# CHAPTER 3

# Child Care Choices and Childhood Obesity

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**JEL Codes:** I12, I18, J13

**Abstract**

Over the past three decades, the U.S. economy experienced a sharp increase in the labor force participation of women, causing a similar increase in the demand for non-parental child care. Concurrent with these developments has been a dramatic rise in the prevalence of childhood obesity, prompting the question as to what extent the increase in child care utilization is responsible for the growth in obesity. This chapter examines the impact of various child care arrangements on school-age children's weight outcomes using panel data from the Early Childhood Longitudinal Study, Kindergarten Cohort (ECLS-K). An advantage of the ECLS-K for our purposes is that it tracks children's child care arrangements between Kindergarten and the 5$^{th}$ grade. Our fixed effects results suggest that non-parental child care arrangements are not strongly associated with children's weight outcomes. Our findings are robust to numerous sensitivity and sub-group analyses.

## 3.1. Introduction

Over the past three decades, the prevalence of obesity has increased from five percent to 10.4 percent among two- to five-year-olds and from 6.5 percent to 19.6 percent among six- to-eleven-year-olds (Ogden, et al., 2008; Ogden et al., 2010). Childhood obesity is identified by public health officials as one of the most pressing health problems in the United States (U.S. Department of Health and Human Services, 2001). This alarming trend is also a growing source of concern among the public. In a 2008 nationwide public opinion survey, obesity was identified as the number-one health problem among children (Mott, 2009).

This anxiety is justified given the immediate and long-term health and social consequences associated with childhood obesity. For example, obese children and adolescents are more likely to have the precursors of cardiovascular disease, including high cholesterol and blood pressure.[1] Such children are also found to perform worse academically and experience such social and psychological problems as stigmatization, depression, and poor self-esteem (Mocan and Tekin, 2010; Strauss, 2000; Daniels, Arnett, and Eckel, 2005; U.S. Surgeon General, 2001). Finally, obese children are likely to remain obese as adults, and therefore risk developing an array of health problems in the future, including heart disease, type 2 diabetes, stroke, several types of cancer, and osteoarthritis (U.S. Surgeon General, 2001). These health problems impose substantial costs on the U.S. health care system. According to one estimate, the direct medical costs from prescription drugs, emergency room visits, and outpatient services total $14.1 billion annually (Trasande and Chatterjee, 2009). The scale of the economic cost becomes more serious if one also considers the estimated $147 billion per year spent on treating obesity-related illnesses among adults (Finkelstein, et al., 2009).

[1] In a sample of 5- to 17-year-olds, 70 percent of obese youth had at least one risk factor for cardiovascular disease (Freedman et al., 2007).

The health and economic costs associated with childhood obesity have spurred a tremendous amount of attention by the research and policy communities devoted to exploring factors that contribute to it. For example, recent studies investigate the role of decreasing food prices (Lakdawalla and Philipson, 2002), the rise in maternal employment (Ruhm, 2008; Anderson, Butcher, and Levine, 2003), changes in agricultural policies (Cawley and Kirwan, 2005), the development of technology to mass produce and preserve food (Philipson and Posner, 1999), and school-based policies (e.g., school breakfast and lunch program) (Hofferth and Curtin, 2005).

Interestingly, the growing prevalence of childhood obesity coincides with a substantial increase in the percentage of mothers participating in the labor force. Between 1970 and 2000, the labor force participation rate of women with children almost doubled, rising from 38 percent to 68 percent (Story et al., 2006). The sharp increase in labor force participation has been followed by an equally dramatic rise in the demand for non-parental child care. Today, of the 35 million children aged six to fourteen, 63 percent spend an average of twenty-one hours per week in the care of someone other than a parent before and after school (Story et al., 2006).

Motivated by the coincident rise in maternal employment and childhood obesity, a strand of empirical work has been devoted to exploring this relationship. Findings from these studies generally suggest that maternal employment is associated with an increase in children's weight outcomes (Ruhm, 2008; Coutemanche, 2007; Anderson et al., 2003; Fertig et al., 2009). For example, Anderson et al. (2003) find that increases in hours of maternal work raise the likelihood that children are obese. The authors also find greater effects among children of white mothers, of mothers with more education, and of mothers at higher income levels. Fertig et al. (2009) examine the mechanisms through which maternal employment influences children's weight

outcomes and find that changes in supervision and nutrition play statistically significant but small roles in the relationship between maternal employment and childhood obesity. Cawley and Liu (2007) find that employed mothers spend significantly less time cooking and playing with their children and are more likely to purchase pre-cooked meals.

The concurrent increase in childhood obesity and the utilization of formal child care raises the relevant question as to what extent the two developments are related to each other. There are numerous reasons why one might observe such a relationship. Given that millions of children spend substantial time in non-parental arrangements before and after they start school, the child care environment has the potential to play an important role in laying the foundation for children's food consumption and exercise patterns. Menu options available in child care settings expose children to a variety of new foods and flavors, which can influence food preferences at home and school (Deckelbaum and Williams, 2001). Structural and process features of the child care environment determine the types and frequency of physical activities in which children are engaged. Finally, child care providers can serve as an effective bridge to aid parents in making healthy food choices at home (Story, Kaphingst, and French, 2006).

Despite this potential association, research on the effect of child care choices on childhood obesity is limited. An exception is Hubbard (2008), who examines the impact of maternal employment and child care choices on children's weight outcomes using data from the ECLS-K. Modeling the employment and child care decisions in a dynamic framework and using a discrete factor random effects estimator, she finds that among mothers working full-time, the use of non-parental child care significantly increases children's likelihood of being obese and overweight. The impact of non-parental care on childhood obesity is insignificant among part-

time working mothers. Contrary to previous research, she finds that maternal employment has a negative and statistically significant effect on the likelihood of being obese.

A number of studies focus on the relationship between Head Start attendance and children's weight outcomes. For example, Frisvold (2007) examines the effect of Head Start participation on childhood obesity using data from the Panel Study of Income Dynamics. He finds that Head Start attendance reduces the likelihood of obesity in late-childhood among black children. Similarly, Carneiro and Ginja (2008) find that participation in Head Start reduces the incidence of childhood obesity. Frisvold and Lumeng (in press) use administrative data from Michigan to examine the obesity effects of full-day Head Start attendance compared to half-day attendance. They find that full-day enrollment significantly reduces the proportion of obese children at the end of the academic year. Such findings are not surprising given that Head Start emphasizes quality through the provision of comprehensive child development services. For example, Whitaker et al. (2009) show that most Head Start programs report doing more to support healthy eating and gross motor activity than required by federal performance standards in these areas. Also the children enrolled in the Head Start program mostly come from low-income families due to the means-tested nature of Head Start eligibility. Therefore, the findings from these studies cannot necessarily serve as a guide for the impact of parental decisions about child care on childhood obesity.

Several descriptive studies examine the nutritional quality of foods offered in child care settings.[2] A review of these studies suggests that the quality of foods offered in center-based care typically falls below the standards recommended by *The Dietary Guidelines for Americans*.[3]

[2] Story, Kaphingst, and French (2006) provide a comprehensive summary of these studies.

[3] A publication put forth every five years by the U.S. Department of Health and Human Services, the *The Dietary Guidelines for Americans* provide authoritative advice for people ages two and over about the relationship between increased healthy dietary habits and the reduction in the risk of major chronic diseases. This publication also serves as the basis for Federal food and nutrition education programs. Additional information may be found here: http://www.health.gov/DietaryGuidelines/.

