0.028 (0.011)	—	0.026 (0.013)	-0.005 (0.003)
Child Was First Born	—	0.002 (0.013)	0.014 (0.018)	-0.007 (0.009)
Number of Children	-0.015 (0.012)	—	0.019 (0.013)	-0.007 (0.008)
Child Was Breast Fed	—	0.012 (0.017)	-0.029 (0.022)	-0.016 (0.010)
Mother's BMI 25 (Overweight or Obese)	0.006 (0.020)	—	-0.016 (0.020)	0.031 (0.010)
Mother's BMI 30 (Obese)	0.046 (0.023)	—	0.023 (0.024)	0.049 (0.014)
Average Family Income Since Birth (in units of $10,000)	-0.001 (0.001)	0.007 (0.008)	-0.018 (0.005)	-0.003 (0.003)
Percent of Child's Life Mother was Married	0.018 (0.048)	-0.025 (0.056)	0.016 (0.038)	-0.014 (0.015)
Birth Weight (in pounds)	—	-0.0004 (0.004)	0.002 (0.006)	0.009 (0.003)
R-Squared	0.016	0.011	0.019	0.041
Number of Observations	4,159	7,919	4,775	15,050
Age of Children in Sample	3 to 11	3 to 11	3 to 11	3 to 11

Notes:

Column 1: The dependent variable represents the difference between the last and first observation for each child in a binary variable equal to 1 if child's BMI is above the 95th percentile for his/her age and sex. Other control variables include differences in: whether the mother reported the child's height and weight, mother's level of education, age, whether the mother was overweight or obese, the number of children in the family, income since birth, and mother's marital status since birth. Estimates are computed using OLS and are weighted using the child's sampling weight. The standard errors are robust, clustered on mother's identification code as there are multiple observations in each household over time.

Column 2: The dependent variable represents the difference between siblings at the same point in time in a binary variable equal to 1 if child's BMI is above the 95th percentile for his/her age and sex. Other control variables include differences in: the child's sex and age, whether the mother reported the child's height and weight, whether the child was breastfed, whether the child was firstborn, birth weight, income since birth, mother's marital status since birth, and year fixed effects. Estimates are computed using OLS and are weighted using the child's sampling weight. The standard errors are robust, clustered on a sibling pair identification code, as there are multiple observations for each sibling pair.

Column 3: The dependent variable represents the difference between siblings at the same age in a binary variable equal to 1 if child's BMI is above the 95th percentile for his/her age and sex. Other control variables include differences in: the child's sex, the years between the two surveys, the number of children in the family, mother's level of education, whether or not the mother was overweight or obese, whether the child was breastfed, whether the child was first born, income since birth, mother's marital status since birth, and whether the mother reported the child's height and weight. Estimates are computed using OLS and are weighted using the child's sampling weight. The standard errors are robust, clustered on a sibling pair identification code, as there are multiple observations for each sibling pair.

Column 4: The dependent variable is a binary variable equal to 1 if child's BMI is above the 95th percentile for his/her age and sex. The same additional explanatory variables are included as in Column 4 of Table 1. The standard errors are robust, clustered on mother's identification code, as there are multiple observations in each household over time. Estimates are weighted using the child's sampling weight.

Table 5: Probit Estimates of the Impact of Maternal Employment Since Child was Born on Childhood Overweight by Average Family Income Since Birth Quartiles (Estimates Represent Derivatives, Robust Standard Errors in Parentheses)

	1st Quartile (1)	2nd Quartile (2)	3rd Quartile (3)	4th Quartile (4)
Percent Overweight in Sample	12.4	11.1	11.7	8.5
PROBIT				
Average Hours per Week if Working Since Child's Birth (in units of 10)	0.001 (0.004)	0.003 (0.005)	0.004 (0.006)	0.013 (0.005)
Number of Weeks Worked Since Child's Birth (in units of 52)	-0.001 (0.005)	0.001 (0.004)	-0.005 (0.004)	0.001 (0.003)
Number of Observations	4,161	4,165	4,161	4,163
INDIVIDUAL LONG DIFFERENCES				
Average Hours per Week if Working Since Child's Birth (in units of 10)	0.001 (0.010)	-0.001 (0.011)	0.025 (0.014)	0.035 (0.017)
Number of Weeks Worked Since Child's Birth (in units of 52)	0.001 (0.011)	-0.017 (0.009)	-0.008 (0.009)	-0.0004 (0.007)
Number of Observations	1,040	1,040	1,040	1,039
SIBLING DIFFERENCES -SAME TIME				
Average Hours per Week if Working Since Child's Birth (in units of 10)	-0.011 (0.011)	-0.013 (0.013)	-0.004 (0.011)	0.038 (0.013)
Number of Weeks Worked Since Child's Birth (in units of 52)	0.021 (0.020)	0.005 (0.013)	-0.020 (0.011)	0.003 (0.008)
Number of Observations	1,980	1,980	1,980	1,979
SIBLING DIFFERENCES - SAME AGE				
Average Hours per Week if Working Since Child's Birth (in units of 10)	0.012 (0.010)	0.001 (0.013)	0.002 (0.013)	0.014 (0.011)
Number of Weeks Worked Since Child's Birth (in units of 52)	0.012 (0.018)	0.009 (0.010)	0.010 (0.013)	-0.003 (0.010)
Number of Observations	1,118	1,118	1,118	1,117

