Body Mass Index and Women's Work Hours in the United States: Much Ado about (practically) Nothing

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ABSTRACT. Most research in the area of economics and obesity attempts to identify the cause(s) of the increase in the average body mass index (BMI) in developed countries. Common themes include lower relative food prices, technological advances that have led to more sedentary work and leisure activities and a larger number of ready-to-eat food products for sale, a cultural shift toward greater discounting of the future, and an increase in the consumption of restaurant and other prepared foods due to the rise in women's labor force participation. This paper includes a survey of the literature regarding women's work behavior and their children's BMIs, and it also contains an analysis of data regarding the children of the female respondents to the National Longitudinal Survey of Youth (NLSY79) from 1996 to 2006 to confirm earlier findings. Missing from the literature are analyses of women's work hours and their own BMIs, and women's work hours and their husbands' BMIs, so this paper also includes analysis of data provided by the respondents of the NLSY79 from 1996 to 2006 to explore these relationships. The results show there is little evidence women's increased participation in the labor force is a significant contributor to higher BMIs in the United States. (I18; J12; J13; J16)

I. Introduction

The increases in obesity rates and average body mass indices (BMIs[1]) occurring over the last four decades around the world have become research fodder for economists. A quick look at the EconLit database shows over 250 scholarly articles regarding "obesity" indexed with the great majority having been written in the last ten years. The perspectives and conclusions are numerous. Some researchers assert policy intervention is necessary (Martin 2005, Brownell 2005, Oswald and Powdthavee 2007) and others insist it is not (Philipson and Posner 2003,

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Bednarek, Jeitschko and Pecchenino 2006); some authors consider the effects of obesity on economic variables such as income (Cawley 2000) and some consider the effects of economic variables such as restaurant prices on obesity (Rashad, Grossman and Chou 2006); there are those who conclude there is no such thing as "overweight" as BMI is an outcome of a person's maximization of a utility function that includes the benefits of eating and the costs of being overweight (Philipson and Posner 2003) and there are those who believe this "self-control problem" poses a significant challenge to the welfare economist (T. G. Smith 2002).

Most research in the area of obesity (including much of the work above) attempts to identify the cause(s) of the increase in the average BMI. Common themes include lower relative food prices (Philipson and Posner 2003, Cutler, Glaeser and Shapiro 2003, Oswald and Powdthavee 2007), technological advances that have led to more sedentary work and leisure activities and a larger number of ready-to-eat food products for sale (Lakdawalla and Philipson 2002, Philipson and Posner 2003), a cultural shift toward greater discounting of the future (Smith, Bogin and Bishai 2005, Oswald and Powdthavee 2007), and an increase in the consumption of restaurant and other prepared foods due to the rise in women's labor force participation (Rashad, Grossman and Chou 2006, Bleich, et al. 2007). There is little doubt that some of these reasons are correct. Economists would agree that lower prices and greater variety would at least tempt people to consume more, and researchers in the biological sciences have made it clear that less activity means fewer calories burned. These changes are well evidenced (see Cutler, Glaeser and Shapiro 2003 and Rashad 2006 as examples), and of course either, and certainly both, would lead logically to increases in average weight; however, it is much more difficult to show that people discount the future more now than in the past or that people are eating more prepared foods *because* a greater percentage of women are in the workforce.

This author is interested in the suggestion that women's increased labor force participation is a reason for the increase in obesity. Scholarship proposing such a link shows a statistically significant positive relationship between the female labor force participation rate and the number of restaurants (Rashad, Grossman and Chou 2006) and obesity rates (Bleich, et al. 2007). The theory is the following: women in the paid workforce do not prepare food at home for their families as much as women who do not work for pay; instead these families eat more restaurant and other prepared foods, which tend to be higher in calories.

Economists are warned, however, not to confuse correlation with causation. An increase in prepared foods and restaurants may be the result of a particular stage of economic development that is also associated with higher female labor force participation rates. In this author's opinion, to provide evidence that obesity is positively related to women's labor force participation, one must show women who work (or work more hours) have larger BMIs than women who do not work (or work fewer hours) and/or the families of women who work (or work more hours) have larger BMIs than women who do not work (or work fewer hours). It would also be important to show the effects of women working (or women's work hours) on their own or their family's BMIs are substantial, not merely statistically significant.