For example, Padget and Briley (2005) compare the dietary intake of children attending center-based care with the recommendations of the Food Guide Pyramid for Young Children. They find that such children generally do not receive an adequate diet, and the intake at home does not compensate for the insufficient consumption of fresh fruits, vegetables, and grains during the time spent in child care. Furthermore, a number of studies show that preschool-age children in various non-parental child care settings do not meet the recommended guidelines for physical activity (Story, Kaphingst, and French, 2006).[4] However, research suggests that preschools implementing practices aimed at increasing quality in general and physical activity in particular can be successful at reaching this goal. For example, in a study of 266 preschoolers, Dowda et al. (2004) find that children in high-quality preschools as measured by child-staff ratios, teacher education, and structural attributes of the facility participate in greater amounts of moderate to vigorous physical activity.

In this chapter, we examine the impact of various child care arrangements on school-age children's weight outcomes using panel data from the Early Childhood Longitudinal Study, Kindergarten Cohort (ECLS-K). We address the potential endogeneity of child care choices using a fixed effects estimator. Our study differs from Hubbard (2008) in several respects. First, we utilize ECLS-K data from the fall of kindergarten, and the spring of 1$^{st}$, 3$^{rd}$, and 5$^{th}$ grades, while she excluded data from Kindergarten wave. Second, she uses a single binary indicator for non-parental child care, which does not allow her to distinguish among various types of arrangements. In particular, her measure is based on the total number of hours children spend in three modes of settings (informal care from a relative, informal care from a baby-sitter, and center care). She then constructs an indicator for whether a given arrangement was utilized

[4] The 2005 *The Dietary Guidelines for Americans* recommend that children and adolescents engage in no less than 60 minutes of physical activity each day. Furthermore, the National Association for Sport and Physical Education (NASPE) recommends that toddlers receive at least 30 minutes of structured physical and 60 minutes of unstructured activity each day. Preschoolers should receive 60 minutes of structured play and another 60 minutes of unstructured play each day.

for more than five hours per week. In this chapter, we employ mutually exclusive and exhaustive groupings of child care arrangements. Specifically, we code children as attending relative care (which includes caregiving inside and outside the child's home), non-relative care (nanny, babysitter, or family-based), center-based care (daycare center), and parental care. Since a non-trivial number of children receive care in multiple arrangements, we focus on the primary arrangement, defined as the one from which the child receives the greatest number of hours of care per week. Third, Hubbard (2008) focuses only on body mass index (BMI) and indicators of overweight and obese, while we also examine the effect of child care choices on the likelihood of being underweight. Finally, her analysis draws upon the balanced sample of children. Limiting the analyses to a balanced sample may be problematic if sample attrition is non-random. Therefore, we retain observations in the fixed effects analysis as long as the obesity and child care variables are non-missing for at least two periods.

The remainder of this chapter is organized as follows. Section 3.2 describes the empirical specification. Section 3.3 introduces the data used in the analyses and Section 3.4 discusses the results. Section 3.5 concludes the chapter.

### 3.2. Empirical Specification

Our goal is to investigate the relationship between the choice of child care arrangements and school-age children's weight outcomes. This relationship can be expressed by the following regression model:

(1) $W_{it} = \alpha_0 + C_{it}\alpha_1 + X_{it}\alpha_2 + \omega_t + \nu_i + \varepsilon_{it}$,

where $W_{it}$ is one of our weight outcomes for child i in grade t; $C_{it}$ is a vector of child care arrangements; $X_{it}$ is a vector of exogenous determinants of children's weight at the child- and family-level; and $\omega_t$ represents a vector of grade fixed effects that account for national

curriculum changes influencing children's weight. For example, as more children become obese during the analysis period, concerns about the problem have likely to be heightened and become more widely known to policy-makers and the public. If, as a result, child care policy was assigned an increased role in the fight against obesity during the same period, the grade fixed effects would account for such nationwide effects.

Finally, the $\nu_i$ represents a vector of child- or family-specific time-invariant unobserved characteristics that may be associated with children's weight outcomes. For example, there may be unobserved genetic characteristics that predispose some children to weight problems (Ding et al., 2006). Alternatively, the $\nu_i$ represents unobserved family resources or parenting style that influences the development of overweight and obesity. Some of these unobservables may also be correlated with parental decisions regarding child care arrangements. For example, a parent who understands the role of TV exposure or other sedentary activities in influencing children's weight may have a preference for center-based care over relative or family day care if she believes that the former is more effective at promoting physical activity and limiting TV exposure. Failure to control for these unobserved preferences may lead to biased estimates of the impact of child care arrangements on childhood obesity. Finally, there might be unobserved demographic, economic, and policy differences across states and localities that are correlated with both child care choices and children's weight outcomes.[5] For example, if a given state identifies childhood obesity as a particularly serious problem, it may require certain child care establishments to implement formal practices to ensure healthy eating and physical activity patterns. Failure to account for this policy heterogeneity would further bias the estimates on

[5] There are very few parents moving to other states during the analysis period in ECLS-K and a majority of these parents drop from the sample automatically as they are not followed.

child care arrangements if parents respond to these policies by placing their children in the regulated services.

We therefore account for time-invariant individual- and family-level unobserved heterogeneity by including child fixed effects in equation (1). The fixed effects approach requires panel data, or repeated observations on children, so that the set of individual time-permanent unobservables can be eliminated. While the child fixed effects approach effectively removes all unobserved heterogeneity that is stable over time, this method does have a number of limitations. First, it does not eliminate time-varying heterogeneity. For example, if a parent becomes more aware of the health risks associated with obesity, she may adjust her parenting style at home or choose different child care arrangements so that her child is exposed to less TV, becomes more physically active, and consumes more fresh fruits and vegetables. Such time-varying changes in parental preferences would still bias the estimated effects of child care arrangements on childhood obesity. Second, child fixed effects produce coefficient estimates only for variables that vary over time, thereby eliminating from the model some factors of interest to the researcher. Finally, measurement error in the explanatory variables can exacerbate attenuation bias when using child fixed effects.

In order to assess the extent of bias from time-invariant unobserved heterogeneity, we estimate versions of equation (1) with and without the child fixed effects. We also take a number of steps to guard against sources of time-varying unobservables that may bias our estimates of child care arrangements in the child fixed effects models. First, we exploit the richness of the ECLS-K and control for a large number of time-varying child and family characteristics, including children's age, the presence of disabilities, and family structure and socioeconomic status. Second, we incorporate period (or grade) effects to capture year-specific policy or

economic shocks that may influence parental decisions on child care and children's weight outcomes.[6]

In some of our pooled OLS specifications, we incorporate county fixed effects to account for unobserved differences across states and localities that might be correlated with both parents' child care choices and children's weight outcomes. Given that state-level economic and policy conditions are identical for children in the same county, these factors are automatically controlled for and are not needed in the model. This is particularly important for states' social policy environment, including recent welfare reforms, expansions to the Earned Income Tax Credit (EITC), and pre-kindergarten initiatives, all of which may influence parent's decisions on child care and children's well-being. In addition, to the extent that the availability of fast food restaurants, supermarkets, and parks is unevenly distributed across the states, inclusion of county fixed effects will control for these factors as well. Another advantage is that any sub-state-level variation in families' demographic characteristics, physical activity and food options, or the social policy environment is captured by the county fixed effects.

### 3.3. Data

The data used in this chapter come from the Early Childhood Longitudinal Study, Kindergarten Cohort (ECLS-K), a nationally representative survey of 21,260 children entering kindergarten in the fall of 1998.[7] Children in the ECLS-K are followed through the eighth grade, with detailed parent, child, and teacher interviews conducted in the Fall of kindergarten (1998) and the spring of 1st (2000), 3rd (2002), 5th (2004), and 8th (2007) grades. An average of more than 20 children per school from over 1,200 public and private schools are included in the sample.