Notes: Probit estimates are obtained from models comparable to Table 2, Column 4. Long difference and sibling difference estimates are obtained from models comparable to Table 4, Columns 1 through 3. See the notes to those tables. In all specifications, children are between the ages of 3 and 11.

Table 6: Probit Estimates of the Impact of Maternal Employment Since Child was Born on Childhood Overweight by Mother's Education
(Estimates Represent Derivatives, Robust Standard Errors in Parentheses)

	High School Dropout (1)	High School Graduate (2)	Some College/ College Grad (3)
Percent Overweight in Sample	12.8	10.7	9.5
	PROBIT		
Average Hours per Week if Working Since Child's Birth (in units of 10)	-0.007 (0.005)	0.009 (0.004)	0.011 (0.005)
Number of Weeks Worked Since Child's Birth (in units of 52)	-0.004 (0.004)	0.001 (0.003)	-0.003 (0.003)
Number of Observations	3,106	8,169	5,375
	INDIVIDUAL LONG DIFFERENCES		
Average Hours per Week if Working Since Child's Birth (in units of 10)	-0.010 (0.013)	0.016 (0.010)	0.029 (0.011)
Number of Weeks Worked Since Child's Birth (in units of 52)	0.005 (0.012)	-0.003 (0.006)	-0.009 (0.006)
Number of Observations	731	1,996	1,432
	SIBLING DIFFERENCES - SAME TIME		
Average Hours per Week if Working Since Child's Birth (in units of 10)	-0.016 (0.010)	-0.011 (0.009)	0.044 (0.012)
Number of Weeks Worked Since Child's Birth (in units of 52)	-0.001 (0.024)	-0.011 (0.007)	0.007 (0.009)
Number of Observations	1,888	3,675	2,356
	SIBLING DIFFERENCES - SAME AGE		
Average Hours per Week if Working Since Child's Birth (in units of 10)	0.017 (0.011)	0.006 (0.008)	0.012 (0.015)
Number of Weeks Worked Since Child's Birth (in units of 52)	-0.037 (0.016)	0.010 (0.009)	0.005 (0.008)
Number of Observations	1,130	2,108	1,233

Notes: Probit estimates are obtained from models comparable to Table 2, Column 4. Long difference and sibling difference estimates are obtained from models comparable to Table 4, Columns 1 through 3. See the notes to those tables. In all specifications, children are between the ages of 3 and 11.

Table 7: Probit Estimates of the Impact of Maternal Employment Since Child was Born on Childhood Overweight by Racial/Ethnic Group
(Estimates Represent Derivatives, Robust Standard Errors in Parentheses)

	Hispanic (1)	Black (non-Hispanic) (2)	White (non-Hispanic) (3)
Percent Overweight in Sample	13.3	15.0	9.5
Average Hours per Week if Working Since Child's Birth (in units of 10)	-0.011 (0.006)	0.005 (0.005)	0.008 (0.003)
Number of Weeks Worked Since Child's Birth (in units of 52)	0.001 (0.004)	-0.005 (0.003)	0.0002 (0.002)
Number of Observations	2,946	4,959	8,745
Average Hours per Week if Working Since Child's Birth (in units of 10)	0.023 (0.017)	0.001 (0.010)	0.019 (0.008)
Number of Weeks Worked Since Child's Birth (in units of 52)	-0.0004 (0.010)	0.002 (0.007)	-0.007 (0.005)
Number of Observations	741	1,265	2,153
Average Hours per Week if Working Since Child's Birth (in units of 10)	-0.019 (0.013)	0.001 (0.013)	0.013 (0.010)
Number of Weeks Worked Since Child's Birth (in units of 52)	0.005 (0.011)	0.007 (0.011)	-0.009 (0.007)
Number of Observations	1,696	2,417	3,806
Average Hours per Week if Working Since Child's Birth (in units of 10)	-0.022 (0.016)	0.014 (0.011)	0.010 (0.008)
Number of Weeks Worked Since Child's Birth (in units of 52)	0.020 (0.016)	-0.007 (0.012)	0.004 (0.008)
Number of Observations	991	1,361	2,119