Several scholars have found a link between maternal employment and childhood obesity, and some have also explored the mechanisms by which maternal employment might increase a child's BMI or risk of becoming obese. Anderson, Butcher and Levine (2003) find a positive and statistically significant relationship between maternal hours worked since a child's birth and the child's probability of being obese when the family is in the highest household income quartile (but not in the lower three quartiles). Fertig, Glomm and Tchernis (2006) find a positive and statistically significant relationship between maternal working hours and the probability of a child being overweight for children whose mothers have more than a high school education (but not for those whose mothers attained education up to graduation from high school). These authors also explore the mechanism by which maternal work affects a child's weight by analyzing time diaries, and find increased TV watching and a smaller number of meals each day are associated with higher BMIs for children. Finally, Liu (2006) uses several different econometric techniques to explore the effect of mothers' full-time work on children's BMIs, and concludes a mother's full-time work has a positive and significant effect on the probability a child will be obese.

Regardless of the statistical significance of the "maternal work hours" or "mother works full time" coefficient in these equations, however, the actual effects of mothers' work behavior on their children's BMIs are very small and do not explain much of the increase in children's obesity at all. It is this author's opinion that, while statistically significant, these coefficients and findings are not at all significant in the more intuitive and important sense of the word. For example, Anderson, et al. (2003) say, "We find that for upper income families, the increase in the average hours worked by mothers between the mid-1970s and the mid-1990s can explain between 12 percent and 35 percent of the increase in obesity among children in these families. The increase in mothers' hours of work is important, but does not explain the whole of the increase in childhood obesity" (p. 31). While the first sentence of this statement might be true, a few simple calculations using their own data cast doubt on the idea maternal work hours are an "important" determinant in childhood obesity. Since the probability of a child in this income category being obese rose about eight percentage points from 1971-75 to 1988-94 (from 2.1 to 9.9 percent (Anderson, Butcher and Levine 2003, 43)), this means the increase in maternal work hours could explain somewhere between 12 and 35 percent of eight percentage points, or between approximately one and three percentage points. To clarify, over approximately 20 years, the increase in maternal work hours may explain an increase of one to three percentage points in the probability a child in the highest household income quartile will be obese. The rest of the increase in this income category (five to seven percentage points), and all the increases in the other three quartiles (from 5.7 to 14.9 percent in the first quartile, from 4.2 to 9.6 percent in the second quartile, and from 5.6 to 8.8 percent in the third quartile (Anderson, Butcher and Levine 2003, 43)) are not explained by women's work behavior.

Fertig, Glomm and Tchernis (2006) confirm this in their work, in which they find "the effects are very small. . . if a highly educated mother doubles her work hours from the average of almost 20 to 40 hours per week, her child's BMI would increase by less than 1 percent because of increased time in front of the TV" (p. 18). On the other hand, Liu (2006) asserts the "average treatment effect of a mother's full-time employment on children's BMI is 2.214" and "the likelihood of children whose mothers work full time becoming overweight is 14.2% higher than among those whose mothers do not work full time." The author therefore concludes, "These findings indicate that full-time working mothers tend to have overweight children" (pp. 78-9). Again, a few simple calculations will show that this is not at all what his findings indicate, even if we accept his assertion these coefficients are the ones with the greatest reliability.[2] If the probability of a child being overweight in 2000 was 15.3 percent (Liu 2006, 7), and a child with a full-time working mother had a 14.2 percent greater chance of being overweight than a child with a mother who did not work full time, then a child with a mother who did not work full time would have approximately a 14.3 percent chance of being overweight and a child with a mother who did work full time would have approximately a 16.3 percent chance of being overweight if half of children have mothers who work full time (roughly the case in Liu's dataset (2006, 27)).[3] This closer look at Liu's findings once again leads us to question the actual significance of the effect of women's work on their children's BMIs—notwithstanding its statistical significance.

This paper confirms these findings. Women's work hours have only a very small correlation with their children's BMIs, and the relationship is only statistically significant (at the 90% level of confidence) for the children of highly educated women. Also explored in this paper is the relationship between women's work hours and their own BMIs, and women's work hours and the BMIs of their husbands. While it will be seen the relationship of wives' work hours with their husbands' BMIs is statistically significant, again, the coefficient is very small. There appears to be no relationship between a woman's own hours worked and her BMI. It is the purpose of this analysis to show there is scant evidence to suggest women's increased participation in the labor force is a significant contributor to higher BMIs in the United States.