[6] See Appendix Table 3.1 for a full list of the time-variant and -invariant variables used in the OLS. The ECLS-K produces an index of socioeconomic status (SES), which combines mother's and father's education, mother's and father's occupational status, and total family income.
[7] The ECLS-K is sponsored by the U.S. Department of Education. For more information, see the ECLS-K website at http://nces.ed.gov/ecls/kindergarten.asp.

The analyses in this chapter use data from the fall of kindergarten, and the spring of 1st, 3rd, and 5th grades. Observations with data missing on BMI and child care arrangements are excluded from the sample. We further limit our sample to children living in one- or two-parent households in which the biological mother is present for the entire survey period.[8] The models also include binary variables for the missing data. Applying these criteria results in a sample of 48,870 observations. [9] About 33 percent of these observations come from fall of kindergarten, while the percentage of observations from the spring of 1st, 3rd, and 5th grades represent about 26 percent, 22 percent, and 19 percent of the full sample, respectively. Therefore, our analysis sample is unbalanced. Any child appearing at least twice in our sample with non-missing obesity and child care variables contributes to the fixed effects analysis. Thus, child specific fixed effects control for any time-invariant unobserved factors leading to some children dropping out of the sample. If sample attrition is non-random, then limiting the sample to a balanced sample would lead to biased estimates. In robustness analyses, we therefore estimate the main model using a balanced sample to assess the impact of sample attrition. Results from this balanced sample are consistent with the main findings. Since the identification of child care effects relies on within-child variation in child care arrangements, it is important to confirm that there is sufficient variation in these variables over time. Of the 48,870 child-time observations, only 11,480 (23.5 percent) come from children who never changed their child care arrangement.[10]

Our outcome variables are based on the BMI, which is calculated as weight in kilograms divided by height in meters squared. In addition to using the BMI, we estimate models using binary indicators for underweight, overweight and obese. One advantage of the ECLS-K is that

[8] Specifically, the children in our sample either lived with their biological mother or with their biological father and a biological or step father. Therefore, children in father only households or those in households in which the mother figure is someone other than the biological mother are excluded from the analyses sample.

[9] The National Center for Educational Statistics requires number of observations to be rounded to the nearest 10 when the restricted version of the ECLS-K is used without sample weights.

[10] Of the 11,480 observations, 7,640 belong to parental care; 1,760 observations are from relative care, and the remaining 600 and 1,480 are from non-relative/non-parental and center care, respectively.

children's BMI is available in each wave and is based on measured values of height and weight. For children ages two to 19, the BMI values are plotted on age- (in months) and gender-specific growth charts from the Centers for Disease Control and Prevention (CDC) to determine the corresponding BMI-for-age percentile. Children at or below the 5$^{th}$ percentile of the gender and age specific BMI distribution are coded as underweight. Children are coded as overweight or obese if their age and gender specific BMIs exceed the 85$^{th}$ percentile and 95$^{th}$ percentiles, respectively.

Our key independent variable is the primary child care arrangement used for the child during that survey year. The ECLS-K produces a composite variable indicating the primary child care arrangement in which the child spends the most time per week at the time of the interview. The values for this variable are: (0) no non-parental care; (1) relative care in child's home; (2) relative care in another home; (3) non-relative care in child's home; (4) non-relative care in another home; (5) center-based care; (6) two or more programs; and (7) location of care varies. Using these categories, we create mutually exclusive groupings of child care arrangements in the following manner: Children in no non-parental care arrangement are defined as using parental care. We combine categories (1) and (2) for relative care arrangements, such as care by a grandparent. Categories (3) and (4) are merged into a single group called non-relative care, which includes nanny or babysitter and family day care, and category (5) remains center care. We delete children in categories (6) and (7), which account for less than 2 percent of the overall sample.

Table 3.1 presents summary statistics for the weight outcomes and child care arrangements. The average BMI in our full sample is 17.8. Approximately 31 percent of children in our sample are overweight, and 15 percent are obese. The proportion of children who

are underweight is 3 percent. These figures are consistent with the national statistics cited earlier. Approximately 60 percent of the school-age children do not participate in any non-parental child care as their primary arrangement. Relative care constitutes the primary child care arrangement for about 18 percent of children, followed by center-based care, which is used by 15 percent of children. The remaining 7.5 percent of children enroll in non-relative care. A comparison of the weight outcomes by child care type reveals that children cared for by relatives have higher BMIs, are more likely to be overweight and obese, and are less likely to be underweight than those in other child care environments. For example, fully 36 percent of such children are overweight and 19 percent are obese, compared to 29 percent and 14 percent, respectively, for children in other non-parental child care modes. Interestingly, there appears to be no significant differences in overweight, obesity, and underweight prevalence across the other child care arrangements.

Our OLS models include a large set of control variables. The list includes child's age, gender, race, birthweight, and indicator for whether the child was born prematurely, disability status of the child, whether the child lives in a single or two parent household, mother's work status, indicators for families' socio-economic status, parent's expectations regarding the child's prospects for finishing high-school and college, number of siblings, indicators for the type of the residential location (city, suburban, town or rural), and grade dummies. In some of the OLS specifications, we also control for county fixed effects. Note that any of these control variables that are time-invariant drop out of the child fixed effects models.

Descriptive statistics for the covariates by the type of child care mode are displayed in Table 3.2. Raw differences in the means suggest that children cared for by their relatives come from poor social and economic backgrounds, which is consistent with their relatively high rates of overweight and obesity as presented in Table 3. 1. For example, relative care is the dominant

arrangement among black children and those living with low-educated mothers. On the other hand, relative care is the least utilized mode of care by white children, who are primarily cared for in non-relative care settings. Center care appears to be more common among children living with their biological mother only. It is also more heavily utilized by mothers employed full-time and among children from high socio-economic status.

### 3.4. Results

Our discussion of the empirical results begins with several OLS regressions constituting a baseline for the estimates obtained from child fixed effects regressions. In all cases, we report robust standard errors clustered at the child level. As displayed in Table 3.3, we present the OLS results in different panels, each containing estimates for the relationship between child care choices and children's weight outcomes for a different specification. In Panel A, we use a single binary indicator for any participation in a non-parental child care. Panel B disaggregates the single binary indicator used in Panel A into three categories: relative care, non-relative care, and center care. Parental care serves as the omitted category. Panel C adds a rich vector of family and child characteristics that might be correlated with children's weight outcomes. Finally, Panel D incorporates county-fixed effects to further account for local policy, economic, and demographic differences affecting childhood obesity. In each Panel, we present estimates on the continuous measure of BMI as well as binary indicators for overweight, obese, and underweight categories. To economize on space, we only present coefficients on the child care choice variables. Full results from the most comprehensive specification (Panel D) are displayed in Appendix Table 3.1.

In Panel A of Table 3.1, in which all three non-parental child care modes are aggregated into one category, the estimates indicate that non-parental care is associated with a higher BMI, a

higher likelihood of being overweight and obese, and a lower likelihood of being underweight. However, these estimates impose the assumption that all types of non-parental child care have the same association with children's weight outcomes.

When we allow the effects to differ by the type of care in Panel B, the estimates suggest that it is the relative care that is associated with a higher BMI and a higher likelihood of being obese and overweight compared to parental care. The estimates on non-relative and center care are small and statistically insignificant. A comparison of estimates in Panels B, C, and D imply that the effect sizes become smaller as control variables are added to the models for all outcomes except for underweight. Specifically, between the specifications with no control variables (Panel B) and those with both county fixed effects and child and family controls (Panel D), the estimates decline in magnitude by 40 to 45 percent for BMI, overweight, and underweight. The estimates in the underweight model, on the other hand, remain fixed as more controls are added to the model.