Notes: Probit estimates are obtained from models comparable to Table 2, Column 4. Long difference and sibling difference estimates are obtained from models comparable to Table 4, Columns 1 through 3. See the notes to those tables. In all specifications, children are between the ages of 3 and 11.

DATA APPENDIX

Our primary data source is the National Longitudinal Survey of Youth 1979 (NLSY); its main characteristics are described in the text. This Appendix provides additional detail on these data as well as some supplemental data used in our analysis. We briefly describe the data used from the NHANES I and III data along with the CPS.

Our key measure of whether a child is overweight is based on the child's body mass index (BMI). BMI is defined as weight in kilograms divided by height in meters squared (kg/m^2) and is a commonly used measure to define obesity and overweight in adults. According to guidelines in National Institutes of Health (1998), adults are considered underweight if their BMI is less than 18.5, overweight if their BMI is 25 or more, and obese if their BMI is 30 or more. Use of the BMI to assess children has been more controversial, although its use is fairly widespread.[20] The Centers for Disease Control (CDC) has recently endorsed the use of BMI to assess overweight in children, and has produced sex-specific BMI charts for children aged 2 to 20 for just this purpose.[21] We use these charts to define overweight cutoffs for children in our samples. For children, however, the nomenclature is somewhat different than for adults. Children with a BMI above the 85th percentile of the BMI distribution for their sex-age group are defined as "at-risk of overweight;" those with a BMI above the 95th percentile for this distribution are termed "overweight." It is important to note that these percentile cutoffs are based mainly on data from

[20] Ideally, one would prefer to measure overweight using a measure that reflects adiposity. Since it is impractical to do so in large scale surveys, researchers have employed the BMI, which only requires the measurement of height and weight. It is somewhat controversial when used to assess overweight among children because children experience growth spurts at individual-dependent ages and this can weaken the relationship between height and weight-based measures to adiposity. See Freeman, et al. (1995) and Whitaker, et al. (1997) for a discussion of the use of BMI in children. Recently, Dietz and Bellizi (1999) reporting on a conference convened by the International Obesity Task Force, noted that the BMI "offered a reasonable measure with which to assess fatness in children and adolescents." Additionally, they conclude that a BMI above the 85th percentile for a child's age and sex group is likely to accord with the adult definition of overweight, and above the 95th percentile with the adult definition of obese.

[21] See http://www.cdc.gov/growthcharts/ for general information, and see http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/bmiage.txt for specific BMI percentiles.

years before our survey began, so that trends in overweight can be detected.[22] Not every child in our sample is actually weighed and measured. Rather, about 15 percent have mother reported weight and 22 percent have mother reported height. All of our models included indicators for these mother reports, since they are more likely to result in errors in BMI, and hence in the classification of overweight status.

Our key explanatory variables are measures of the child's exposure to maternal employment at different periods of life. To create these variables, we use employment history data available in each year of the survey.[23] The starting and ending dates of up to 5 jobs that the mother has held since the last interview are recorded in each survey. For each of these jobs, the usual hours worked per week or per day are recorded. For each job worked, the starting and ending dates of up to 4 periods of unpaid leave are also recorded. Additionally, each survey year contains created variables equal to the total number of hours and weeks worked since the last interview.[24]

We begin with the child's birth date, and then look week-by-week at whether that date is between the start and end dates of reported job. If so, then the week is coded as being at work, and the usual hours per week are added to the total number of weeks worked.[25] If however, this week is between the start and ending date of a leave period, the week and hours are subtracted back off. This accumulation of weeks and hours is continued until the first interview date after the child's birth. For each successive survey, the NLSY-created number of weeks and hours since the last interview are added on to our cumulative measure to create weeks and hours worked since birth as of that survey. The variable labeled "Average Hours per Week if Working Since Child's Birth" is then created by dividing hours worked by

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[22]These percentile cutoffs refer to the BMI distribution from an earlier period in order to provide a fixed standard for assessing overweight. Thus while the new CDC growth charts covering a large number of developmental markers are based on data from 1963-1994, the 1988-1994 data from NHANES III is generally excluded from the BMI chart. Prior to the release of these charts, percentiles based entirely on NHANES I from 1971-1974 had been available for older children. The newly released cutoffs are similar.