II. Data

The analyses of both adults and children are derived from six rounds of data from the National Longitudinal Survey of Youth (NLSY79), from 1996 to 2006. The NLSY79 is described as "a nationally representative sample of 12,686 young men and women who were 14-22 years old when they were first surveyed in 1979. These individuals were interviewed annually through 1994 and are currently interviewed on a biennial basis" (Bureau of Labor Statistics 2006). The data analyzed here are from both the main interviews and the Child/Young Adult supplement, which provides information about original female participants in the survey and also their children.

A. ADULT DATA

Men and women aged 31 to 39 in 1996 were included in this study; the same group was therefore 41 to 49 by the last survey year used. Six biennial surveys (1996 to 2006) were used to study effects across individuals and within individuals over time. Excluded were any observations in which one of the variables in the model was unknown or unclear (e.g. unknown race, unknown hours worked) and individuals who were not married or not living with their spouses since we are interested in how work behavior affects not only the woman's BMI, but also the BMIs of her family members. There were 2552 individuals with appropriate data for at least one survey year (1353 women and 1199 men). The number of observations for all individuals over the ten year period was 6597 for women and 5326 for men (not all individuals completed six surveys). The data were cleaned of extreme outliers for BMI that suggested a mistake in data entry, and for average weekly hours worked that suggested a problem with the understanding of the survey question.[4]

B. CHILD DATA

The same biennial NLSY79 surveys were also used to explore the relationship of women's work behavior on their children's BMIs. Included were children age three to 10.25 years and these data were matched with their mothers' data. Children over age 10.25 were excluded because mother's hours worked were only available for the first 40 quarters of the child's life. There were 1674 individual children with appropriate data for at least one survey year. The number of observations for all individuals over the ten year period was 2463 (few children were included in all six surveys). The data were cleaned of extreme outliers for BMI that suggested a mistake in data entry.[5] "Mother's hours worked" were the average weekly hours the mother had worked over the two previous years. This was calculated by quarters of years in the child's age. For example, for a child aged three to 3.25 years old, "average weekly hours mother works" related to the eight quarters the child was ages one to three years old; for a child aged 5.5 to 5.75 years old, "average weekly hours mother works" related to the eight quarters the child was ages 3.5 to 5.5 years old.

C. GENERAL DATA ISSUES

As previously stated, the main question is whether or not women's work behavior is related to her or her family members' BMIs to a substantial degree. Previous research has found links between BMI and other traits, and so these are included as control variables as described in the methods section below. As children's height and weight were either measured by the interviewer or recalled by the mother, this is also a control variable in the models for children (a dummy variable equaling one if height or weight was recalled rather than measured), as are birth weight and mother's BMI. Height and weight were recalled (not measured) for adults. NSLY79 data are generally straightforward, but it should be noted that the variable "highest grade completed" is truncated at twenty (eight or more years of college), and income is "total net family income" in thousands, which includes wages and salaries from all sources as well as investment income, child support, and any government transfers the family receives. In the adult analysis, "family size" is the number of persons in the household. In the child analysis, "number of children in household" is the number of children under age 18 living in the household. The adult data is analyzed by sex, as we are interested in women's work behavior and her own and her husband's BMIs, and the child data is analyzed with all mothers and then for highly educated mothers, as previous work has suggested different effects for that subcategory (Fertig, Glomm and Tchernis 2006).[6]

III. Models and Results

A. MODELS

For adults, the model estimated is the following:

$$\text{ADULT BMI} = \text{C} + \text{DEMOGRAPHIC} + \text{EDUCATION} + \text{INCOME} + \text{WORK BEHAVIOR} + \text{U}. \quad (1)$$

Variables suggested as controls by earlier scholarship on adults' BMIs include age, age squared, sex, race, family size, education, and income, and so these explanatory variables are included in these models as well. Work behavior includes the respondent's average weekly work hours in the fifty-two weeks prior to the survey, and the respondent's spouse's average weekly work hours in the last full calendar year (January through December). U is the error term.

It would be ideal to have the same time period for both the respondent's and the spouse's average weekly work hours, but these were the only time periods available for calculating average weekly hours worked. It would also be ideal to have other control variables, such as parents' BMIs, birth weight, and caloric intake and activity levels of the respondents. These data are not available. To attempt to control for this and other unobserved heterogeneity between subjects, the linear-mixed model is estimated with random intercepts by subject and fixed coefficients of factors and covariates. Another possible method to use in this case is a linear-mixed model with fixed intercepts but using an autoregressive heterogeneous covariance structure to account for correlated errors within individuals. Both models were estimated with similar results; however, the Akaike Information Criterion (AIC) was slightly lower in the random intercepts model. This indicates a better fit for the data so these results are reported here. The linear-mixed model is suggested in this case because it correctly models correlated errors and unbalanced data. Both issues are relevant with these data as there are observations of individual subjects over time and not all subjects participated in every survey year. (For more on linear-mixed models, see Verbeke and Molenberghs (2000).)