Focusing on the estimates in Panel D, relative care is associated with a higher BMI by 0.304 points compared to parental care. Children in relative care are four and 2.5 percentage points more likely to be overweight and obese, respectively, than children in parental care. These children are also 0.5 percentage points less likely to be underweight than their counterparts in parental care. None of the estimates on non-relative and center care are statistically significant in any of the weight models, except for the center care, which is statistically significant at the 10 percent level and associated with a small decrease in the likelihood of underweight. All other coefficients are statistically insignificant and too small in magnitude to have any noteworthy implications.

Results from the OLS models are consistent with the descriptive statistics suggesting that relative care is associated with a higher BMI and a higher likelihood of becoming overweight and obese. There appears to be no statistically significant differences in the obesity outcomes of children in parental care and those in non-relative or center environments. However, these estimates may be biased due to unobserved heterogeneity correlated with both child care arrangements and children's weight outcomes. Even after controlling for a large number of covariates and county fixed effects, it is no guarantee that one eliminates potential biases.

In Table 3.4, we present results from the child fixed effects model, which eliminates all sources of time-invariant unobserved heterogeneity. To guard against potential bias from any remaining time-varying heterogeneity, we include in these models the control variables that vary between grades, such as socio-economics. According to the estimates presented in Table 3.4, any non-parental child care participation, regardless of the type, appears to have no effect on children's weight outcomes once the time-invariant unobserved heterogeneity is accounted for. Unlike the OLS results presented in Table 3.3, estimates on relative care become zero and no longer statistically significant. In fact, none of the coefficients in Table 3.4 are large enough to have any significant policy implications. Taken together, the fixed effects results suggest that the raw differences observed in children's weight outcomes are not the result of child experiences, but rather due to differences in observed and unobserved characteristics of children and their families.[11]

In order to assess the sensitivity of our results to using a balanced panel, we estimate the child fixed effects models after limiting the sample to children who participated in all four waves of the ECLS-K. This results in a reduction of the sample size by about half. As presented in Table 3.5, the estimates from the balanced panel are largely consistent with those from the

[11] Adding child specific linear time trends to our fixed effects model do not change any of the current results.

unbalanced panel, suggesting that the effects of non-parental child care modes on children's weight outcomes are small and not different from those of parental child care. The only exception to this is center care, which is now associated with a reduction in the likelihood of underweight by 0.9 percentage points and significant at the 10 percent level. Center care is also associated with an increase in BMI of 0.12 points. Even though two of the coefficients for center care are now estimated with some precision, they are nevertheless still small in magnitude, and do not change the implications obtained from the unbalanced panel.

In Table 3.6, we continue to check the robustness of our findings by including two key control variables in the fixed effects model. In the upper panel, we control for the mother's employment status. Since child care decisions are typically made in conjunction with the employment decision, one of the primary channels through which child care choices can exert an influence on children's weight outcomes is through maternal employment. By controlling for the mother's employment status, we attempt to obtain the effect of child care choices on children's weight outcomes net of the influence of mothers' labor force decisions. As illustrated in Table 3.6, this exercise does not produce any different results. All of the estimates on non-parental child care arrangements continue to be small and imprecisely estimated. However, one should interpret these results with caution, as the maternal employment is likely to be endogenous.[12]

The models so far assume that the intensity of non-parental care is the same across all three types. That is, once a child uses a certain type of care as the primary arrangement, it does matter how many hours he or she spends in it. However, there are slight differences in the average number of hours spent in non-parental child care modes as illustrated in Table 3.2. For example, children whose primary arrangement is center care spend about 12.4 hours per week on average in this care, while those in relative and non-relative care spend about 15.3 and 14.5

[12] See Hubbard (2008) for an exercise accounting for the endogeneity of both maternal employment and child care arrangements.

hours per week in these modes, respectively. To account for these differences, we control for the number of hours spent in non-parental care in the fixed effects models. As presented in the bottom panel of Table 3.6, controlling for this variable does not lead to any meaningful changes in the estimates.

In the next five tables, we present results from a number of sub-group analyses. In Table 3.7, we present the fixed effects results separately for boys and girls. There appear to be no appreciable differences in the impact of child care choices on weight outcomes across boys and girls. For both groups, the estimates continue to be very small and statistically indistinguishable from zero. In Table 3.8, we present results separately across white and black children. Again, allowing the effects of child care choices on weight outcomes to be different between white and black children does not cause any changes to our main findings. In our third sub-group analysis, we estimate models separately for working and non-working mothers. As presented in Table 3.9, the current findings largely hold when we estimate models separately for working and non-working mothers, except that there is a small reduction in the likelihood of underweight for children using center care as their primary mode of care.

In Table 3.10, we present results separately for children in the bottom and top quintile of the SES distribution. This exercise reveals that children from the bottom quintile of the SES distribution are about two percentage points more likely to be underweight than children in parental care if their primary mode of care is relative care. In addition, the children in the bottom quintile are eight percentage points less likely to be overweight if their primary mode of care is non-relative care. The coefficients on center care are very small and statistically insignificant. For children in the top quintile of the SES distribution, the only statistically significant effect applies to center care in the underweight model, which indicates that center care is associated

with a reduction in the likelihood of underweight by 1.6 percentage points. Again, the remaining coefficients are small and imprecisely estimated.

Finally, we report results separately for children living with single biological mothers and married biological mothers. As shown in Table 3.11, allowing the effects of child care choices on children's weight outcomes to differ between children of single and married mothers does not cause any changes to our main findings. None of the estimates are large enough to have any meaningful implications and statistically significant at conventional levels.

### 3.5. Conclusion

Motivated by the simultaneous rise in the use of non-parental child care arrangements and childhood obesity in the U.S. over the last three decades, this chapter seeks to understand to what extent non-parental child care is responsible for the sharp increase in childhood obesity. We do not find evidence to support the hypothesis that the two developments are related. Although the OLS findings point to a positive association between relative care and obesity and a negative association between relative care and the likelihood of underweight among school-age children, we show that this relationship is due to the endogeneity of the child care choice, parents and children using relative care differ in many ways that are also likely to be correlated with children's weight outcomes. Once we control for these characteristics, we find no evidence that relative care is more harmful for school-age children's weight outcomes than any other type of care. Our findings are robust to numerous sensitivity and sub-group analyses.

Our data do not provide information on the exact nature of experiences that children have in various child care environments. For example, physical activity patterns may play a more important role in one type of arrangement and the dietary conditions may matter more in another type. Therefore, it would be interesting to analyze this question using data with detailed

information on the environments in each ofthese arrangements. Furthermore, the relationship between child care and children's weight outcomes may be non-linear. For example, using quantile regression techniques, Herbst and Tekin (in press) show that child care subsidy is associated with a higher likelihood of obesity for children who are already overweight and obese, but not for other children. An interesting avenue for future research could be to implement a similar analysis for the association between child care choices and children's weight outcomes.

## References


Anderson, P.M., K.F. Butcher and P.B. Levine, 2003, Maternal employment and overweight children. Journal of Health Economics 22, 477-504.

Carneiro, P. and R. Ginja, 2008, Preventing behavior problems in childhood and adolescence: evidence from Head Start," University College London working paper.

Cawley, J. and B Kirwan, 2005, "U.S. agricultural policy and obesity," unpublished manuscript, Cornell University.