[23] Only children born after the start of the survey are included in the sample.

[24] These created variables occasionally cover slightly less than 100% of the elapsed time period. However, since our key variable is hours divided by weeks, even for these individuals our measure should be highly correlated with the true lifetime average.

weeks worked, trimmed at 80 to avoid outliers.[26] If weeks worked is equal to zero, the hours per week variable is set to zero. We also continue with the week-by-week formation of hours and weeks worked for each year up to age 6. This allows us to create similar average hours per week measures for weeks worked in the first year of life, second year, first three years, first six years, etc. in order to investigate timing issues.

The NLSY data must be modified to create the long differences and sibling differences used in estimation and described in the text. To create long differences, we start with our analysis sample and subtract the first observation for a child from the last observation, to obtain one difference per child. The median (and modal) observation looks back 3 surveys (and thus 6 years) to create the long difference. Sibling differences are similar except rather than creating differences over time, the differences are within family. For these models, each child-year observation is joined pair wise with child-year observations for all available siblings in either the same year, or at the same age. Differences are then created across these pairs. Note that both siblings must be within our age range.

To estimate instrumental variable models, we need to supplement the NLSY data with outside data that we use as instruments. The instruments we use to predict maternal employment are state child care regulations, wages of child care workers, welfare benefit levels, the status of welfare reform in the state, and the annual unemployment rate in the state. The state child care regulations were generously provided by Joe Hotz and Rebecca Kilburn, who used these data in Hotz and Kilburn (1996). These regulation data include indicators for requirements for liability insurance, for training beyond high school for directors, and for more than one inspection per year. We also average the maximum caregiver/child ratio at each of 6 ages (0-11 months, 12-23, 24-35, 36-47, 48-59 and 60+) to create one variable. Each type of regulation is reported separately for center-based care and for family-based care.

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[25] If instead usual hours per day are reported, that number is multiplied by 5 to obtain weekly hours worked.

[26] Just 28 observations (less than 0.2 percent of the analysis sample) are recoded in this step.

In addition to these regulation variables, the hourly wage of workers in the child care sector is calculated for each state from the CPS's monthly outgoing rotation group datafile available from the National Bureau of Economic Research. Two variables relating to the state welfare system are also employed as instruments. These variables include the maximum AFDC benefit level in the state for a family of three in a given year and an indicator variable for whether a state in a given year had a waiver to implement pre-TANF reforms. They are obtained from the data file used in Council of Economic Advisers (1997) and are described there. A final instrument is the state unemployment rate for each year, obtained from the Bureau of Labor Statistics. The source data for the instruments is available annually starting in 1983 for the regulation variables and in 1979 for all other variables. Our instruments are created as a weighted average value over the child's lifetime (or since 1983 for the regulations). The results of the first stage regressions using these instruments are shown in Appendix Table 2.

Information from the NHANES I and NHANES III along with data from the CPS are used at the end of the paper to simulate the extent to which increased maternal employment can explain the increase in the rate of childhood overweight. Estimates from these sources used as inputs to that simulation are reported in Appendix Table 3.

The NHANES I and NHANES III were conducted in 1971-1975 and 1988-1994, respectively. Each is a national survey that over-represents certain population subgroups, but provides sampling weights to generate national representative estimates. Weight and height are physically measured for each survey respondent. In these data, we calculate income quartiles using the categorical measures of income in the past calendar year. A comparison of rates of overweight by race over time is complicated by changes in racial/ethnic categories over time. In particular, the earlier survey did not separate Hispanics from whites and blacks and the later survey separates out "Mexican-Americans" rather than all Hispanics. An examination of maternal education is hindered by difficulties in linking children with mothers in these data. Instead, we use the educational attainment of the head of the household.

We also used data from the March 1976 and March 1995 CPS. These data provide information on the work behavior of respondents in the previous calendar years. We chose the 1976 and 1995 surveys because they provide employment data for the 1975 and 1994 calendar years, which correspond to the final years of the two NHANES surveys. To measure maternal employment we used the employment patterns of all women age 16 and over who have a child under the age of 18 living in their home. Income quartiles are defined based on a continuous income measure of the past calendar year. For educational attainment in 1976, we defined high school dropouts to be those with less than 12 years of schooling, high school graduates to be those with 12 years of schooling, and some college as those with more than 12 years of schooling. In 1995 these categories are obtained directly. Race and ethnicity is defined consistently across the two surveys.