For children, the model is estimated as the following:

CHILD BMI = C + DEMOGRAPHIC + EDUCATION OF MOTHER + BIRTH WEIGHT + MOTHER'S BMI + MOTHER'S WORK BEHAVIOR + E. (2)

Demographic variables include the child's age, race, and sex, whether or not the child's mother's partner or spouse is present in the household, and the number of children in the household. Education of mother is the highest grade completed by the child's mother. Income is total net family income, as defined above. Birth weight is the child's birth weight in pounds. Mother's BMI is calculated from her reported height and weight. E is the error term. Again, it would be ideal to have data on caloric intake and activity levels, but these data are not available. In this case, a linear-mixed model with autoregressive heterogeneous variance had a lower AIC (than the random intercepts model), so it is reported here.[7]

Multicollinearity might be of concern in these models, as one might expect the variables on work hours, spouse work hours, incomes, family size, children present in household, and/or education levels to be collinear. To test for this, multicollinearity diagnostics were performed for each data set. For only "age" and "age squared" in the adult model were the variance inflation factors above 1.3 (tolerances above .78), and the high VIF for "age" and "age squared" is to be expected because one is a function of the other, and they would be correlated with the survey year. This indicates multicollinearity is not a concern in these models.

B. RESULTS OF ADULT MODELS

Tables 1 and 2 show the results of the linear-mixed model with random intercepts by subject for married women and married men, respectively. The signs of the coefficients for "age" and "age squared" are as expected, since BMI tends to increase at a decreasing rate as we age. Lower activity levels and metabolism are generally accepted as reasons for this effect. The coefficients are smaller and less statistically significant than they would be if survey year were not a control variable. This is to be expected, as age would be collinear with survey year. The coefficients for race are relatively large, and the signs are as expected from earlier scholarship for men, with BMI being positively related to black and Latina/o race, and negatively related to Asian race. Race is a rough proxy for genetic differences, and perhaps also affects BMI through different food choices. For women the sign of the coefficient for Asian race is unusual, but this can perhaps be accounted for by the fact there are few Asians in this data set (less than 1% of the observations relate to an Asian subject). For more on the effects of age and race on BMI see, for example, Baum (2007).

TABLE 1–Married Women, Dependent Variable is BMI

Explanatory Variable	Model 1	Model 2	Model 3
Age	0.283 (0.149)	0.279 (0.149)	0.279 (0.149)
Age Squared	-0.004* (0.002)	-0.004* (0.002)	-0.004* (0.002)
Asian	5.133 (2.811)	5.105 (2.811)	5.102 (2.810)
Latina	2.153** (0.461)	2.146** (0.461)	2.141** (0.461)
Black	3.501** (0.446)	3.490** (0.446)	3.490** (0.446)
Highest Grade Completed	-0.191** (0.047)	-0.192** (0.048)	-0.192** (0.048)
Family size	-0.099* (0.047)	-0.096* (0.047)	-0.096* (0.047)
Income	-4.100×10^{-4} (4.080×10^{-4})	-4.280×10^{-4} (4.090×10^{-4})	-4.110×10^{-4} (4.100×10^{-4})
Average weekly hours of work	X	0.002 (0.002)	0.002 (0.002)
Spouse's average weekly hours of work	X	X	-0.002 (0.003)
Number of observations	6597	6597	6597

Notes: Method is restricted maximum likelihood estimator, variance components, random intercept by subject. Standard errors are in parentheses. *Statistically significant at 95% level of confidence. **Statistically significant at 99% level of confidence. "White" is the omitted variable for race. Also controlled for is survey year.