Cawley, J. and F. Liu, 2007, Mechanisms for the association between maternal employment and child cognitive development. NBER Working Paper, No. 13609

Courtemanche, C., 2007, Working yourself to death? The relationship between work hours and obesity."Washington University in St. Louis Working Paper.

Mott, C.S., 2009, Children's hospital. National poll on children's health., 7(2):1.

Daniels, S.R., D.K. Arnett, R.H. Eckel et al., 2005, Overweight in children and adolescents: pathophysiology, consequences, prevention, and treatment. Circulation. 111, 1999–2002.

Deckelbaum, R. and C. Williams, 2001, Childhood obesity: the health issue. Obesity Research 9, 239S-243S.

Ding, W., S.F. Lehrer, J.N. Rosenquist and J. Audrain-McGovern, 2006, The impact of poor health on education: new evidence using genetic markers. National Bureau of Economic Research Working Paper, No. 12304.

Dowda, M., R. Pate, S. Trost, M. Joao, C. Almeida and J. Sirard, 2004, Influences of preschool policies and practices on children's physical activity. Journal of Community Health, 29, 183-196.

Federal Interagency Forum on Child and Family Statistics, 2009, America's children: key national indicators of well-being, 2009.
http://childcare.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=childcare&cdn=parenting&tm=9&gps=472_117_1242_841&f=10&tt=13&bt=0&bts=1&zu=http%3A//childstats.gov/americaschildren/index.asp

Fertig, A.R., G. Glomm and R. Tchernis, 2009, The connection between maternal employment and childhood obesity: inspecting the mechanisms, Review of Economics of the Household 7(3): 227-255.

Finkelstein, E.A., J.G. Trogdon, J.W. Cohen and W. Dietz, 2009, Annual medical spending attributable to obesity: payer- and service-specific estimates. Health Affairs, 28(5), w822–31.

Freedman, D.S., M. Zuguo, S.R. Srinivasan, G.S. Berenson and W.H. Dietz, 2007, Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study. Journal of Pediatrics150, 12–17.

Frisvold, D., 2007, Head Start participation and childhood obesity: does investing in early childhood education reduce obesity? Working Paper, University of Michigan.

Frisvold D., and J. Lumeng, in press, Expanding exposure: can increasing the daily duration of Head Start reduce childhood obesity? Journal of Human Resources.

Herbst, C. and E.Tekin, in press, Child care subsidies and childhood obesity. Review of Economics of Household.

Hofferth, S. and S. Curtin, 2005, Poverty, food programs and childhood obesity. Journal of Policy Analysis and Management 24: 703-726.

Hubbard, M., 2008, The effect of mothers' employment and child care decisions on the body mass status of young children. The University of North Carolina at Chapel Hill Working Paper, November.

Lakdawalla, D. and T. Philipson, 2002, The growth of obesity and technological change: a theoretical and empirical examination. NBER Working Paper no. 8946.

Mocan, N. and E. Tekin, 2010, Obesity, self-esteem, and wages," NBER Working Paper No. (15101). Forthcoming in Economic Aspects of Obesity, Michael Grossman and Naci Mocan (eds.), University of Chicago Press.

Ogden, C.L., M.D. Carroll, L.R. Curtin, M.M. Lamb, and K.M. Flegal, 2010, Prevalence of high body mass index in US children and adolescents, 2007–2008. The Journal of American Medical Association, 303, 242–249.

Ogden, C.L., M.D. Carroll and K.M. Flegal, 2008, High body mass index for age among US children and adolescents, 2003–2006. The Journal of American Medical Association, 299, 2401–2405.

Padget, A. and M. Briley, 2005, Dietary intakes at child-care centers in central Texas fail to meet food guide pyramid recommendations. Journal of the American Dietetic Association, 105, 790-793.

Philipson, T.J. and R.A. Posner, 1999, The long-run growth in obesity as a function of technological change. Cambridge (MA): National Bureau of Economic Research. NBER Working Paper no. 7423.

Ruhm, C., 2008, Maternal employment and adolescent development. Labour Economics, 15, 958-983.

Story, M., K. Kaphingst, and S. French, 2006, The role of child care settings in obesity prevention. The Future of Children, 10, 143-168.

Strauss, R., 2000, Childhood obesity and self-esteem. Pediatrics, 105, E15.

Trasande, L. and S. Chatterjee, 2009, The impact of obesity on health service utilization and costs in childhood. Obesity,17, 1749–5.

U.S. Department of Health and Human Services, 2001, The surgeon general's call to action to prevent and decrease overweight and obesity. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General.

U.S. Surgeon General, 2001, Overweight and obesity: health consequences. Rockville, MD

U.S. Department of Labor, 2008. Women in the labor force: A Databook Edition. http://www.bls.gov/cps/wlf-databook-2008.pdf

Whitaker, R.C., R.A. Gooze, C.C. Hughes, and D.M. Finkelstein, 2009, A national survey of obesity prevention practices in Head Start. Archives of Pediatrics and Adolescent Medicine, 163(12): 1144-1150.

**Table 3.1: Summary Statistics for Obesity and Child Care Arrangements**

| Variable | Full Sample | Parent Care | Relative Care | Non-Relative Care | Center Care |
|---|---|---|---|---|---|
| Body mass index | 17.760 | 17.787 | 18.172 | 17.193 | 17.426 |
| | (3.699) | (3.698) | (4.020) | (3.158) | (3.468) |
| Child is Overweight (%) | 0.309 | 0.300 | 0.360 | 0.288 | 0.288 |
| | (0.462) | (0.458) | (0.480) | (0.453) | (0.453) |
| Child is Obese (%) | 0.154 | 0.149 | 0.190 | 0.135 | 0.138 |
| | (0.361) | (0.356) | (0.393) | (0.341) | (0.345) |
| Child is Underweight (%) | 0.032 | 0.033 | 0.029 | 0.034 | 0.033 |
| | (0.177) | (0.179) | (0.167) | (0.181) | (0.178) |
| *Primary Type of Child Care* | | | | | |
| Parent Care (%) | 0.595 | 1 | 0 | 0 | 0 |
| | (0.491) | 0 | 0 | 0 | 0 |
| Relative Care (%) | 0.184 | 0 | 1 | 0 | 0 |
| | (0.387) | 0 | 0 | 0 | 0 |
| Non-Relative Care (%) | 0.075 | 0 | 0 | 1 | 0 |
| | (0.263) | 0 | 0 | 0 | 0 |
| Center Care (%) | 0.147 | 0 | 0 | 0 | 1 |
| | (0.354) | 0 | 0 | 0 | 0 |
| *Survey Wave Dummies* | | | | | |
| Kindergarten-Fall Dummy (%) | 0.325 | 0.292 | 0.330 | 0.453 | 0.390 |
| | (0.469) | (0.455) | (0.470) | (0.498) | (0.488) |
| First Grade-Spring Dummy (%) | 0.262 | 0.256 | 0.267 | 0.285 | 0.265 |
| | (0.439) | (0.436) | (0.443) | (0.452) | (0.442) |
| Third Grade-Spring Dummy (%) | 0.224 | 0.239 | 0.210 | 0.163 | 0.208 |
| | (0.417) | (0.427) | (0.407) | (0.370) | (0.406) |
| Fifth Grade-Spring Dummy (%) | 0.190 | 0.213 | 0.193 | 0.099 | 0.137 |
| | (0.392) | (0.409) | (0.395) | (0.299) | (0.343) |
| Observations | 48,870 | 29,050 | 8,980 | 3,660 | 7,180 |

Note: Standard deviations in parentheses.