Appendix Table 1: Means of Variables Included in Regression Analyses
(Standard Deviations in Parentheses)

	Ages 3-11	Ages 3-5	Ages 6-11
Overweight	0.106	0.109	0.104
	(0.308)	(0.311)	(0.305)
Average Hours per Week if Working	2.968	2.799	3.075
Since Child’s Birth (in units of 10)	(1.491)	(1.640)	(1.377)
Number of Weeks Worked	3.774	2.373	4.671
Since Child’s Birth (in units of 52)	(2.894)	(1.792)	(3.102)
African American	0.154	0.141	0.162
	(0.361)	(0.348)	(0.368)
Hispanic	0.066	0.062	0.069
	(0.249)	(0.242)	(0.254)
Mother’s Highest Grade Completed	12.666	12.878	12.531
	(2.058)	(2.116)	(2.008)
Mother’s AFQT Score	43.602	45.776	42.210
	(27.198)	(27.477)	(26.928)
Child Was First Born	0.480	0.444	0.503
	(0.500)	(0.497)	(0.500)
Number of Children	2.493	2.336	2.593
	(1.066)	(1.023)	(1.082)
Child Was Breast Fed	0.521	0.547	0.504
	(0.500)	(0.498)	(0.500)
Mother’s BMI 25	0.411	0.386	0.427
(Overweight or Obese)	(0.492)	(0.487)	(0.495)
Mother’s BMI 30	0.166	0.147	0.178
(Obese)	(0.372)	(0.354)	(0.382)
Average Family Income	40.224	42.827	38.557
Since Birth (in units of $10,000)	(26.550)	(29.080)	(24.652)
Percent of Child’s Life	0.721	0.754	0.699
Mother was Married	(0.367)	(0.367)	(0.365)
Mother Reported Child’s Weight	0.219	0.228	0.213
	(0.413)	(0.420)	(0.409)
Mother Reported Child’s Height	0.149	0.148	0.150
	(0.356)	(0.356)	(0.357)
Child’s Birth Weight in Pounds	7.410	7.443	7.388
	(1.307)	(1.330)	(1.292)
Hours per Week Trimmed at 80	0.001	0.002	0.001
	(0.039)	(0.049)	(0.030)
Child’s Age in Years	6.676	4.031	8.205
	(2.478)	(0.812)	(1.686)
Child is Female	0.483	0.483	0.483
	(0.500)	(0.500)	(0.500)
Mother’s Age in Years	31.537	30.416	32.254
	(3.612)	(3.700)	(3.364)
Mother’s Mother’s Highest Grade	10.363	10.616	10.202
	(3.851)	(3.792)	(3.879)
Mother’s Father’s Highest Grade	8.298	8.676	8.055
	(5.833)	(5.869)	(5.191)
Mother’s Mother Present	0.932	0.938	0.927
When She was 14	(0.253)	(0.241)	(0.260)
Mother’s Father Present when	0.735	0.750	0.725
She was 14	(0.441)	(0.433)	(0.446)
Year 1	0.083	0.161	0.033
	(0.276)	(0.367)	(0.179)
Year 2	0.139	0.180	0.113
	(0.346)	(0.383)	(0.316)
Year 3	0.183	0.175	0.188
	(0.387)	(0.380)	(0.391)
Year 4	0.200	0.176	0.215
	(0.400)	(0.381)	(0.411)
Year 5	0.206	0.182	0.222
	(0.405)	(0.385)	(0.416)
Number of Observations	16650	6565	10085

Notes: All estimates are weighted using the child’s sampling weight.

Appendix Table 2: First Stage Regressions for the IV Estimates Reported in Table 4
(Robust Standard Errors in Parentheses)