TABLE 2–Married Men, Dependent Variable is BMI

Explanatory Variable	Model 1	Model 2	Model 3
Age	0.083 (0.125)	0.087 (0.125)	0.091 (0.125)
Age Squared	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Asian	-1.367 (2.234)	-1.348 (2.234)	-1.359 (2.229)
Latino	1.722** (0.381)	1.730** (0.381)	1.721** (0.380)
Black	1.336** (0.358)	1.343** (0.358)	1.301** (0.358)
Highest Grade Completed	-0.135** (0.044)	-0.135** (0.044)	-0.133** (0.044)
Family size	-0.073 90.042)	-0.073 (0.042)	-0.059 (0.042)
Income	-2.120×10^{-4} ($3.780 \times 10^{-4)}$)	-2.480×10^{-4} (3.790×10^{-4})	-3.370×10^{-4} (3.810×10^{-4})
Average weekly hours of work	X	0.003 (0.002)	0.003 (0.002)
Spouse's average weekly hours of work		X	0.006* (0.003)
Number of observations	5326	5326	5326

Notes: Method is restricted maximum likelihood estimator, variance components, random intercept by subject. Standard errors are in parentheses. *Statistically significant at 95% level of confidence. **Statistically significant at 99% level of confidence. "White" is the omitted variable for race. Also controlled for is survey year.

The coefficients for the remaining variables, including those on work behavior, are relatively small considering the average BMI for women in the sample is 26.9 and it is 28.3 for men. The strongest relationship with BMI for the remaining variables for both sexes is education level, yet this effect is still fairly small (about -0.19 for women and -0.13 for men) but statistically significant at the 99% level of confidence. This would indicate for every five additional years of education a woman has, for example, her BMI would be approximately one point lower on average. This is consistent with earlier scholarship, for example, Rashad, Grossman, and Chou (2006). Possible reasons for this effect include a greater understanding among better educated people of how food choice and activity levels affect BMI and health, and a greater focus on weight in better educated social circles. Family size has a small but statistically significant effect on women's BMIs (about -0.1) but this effect is smaller and not statistically significant for men. This effect might be the result of simply having more mouths to feed on a food budget, or perhaps a higher activity level associated with having more people in the household. The coefficient for income is very small, and not statistically significant in any specification of the model. The sign of this coefficient and the fact it is larger for women (in an absolute sense) are consistent with earlier scholarship (Chou, Grossman and Saffer 2002, Rashad, Grossman and Chou 2006). While it is often noted that BMI is negatively related to income in developed countries, it appears that once other factors such as race and education level are accounted for, the effect of income on BMI becomes very small.

Regarding the variables pertaining to work behavior, one can see a woman's own work hours do not have a large or statistically significant correlation with her own BMI, nor do her spouse's work hours. For men, their own work hours do not have a large or statistically significant relationship with their BMIs, but we see wives' work hours have a positive and statistically significant correlation with their husbands' BMIs at the 95% level of confidence. However, this coefficient is very small (0.006). This implies an increase in a wife's work hours of 20 hours per week would be associated with an increase in her husband's BMI of about one tenth of a point (or about 0.4% of the average man's BMI). This small positive relationship could be accounted for by a number of things, including the husband eating more prepared or restaurant foods and/or the couple being less active due to greater time constraints. However, it is clear there is little evidence here to suggest women's working or working more hours is associated with substantially higher BMIs for their husbands or themselves.

TABLE 3–Children Residing with Mother
Dependent Variable is Child's BMI

Explanatory Variable	Model 1	Model 2
Age	0.391** (0.038)	0.391** (0.038)
Latina/o	0.417 (0.238)	0.407 (0.238)
Black	1.005** (0.226)	0.986** (0.239)
Male	-0.104 (0.172)	-0.104 (0.172)
Mother's BMI	0.141** (0.015)	0.141** (0.015)
BMI measured	-0.763** (0.147)	-0.763** (0.147)
Birth weight	0.277** (0.066)	0.277** (0.066)
Spouse or partner not present	0.156 (0.212)	0.149 (0.212)
Number of children in household	-0.330** (0.088)	-0.326** (0.088)
Highest grade completed by mother	-0.078* (0.036)	-0.078* (0.036)
Income	-3.300×10^{-4} (9.320×10^{-4})	-3.297×10^{-4} (6.430×10^{-4})
Average weekly hours mother works	X	0.004 (0.006)
Observations	2463	2463

Notes: Method is restricted maximum likelihood estimator, autoregressive heterogeneous variance. Standard errors are in parentheses. *Statistically significant at 95% level of confidence. **Statistically significantly at 99% level of confidence. "White" is omitted variable for race. Also controlled for is survey year.