**Table 3.2: Descriptive Statistics**

| Variable | Full Sample | Parent Care | Relative Care | Non-Relative Care | Center Care |
|---|---|---|---|---|---|
| Number of Hours Spent in Non-Parental Care | 5.732 | 0.000 | 15.325 | 14.523 | 12.448 |
| | (10.181) | 0.000 | (13.353) | (12.022) | (8.746) |
| Child Has Disability (%) | 0.172 | 0.175 | 0.159 | 0.161 | 0.177 |
| | (0.377) | (0.380) | (0.366) | (0.368) | (0.382) |
| Child Lives with Bio Mother and Father (Omitted, %) | 0.718 | 0.793 | 0.555 | 0.689 | 0.636 |
| | (0.450) | (0.406) | (0.497) | (0.463) | (0.481) |
| Child Lives with Bio Mother and Other Father (%) | 0.087 | 0.079 | 0.103 | 0.098 | 0.094 |
| | (0.282) | (0.270) | (0.303) | (0.298) | (0.291) |
| Child Lives with Bio Mother (%) | 0.195 | 0.129 | 0.343 | 0.212 | 0.270 |
| | (0.396) | (0.335) | (0.475) | (0.409) | (0.444) |
| Boy (%) | 0.508 | 0.511 | 0.501 | 0.485 | 0.513 |
| | (0.500) | (0.500) | (0.500) | (0.500) | (0.500) |
| Child Age in Months | 95.362 | 97.646 | 94.949 | 86.982 | 90.911 |
| | (24.931) | (25.167) | (25.075) | (21.876) | (23.684) |
| Race/Ethnicity: White (Omitted, %) | 0.602 | 0.627 | 0.463 | 0.718 | 0.615 |
| | (0.490) | (0.484) | (0.499) | (0.450) | (0.487) |
| Race/Ethnicity: Black (%) | 0.117 | 0.087 | 0.203 | 0.069 | 0.153 |
| | (0.321) | (0.283) | (0.402) | (0.253) | (0.360) |
| Race/Ethnicity: Hispanic (%) | 0.174 | 0.179 | 0.200 | 0.142 | 0.136 |
| | (0.379) | (0.383) | (0.400) | (0.349) | (0.343) |
| Race/Ethnicity: Asian (%) | 0.056 | 0.056 | 0.071 | 0.033 | 0.048 |
| | (0.230) | (0.230) | (0.256) | (0.179) | (0.214) |
| Race/Ethnicity: Other (%) | 0.051 | 0.049 | 0.063 | 0.038 | 0.047 |
| | (0.219) | (0.217) | (0.243) | (0.191) | (0.212) |
| Birth Weight in 250 Grams | 13.487 | 13.536 | 13.333 | 13.550 | 13.445 |
| | (2.355) | (2.361) | (2.364) | (2.326) | (2.326) |
| Child is Born More Than Two Weeks Premature (%) | 0.164 | 0.161 | 0.168 | 0.160 | 0.176 |
| | (0.371) | (0.367) | (0.374) | (0.367) | (0.381) |
| Current Mother Does Not Work (Omitted, %) | 0.289 | 0.434 | 0.084 | 0.056 | 0.077 |
| | (0.453) | (0.496) | (0.277) | (0.229) | (0.266) |
| Current Mother Works Full Time (%) | 0.479 | 0.303 | 0.731 | 0.713 | 0.755 |
| | (0.500) | (0.460) | (0.443) | (0.452) | (0.430) |
| Current Mother Works Part Time (%) | 0.232 | 0.263 | 0.185 | 0.231 | 0.169 |
| | (0.422) | (0.440) | (0.388) | (0.421) | (0.375) |
| Family SES in 1st Quintile (%) | 0.159 | 0.176 | 0.184 | 0.104 | 0.091 |
| | (0.366) | (0.381) | (0.388) | (0.305) | (0.288) |
| Family SES in 2nd Quintile (%) | 0.184 | 0.176 | 0.245 | 0.168 | 0.145 |
| | (0.387) | (0.381) | (0.430) | (0.374) | (0.352) |
| Family SES in 3rd Quintile (%) | 0.197 | 0.182 | 0.238 | 0.205 | 0.202 |
| | (0.398) | (0.386) | (0.426) | (0.403) | (0.402) |
| Family SES in 4th Quintile (%) | 0.216 | 0.214 | 0.195 | 0.225 | 0.246 |
| | (0.412) | (0.410) | (0.396) | (0.418) | (0.431) |
| Family SES in 5th Quintile (Omitted, %) | 0.244 | 0.252 | 0.137 | 0.299 | 0.316 |
| | (0.429) | (0.434) | (0.344) | (0.458) | (0.465) |
| Parent Expects HS or Less for Child (Omitted, %) | 0.087 | 0.093 | 0.102 | 0.062 | 0.058 |
| | (0.282) | (0.290) | (0.303) | (0.242) | (0.234) |
| Parent Expects Some College for Child (%) | 0.143 | 0.139 | 0.170 | 0.157 | 0.117 |
| | (0.350) | (0.346) | (0.375) | (0.364) | (0.322) |
| Parent Expects BA for Child (%) | 0.510 | 0.508 | 0.476 | 0.526 | 0.553 |
| | (0.500) | (0.500) | (0.500) | (0.499) | (0.497) |
| Parent Expects > BA for Child (%) | 0.260 | 0.261 | 0.252 | 0.255 | 0.272 |
| | (0.439) | (0.439) | (0.434) | (0.436) | (0.445) |
| Only Child (Omitted, %) | 0.134 | 0.096 | 0.174 | 0.160 | 0.229 |

| | | | | | |
|---|---|---|---|---|---|
| | (0.341) | (0.294) | (0.379) | (0.367) | (0.420) |
| One Sibling (%) | 0.429 | 0.404 | 0.422 | 0.496 | 0.500 |
| | (0.495) | (0.491) | (0.494) | (0.500) | (0.500) |
| Two Siblings (%) | 0.282 | 0.312 | 0.260 | 0.256 | 0.203 |
| | (0.450) | (0.463) | (0.438) | (0.436) | (0.402) |
| Three Siblings (%) | 0.103 | 0.125 | 0.094 | 0.068 | 0.046 |
| | (0.304) | (0.330) | (0.292) | (0.251) | (0.209) |
| Four or More Siblings (%) | 0.052 | 0.064 | 0.051 | 0.021 | 0.022 |
| | (0.222) | (0.244) | (0.219) | (0.144) | (0.148) |
| Large or Mid-size City (Omitted, %) | 0.384 | 0.375 | 0.396 | 0.336 | 0.435 |
| | (0.487) | (0.484) | (0.489) | (0.472) | (0.496) |
| Large or Mid-size Suburb (%) | 0.395 | 0.400 | 0.357 | 0.414 | 0.413 |
| | (0.489) | (0.490) | (0.479) | (0.493) | (0.492) |
| Large or Small Town, or Rural (%) | 0.221 | 0.226 | 0.247 | 0.251 | 0.153 |
| | (0.415) | (0.418) | (0.431) | (0.434) | (0.360) |
| Observations | 48,870 | 29,050 | 8,980 | 3,660 | 7,180 |

Note: Standard deviations in parentheses.