	Mother's Work: Average Hours per Week Since Child's Birth	Mother's Work: Average Weeks per Year Since Child's Birth
Maximum AFDC/TANF Benefit for a Family of 3	-0.00006 (0.0003)	0.0004 (0.0005)
Pre-TANF Welfare Reform Implemented (Waiver State)	-0.336 (0.275)	-1.392 (0.407)
Years of Education Required for Director of Day Care Center	-0.003 (0.010)	0.021 (0.017)
Years of Education Required for Family Day Care Provider	0.033 (0.020)	-0.032 (0.034)
Average caregiver/child Ratio, Center based	0.050 (0.016)	0.120 (0.029)
Average caregiver/child Ratio, Family based	0.022 (0.026)	0.083 (0.049)
Is Center Required to Carry Liability Insurance	-0.105 (0.099)	-0.247 (0.174)
Is Family Care Required to Carry Liability Insurance	0.180 (0.201)	0.196 (0.325)
Number of Annual Inspections Conducted by Licensing Agency, Center Based	-0.040 (0.115)	-0.632 (0.184)
Number of Annual Inspections Conducted by Licensing Agency, Family based	-0.024 (0.034)	0.283 (0.149)
More than One Inspection per Year, Center based	0.332 (0.269)	1.328 (0.433)
More than One Inspection per year, Family based	0.284 (0.176)	-0.353 (0.291)
Training Beyond H.S. Required for Director, Center based	-0.058 (0.108)	0.028 (0.181)
Training Beyond H.S. Required for Director, Family based	8.702 (2.207)	-6.109 (6.168)
Hourly Wage of Workers in Child Care Sector	-0.005 (0.063)	-0.162 (0.106)
Unemployment Rate	-0.077 (0.023)	-0.105 (0.039)
Mother Reported Child's Weight	-0.085 (0.054)	-0.075 (0.094)
Mother Reported Child's Height	-0.013 (0.065)	-0.067 (0.112)
Child's Birth Weight in Pounds	0.013 (0.022)	0.070 (0.035)
Black	0.176 (0.088)	0.501 (0.141)
Hispanic	0.172 (0.115)	0.371 (0.174)
Child's Age in Years	0.084 (0.012)	0.571 (0.022)
Child is Female	0.014 (0.046)	0.210 (0.078)
Mother's Highest Grade Completed	0.014 (0.023)	0.078 (0.035)
Mother's AFQT Score	0.002 (0.002)	0.014 (0.003)
Mother's Age in Years	-0.046 (0.016)	0.030 (0.026)
Mother's BMI 25 (Overweight or Obese)	0.116 (0.059)	0.056 (0.101)
Mother's BMI 30 (Obese)	-0.073 (0.081)	-0.267 (0.134)
Mother's Mother's Highest Grade	-0.003 (0.016)	0.037 (0.025)
Mother's Father's Highest Grade	-0.033 (0.014)	-0.039 (0.022)
Mother's Mother Present When She was 14	0.040 (0.203)	-0.438 (0.324)
Mother's Father Present when She was 14	0.327 (0.158)	0.692 (0.251)
Child Was Breast Fed	-0.130 (0.062)	-0.283 (0.108)
Child Was First Born	-0.094 (0.047)	-0.251 (0.076)

Number of Children	-0.297 (0.038)	-0.623 (0.056)
Average Family Income Since Birth (in units of $10,000)	0.003 (0.002)	0.015 (0.003)
Percent of Child's Life Mother was Married	-0.200 (0.096)	0.090 (0.160)
Year 1	-0.424 (0.225)	-0.884 (0.355)
Year 2	-0.343 (0.177)	-0.837 (0.288)
Year 3	-0.310 (0.135)	-0.778 (0.224)
Year 4	-0.244 (0.096)	-0.501 (0.161)
Year 5	-0.110 (0.058)	-0.301 (0.102)
R-squared	0.104	0.378
Number of Observations	15050	15050

Appendix Table 3: Rates of Overweight in NHANES I and NHANES III
and Hours Worked per Week by Mothers in the March 1976 and March 1995 CPS by Socioeconomic Status

	Rates of Overweight		Average Hours Worked Per Week	
	NHANES I (1971-1975)	NHANES III (1988-1994)	March 1976 CPS	March 1995 CPS
All	4.5	10.3	17.9	23.9
By Income Quartile				
1st Quartile	5.7	14.9	15.3	17.2
2nd Quartile	4.2	9.6	17.4	24.6
3rd Quartile	5.6	8.8	18.6	26.5
4th Quartile	2.1	9.9	20.1	27.2
By Maternal Education				
Less than High School Degree	4.9	12.0	13.8	13.4
High School Degree	5.2	12.0	19.7	26.9
Some College or More	3.0	8.1	20.6	27.8
By Race/Ethnicity				
Hispanic	---	---	16.2	19.8
Black	4.4	12.9	19.6	24.0
White	4.5	10.1	17.7	24.7

Notes: Income quartiles are created based on categorical measures of family income in the preceding calendar year. In NHANES I, blacks and whites include Hispanics, who could be of either race, but in NHANES III these categories represent non-Hispanics.

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