C. RESULTS FOR CHILDREN

The results for children of all mothers (table 3) show the expected signs and statistical significance of earlier work, with children's BMIs being positively and statistically significantly related to age, mother's BMI, being of black race, and birth weight, and being negatively related to the number of children in the household and mother's education. The largest positive effect of these variables is age (about 0.4) and the largest negative effect is the number of children in the household (-0.33 per child). Also positive but not statistically significant are the effects of being Latina/o and there being no spouse or partner of the mother in the home. Interestingly, the child's BMI being measured rather than recalled had a statistically significant negative effect on BMI in the full sample of children. This indicates mothers tended to overestimate the child's weight or underestimate the child's height when recalling this information. Income, as with adults, had a very small negative effect on BMI and this was not statistically significant. As can be seen, the average weekly hours the child's mother had worked in the prior two years had a very small positive relationship that was also not statistically significant.

TABLE 4–Children Residing with Mother
Mother's Education is Six Years of college or More
Dependent Variable is Child's BMI

Explanatory Variable	Model 1	Model 2
Age	0.314** (0.097)	0.313** (0.096)
Latina/o	0.881 (0.655)	0.852 (0.650)
Black	0.991 (0.592)	0.889 (0.591)
Male	0.120 (0.407)	0.178 (0.406)
Mother's BMI	0.121** (0.040)	0.106** (0.041)
BMI measured	0.383 (0.329)	0.395 (0.329)
Birth weight	0.192 (0.168)	0.277 (0.174)
Spouse or partner not present	1.335* (0.662)	1.206[x] (0.662)

Explanatory Variable	Model 1	Model 2
Number of children in household	0.236 (0.230)	0.228 (0.229)
Highest grade completed by mother	0.234 (0.245)	0.310 (0.247)
Income	-0.001 (.001)	-0.001 (0.001)
Average weekly hours mother works	X	0.022[x] (0.013)
Observations	357	357

Notes: Method is restricted maximum likelihood estimator, autoregressive heterogeneous variance. Standard errors are in parentheses. *Statistically significant at 95% level of confidence. **Statistically significantly at 99% level of confidence. "White" is omitted variable for race. Also controlled for is survey year. [x]Statistically significant at 90% level of confidence (90% confidence interval includes zero).

In earlier scholarship indicating a mother's work hours did affect the child's BMI or the probability of the child being overweight, the authors discovered the findings were driven by a subset of the population. In the case of Anderson, Butcher, and Levine (2003), the probability of a child being overweight was greater for children of mothers with at least some college, but this was not the case for children of mothers with a high school education or less. Therefore, the model is estimated again here for highly educated mothers. In this sample, the coefficient of mothers' work hours was still statistically insignificant for mothers with some college and with a college degree. Only the BMIs of children with mothers with six years of college or more were affected to a degree that was statistically significant, and then only at the 90% level of confidence (so the confidence interval includes zero). These results are shown in table 4.[8] The coefficient of mother's work hours is still small (0.022), and it only applies to children of women with six or more years of college (less than 10% of this sample). This would imply an increase in mother's work hours of 20 hours per week would be associated with an increase on average in these children's BMI of 0.4, or about 2.3% of the average child's BMI.

The number of subjects in this category being about 10% of the original sample (165 children and 357 observations) may account for the differences in the coefficients of other variables. For example, for the children of highly educated mothers, the coefficients for birth weight, being of black race, and BMI being measured rather than recalled are not statistically significant. However, the mother's spouse or partner not being present has a much larger positive effect that is statistically significant for this subsample compared to the whole sample (but is only significant at the 90% level of confidence once mother's hours of work are accounted for). It is unclear to this author why this effect would be so much larger for children of highly educated mothers, unless it indicates a difference in the choice of childcare as was suggested by Fertig, Glomm, and Tchernis (2006) in their analysis by income category. The children of highly educated mothers may be less active if these mothers are less likely to have their children in group child care and more likely to have them cared for at home. It may also be noted the coefficients for the number of children in the household and mother's highest grade completed change sign for this group (they are positive), but they are not statistically significant. The coefficient of income remains negative, small, and not statistically significant.