**Table 3.3: OLS Results for the Relationship Between Child Care Choices and Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| ***Panel A*** | | | | |
| Any Non-Parental Care | 0.264*** | 0.031*** | 0.021*** | -0.004** |
| | (0.040) | (0.005) | (0.004) | (0.002) |
| Child and Family Characteristics | No | No | No | No |
| County Fixed Effects | No | No | No | No |
| R-squared | 0.186 | 0.013 | 0.012 | 0.002 |
| ***Panel B*** | | | | |
| Relative Care | 0.531*** | 0.065*** | 0.046*** | -0.005** |
| | (0.055) | (0.007) | (0.006) | (0.002) |
| Non-Relative Care | 0.053 | 0.009 | 0.002 | -0.003 |
| | (0.063) | (0.010) | (0.007) | (0.003) |
| Center Care | 0.032 | -0.000 | -0.001 | -0.003 |
| | (0.053) | (0.007) | (0.006) | (0.003) |
| Child and Family Characteristics | No | No | No | No |
| County Fixed Effects | No | No | No | No |
| R-squared | 0.188 | 0.015 | 0.014 | 0.002 |
| ***Panel C*** | | | | |
| Relative Care | 0.328*** | 0.041*** | 0.028*** | -0.006** |
| | (0.055) | (0.007) | (0.006) | (0.002) |
| Non-Relative Car | 0.094 | 0.010 | 0.005 | -0.003 |
| | (0.061) | (0.009) | (0.007) | (0.003) |
| Center Care | 0.046 | -0.003 | -0.002 | -0.004 |
| | (0.053) | (0.007) | (0.006) | (0.003) |
| Child and Family Characteristics | Yes | Yes | Yes | Yes |
| County Fixed Effects | No | No | No | No |
| R-squared | 0.224 | 0.046 | 0.039 | 0.012 |
| ***Panel D*** | | | | |
| Relative Care | 0.304*** | 0.039*** | 0.025*** | -0.005** |
| | (0.055) | (0.007) | (0.006) | (0.002) |
| Non-Relative Care | 0.058 | 0.007 | 0.003 | -0.001 |
| | (0.062) | (0.009) | (0.007) | (0.003) |
| Center Care | 0.068 | -0.000 | -0.000 | -0.005* |
| | (0.054) | (0.007) | (0.006) | (0.003) |
| Child and Family Characteristics | Yes | Yes | Yes | Yes |
| County Fixed Effects | Yes | Yes | Yes | Yes |
| R-squared | 0.240 | 0.065 | 0.055 | 0.040 |
| Observations | 48,870 | 48,870 | 48,870 | 48,870 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.4: The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| Relative Care | 0.004 | 0.001 | 0.008 | 0.002 |
| | (0.046) | (0.007) | (0.006) | (0.004) |
| Non-Relative Care | 0.061 | 0.005 | -0.000 | 0.001 |
| | (0.059) | (0.010) | (0.007) | (0.005) |
| Center Care | 0.055 | -0.008 | 0.002 | -0.005 |
| | (0.052) | (0.008) | (0.006) | (0.004) |
| Observations | 48,870 | 48,870 | 48,870 | 48,870 |
| R-squared | 0.872 | 0.779 | 0.788 | 0.566 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.5: The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes - Balanced Panel**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| Relative Care | 0.009 | 0.007 | 0.009 | 0.005 |
| | (0.058) | (0.009) | (0.007) | (0.004) |
| Non-Relative Care | 0.069 | 0.009 | 0.001 | -0.002 |
| | (0.074) | (0.012) | (0.009) | (0.006) |
| Center Care | 0.118* | 0.002 | 0.008 | -0.009* |
| | (0.063) | (0.010) | (0.007) | (0.005) |
| Observations | 24,060 | 24,060 | 24,060 | 24,060 |
| R-squared | 0.849 | 0.731 | 0.745 | 0.466 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.6: The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| ***Mother's Employment Status Controlled*** | | | | |
| Relative Care | 0.014 | 0.002 | 0.008 | 0.001 |
| | (0.047) | (0.007) | (0.006) | (0.004) |
| Non-Relative Care | 0.071 | 0.006 | -0.000 | -0.000 |
| | (0.059) | (0.010) | (0.007) | (0.005) |
| Center Care | 0.064 | -0.007 | 0.002 | -0.005 |
| | (0.052) | (0.008) | (0.006) | (0.004) |
| Observations | 48,870 | 48,870 | 48,870 | 48,870 |
| R-squared | 0.872 | 0.779 | 0.788 | 0.566 |
| ***Number of Hours Spent in Non-Parental Care Controlled*** | | | | |
| Relative Care | 0.114 | -0.010 | 0.008 | 0.007 |
| | (0.083) | (0.013) | (0.010) | (0.007) |
| Non-Relative Care | 0.172* | -0.006 | -0.001 | 0.006 |
| | (0.092) | (0.015) | (0.011) | (0.008) |
| Center Care | 0.162* | -0.018 | 0.001 | -0.000 |
| | (0.085) | (0.013) | (0.010) | (0.007) |
| Observations | 48,870 | 48,870 | 48,870 | 48,870 |
| R-squared | 0.872 | 0.779 | 0.788 | 0.566 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.7: The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| ***Boys*** | | | | |
| Relative Care | -0.016 | 0.003 | 0.012 | 0.002 |
| | (0.067) | (0.011) | (0.008) | (0.005) |
| Non-Relative Care | 0.033 | -0.003 | -0.008 | -0.002 |
| | (0.085) | (0.015) | (0.011) | (0.008) |
| Center Care | -0.020 | -0.019 | -0.007 | -0.006 |
| | (0.072) | (0.012) | (0.008) | (0.006) |
| Observations | 24,800 | 24,800 | 24,800 | 24,800 |
| R-squared | 0.869 | 0.771 | 0.788 | 0.545 |
| ***Girls*** | | | | |
| Relative Care | 0.026 | -0.000 | 0.005 | 0.002 |
| | (0.064) | (0.010) | (0.007) | (0.005) |
| Non-Relative Care | 0.086 | 0.012 | 0.007 | 0.004 |
| | (0.081) | (0.013) | (0.010) | (0.007) |
| Center Care | 0.132* | 0.004 | 0.010 | -0.004 |
| | (0.074) | (0.011) | (0.009) | (0.006) |
| Observations | 24,060 | 24,060 | 24,060 | 24,060 |
| R-squared | 0.876 | 0.787 | 0.789 | 0.586 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.8: The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| ***Whites*** | | | | |
| Relative Care | -0.059 | 0.002 | 0.001 | 0.002 |
| | (0.062) | (0.010) | (0.008) | (0.005) |
| Non-Relative Care | -0.049 | 0.007 | -0.007 | -0.000 |
| | (0.069) | (0.012) | (0.009) | (0.006) |
| Center Care | 0.012 | -0.010 | -0.001 | -0.008 |
| | (0.063) | (0.010) | (0.008) | (0.005) |
| Observations | 29,420 | 29,420 | 29,420 | 29,420 |
| R-squared | 0.862 | 0.765 | 0.776 | 0.542 |
| ***Blacks*** | | | | |
| Relative Care | 0.094 | 0.001 | 0.018 | -0.004 |
| | (0.138) | (0.019) | (0.016) | (0.009) |
| Non-Relative Care | -0.033 | -0.031 | 0.013 | 0.001 |
| | (0.238) | (0.036) | (0.030) | (0.018) |
| Center Care | 0.006 | -0.011 | -0.000 | -0.002 |
| | (0.170) | (0.023) | (0.019) | (0.013) |
| Observations | 5,710 | 5,710 | 5,710 | 5,710 |
| R-squared | 0.888 | 0.805 | 0.791 | 0.629 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.9: The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| ***Non-Working Mothers*** | | | | |
| Relative Care | 0.023 | 0.010 | 0.023 | 0.004 |
| | (0.195) | (0.031) | (0.022) | (0.016) |
| Non-Relative Care | 0.116 | 0.058 | 0.011 | 0.004 |
| | (0.273) | (0.048) | (0.036) | (0.035) |
| Center Care | 0.149 | 0.003 | -0.005 | 0.021 |
| | (0.208) | (0.032) | (0.025) | (0.020) |
| Observations | 14,010 | 14,010 | 14,010 | 14,010 |
| R-squared | 0.910 | 0.846 | 0.855 | 0.705 |
| ***Working Mothers*** | | | | |
| Relative Care | 0.040 | 0.009 | 0.009 | 0.001 |
| | (0.056) | (0.009) | (0.007) | (0.004) |
| Non-Relative Care | 0.111 | 0.005 | 0.000 | -0.002 |
| | (0.069) | (0.012) | (0.008) | (0.006) |
| Center Care | 0.081 | -0.005 | 0.002 | -0.009* |
| | (0.061) | (0.010) | (0.007) | (0.005) |
| Observations | 34,510 | 34,510 | 34,510 | 34,510 |
| R-squared | 0.887 | 0.799 | 0.810 | 0.591 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.10: : The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| ***Bottom Quintile*** | | | | |
| Relative Care | -0.001 | -0.015 | 0.004 | 0.019* |
| | (0.140) | (0.021) | (0.017) | (0.010) |
| Non-Relative Care | -0.184 | -0.080** | -0.016 | 0.001 |
| | (0.223) | (0.039) | (0.030) | (0.022) |
| Center Care | 0.014 | -0.020 | 0.001 | 0.000 |
| | (0.188) | (0.031) | (0.022) | (0.012) |
| Observations | 7,790 | 7,790 | 7,790 | 7,790 |
| R-squared | 0.910 | 0.827 | 0.844 | 0.690 |
| ***Top Quintile*** | | | | |
| Relative Care | 0.020 | 0.008 | -0.000 | -0.012 |
| | (0.112) | (0.020) | (0.014) | (0.011) |
| Non-Relative Care | 0.022 | 0.019 | 0.014 | -0.009 |
| | (0.111) | (0.019) | (0.015) | (0.012) |
| Center Care | 0.016 | -0.003 | 0.007 | -0.016* |
| | (0.096) | (0.016) | (0.013) | (0.009) |
| Observations | 11,920 | 11,920 | 11,920 | 11,920 |
| R-squared | 0.876 | 0.790 | 0.787 | 0.615 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Table 3.11: The Fixed Effects Estimates of the Effect of Child Care Choices on Children's Weight Outcomes**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| ***Single Mothers*** | | | | |
| Relative Care | -0.005 | -0.008 | 0.023 | 0.006 |
| | (0.116) | (0.018) | (0.015) | (0.009) |
| Non-Relative Care | 0.162 | 0.022 | 0.032 | 0.021 |
| | (0.173) | (0.030) | (0.025) | (0.015) |
| Center Care | -0.125 | -0.017 | -0.009 | -0.004 |
| | (0.144) | (0.021) | (0.018) | (0.012) |
| Observations | 9,530 | 9,530 | 9,530 | 9,530 |
| R-squared | 0.911 | 0.836 | 0.835 | 0.691 |
| ***Married Mothers*** | | | | |
| Relative Care | -0.001 | 0.006 | 0.002 | 0.001 |
| | (0.055) | (0.009) | (0.007) | (0.005) |
| Non-Relative Care | 0.046 | 0.006 | -0.011 | -0.004 |
| | (0.067) | (0.011) | (0.008) | (0.006) |
| Center Care | 0.105* | -0.003 | 0.003 | -0.006 |
| | (0.060) | (0.009) | (0.007) | (0.005) |
| Observations | 39,340 | 39,340 | 39,340 | 39,340 |
| R-squared | 0.876 | 0.786 | 0.795 | 0.577 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at the 0.10, 0.05, and 0.01 levels, respectively.