IV. Policy Implications and Conclusions

This study and others suggest women's work hours are not an important determinant of BMIs in general. There is general agreement, however, on several factors that do affect BMI. Some of these factors are not subject to change (age, race, etc.), but others such as calorie intake, activity levels, and years of education can be varied. The policy implications regarding calorie intake and activity levels are clear, at least for children. Schools need to offer children healthy foods and limit the choices of unhealthy ones during the school day. Schools also need to make physical activity for children a priority. The extent to which BMI can be affected by education depends upon the mechanism of the relationship between the two. It would be difficult to suggest that people should engage in more schooling solely to decrease their BMIs, especially since this study shows a rather small effect for each additional year of schooling. However, if BMI is affected by education because better educated people are exposed to more information about the importance of food choice and activity, this information should be integrated into education at lower grade levels. If, on the other hand, education is associated with lower BMIs simply because the culture of better educated people is more focused on weight, earlier education on food and activity is not likely to have much effect. Further research is needed in this area.

Of course, research in the biology of obesity is also ongoing. Recent research in these areas includes the relationship between obesity and certain types of food such as high fructose corn syrup (Bray, Nielsen and Popkin 2004) and high glycemic foods (Pal, Lim and Egger 2008), addiction to certain foods like sugar, fat, and/or salt (Avenaa, Radaa and Hoebel 2008), and the possibility of a link between certain digestive tract bacteria and hunger control (Weigt and Malfertheiner 2009).

This analysis of six biennial surveys from NLSY79 data more clearly examines the relationship between women's work behavior and their own BMIs, as well as women's work behavior and their families' BMIs, than past research. This and previous scholarship suggest there is little evidence to support the idea that women's work behavior is an important reason for higher BMIs. One shortcoming of these datasets is the absence of measured height and weight as opposed to reported height and weight, especially for adults. Cawley and Burkhauser (2006) suggest an adjustment method to partially correct for the differences between reported and measured BMIs, but they calculate correction factors for whites, blacks, and Latina/os, and the dataset in this analysis includes other races as well for adults, and the adjustment method does not apply to children. As stated previously, it would also be helpful to have information about the respondent's genetic tendencies regarding BMI, perhaps proxied by parental BMI(s). Unfortunately these are not available for adults, and only mother's BMI is available for children in the NLSY79.

It is this author's hope that the question of women's work behavior and the increase in the average BMI in the United States can be put to rest. All the scholarship in this area points to the conclusion if there is any positive relationship (as with children of highly educated mothers and the husbands of working women), it is very small. Instead of putting the responsibility for this problem on working women, our energies could be put to better use developing policies to promote methods that have been shown to help people (especially children) reach or maintain healthy weight (such as healthier foods and more activities in our schools).

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Endnotes

1. Body mass index (BMI) is calculated as weight in kilograms divided by height in meters squared (kg/m^2). BMI is calculated in the same way for adults and children. A healthy BMI is generally considered to be between 19 and 25 for adults, whereas a healthy BMI for children is between the 5^{th} and 85^{th} percentile. (The latter standard is problematic considering the upward trend in average BMI among children.) The average BMI for both adults and children has been rising over the past few decades, and a greater percentage of people are falling into the unhealthy BMI categories.
2. Liu (2006) uses several techniques to explore the effect of mothers' work behavior on children's BMIs, and the coefficients for "mother's full time work" vary widely depending on the method.
3. 14.2 percent of 14.3 percent is about 2 percentage points, the difference between 16.3 and 14.3 percent.
4. Three observations with BMIs of 7, 10, and 106 were deleted as they were all extreme outliers and also inconsistent with observations in previous and subsequent survey years. Several other observations were deleted due to extreme outliers of average weekly hours worked for either the individual or the spouse. The deleted observations reported average weekly hours worked of 168, which would indicate

working twenty-four hours a day seven days a week. The author believes that the respondents either did not understand the question or were defining work in such a way that makes the observations irrelevant for this study.

5. There were three BMIs corrected. Data entry mistakes were obvious. For example, a child was reported as being 3 feet 8 inches tall in 1996, 1 foot 4 inches tall in 1998, and 4 feet 3 inches tall in 2000. The BMI for 1998 was therefore incorrectly calculated and extremely high. I therefore corrected the height data for 1998 to read 4 feet 1 inches tall, believing this to be the most likely error. Two other similar cases were corrected.
6. These data were also analyzed for different income quartiles, with no large or statistically significant effects of mother's work hours on child's BMI for any quartile.
7. A linear-mixed model with random intercepts was also estimated with similar results, but the Hessian matrix was not positive definite and the reliability of the results could not be guaranteed.
8. Fertig, Glomm, and Tchernis (2006) found similar results for women with higher incomes. Therefore a model for the highest income quartile was also estimated, but without statistically significant results for mother's hours worked.