**Appendix 3.1: OLS Estimates - Full Sample**

| | (1) BMI | (2) Overweight | (3) Obese | (4) Underweight |
|---|---|---|---|---|
| Relative Care | 0.304*** | 0.039*** | 0.025*** | -0.005** |
| | (0.055) | (0.007) | (0.006) | (0.002) |
| Non-Relative Care | 0.058 | 0.007 | 0.003 | -0.001 |
| | (0.062) | (0.009) | (0.007) | (0.003) |
| Center Care | 0.068 | -0.000 | -0.000 | -0.005* |
| | (0.054) | (0.007) | (0.006) | (0.003) |
| Child Has Disability (%) | 0.099* | 0.012* | 0.010* | 0.007*** |
| | (0.053) | (0.007) | (0.005) | (0.002) |
| Child Lives with Bio Mother and Other Father (%) | -0.146* | -0.013 | -0.017** | 0.001 |
| | (0.082) | (0.011) | (0.008) | (0.003) |
| Child Lives with Bio Mother (%) | 0.031 | -0.000 | -0.000 | -0.004 |
| | (0.070) | (0.008) | (0.007) | (0.003) |
| Boy (%) | -0.012 | 0.010 | 0.020*** | -0.001 |
| | (0.049) | (0.006) | (0.005) | (0.002) |
| Child Age in Months | 0.032*** | -0.001 | -0.000 | 0.000* |
| | (0.006) | (0.001) | (0.001) | (0.000) |
| Race/Ethnicity: Black (%) | 0.738*** | 0.074*** | 0.049*** | -0.002 |
| | (0.103) | (0.012) | (0.010) | (0.004) |
| Race/Ethnicity: Hispanic (%) | 0.774*** | 0.099*** | 0.072*** | -0.004 |
| | (0.083) | (0.011) | (0.009) | (0.003) |
| Race/Ethnicity: Asian (%) | -0.021 | 0.012 | 0.026** | 0.028*** |
| | (0.110) | (0.014) | (0.011) | (0.006) |
| Race/Ethnicity: Other (%) | 0.412*** | 0.041*** | 0.031** | 0.009 |
| | (0.124) | (0.015) | (0.013) | (0.006) |
| Birth Weight in 250 Grams | -0.050 | -0.017** | -0.015** | -0.015*** |
| | (0.069) | (0.009) | (0.007) | (0.004) |
| Birth Weight in 250 Grams Squared | 0.010*** | 0.002*** | 0.001*** | 0.000** |
| | (0.003) | (0.000) | (0.000) | (0.000) |
| Child is Born More Than Two Weeks Premature (%) | 0.200*** | 0.024** | 0.013* | -0.003 |
| | (0.074) | (0.010) | (0.008) | (0.004) |
| Family SES in 1st Quintile (%) | 0.779*** | 0.085*** | 0.065*** | -0.004 |
| | (0.089) | (0.011) | (0.009) | (0.004) |
| Family SES in 2nd Quintile (%) | 0.846*** | 0.093*** | 0.072*** | -0.007** |
| | (0.077) | (0.010) | (0.008) | (0.003) |
| Family SES in 3rd Quintile (%) | 0.545*** | 0.065*** | 0.045*** | -0.004 |
| | (0.067) | (0.009) | (0.007) | (0.003) |
| Family SES in 4th Quintile (%) | 0.271*** | 0.029*** | 0.020*** | -0.003 |
| | (0.058) | (0.008) | (0.006) | (0.003) |
| Parent Expects Some College for Child (%) | 0.005 | 0.009 | -0.003 | -0.000 |
| | (0.082) | (0.010) | (0.009) | (0.004) |
| Parent Expects BA for Child (%) | -0.097 | -0.003 | -0.010 | 0.001 |
| | (0.078) | (0.010) | (0.008) | (0.003) |
| Parent Expects > BA for Child (%) | -0.011 | 0.012 | -0.006 | 0.002 |
| | (0.084) | (0.010) | (0.009) | (0.004) |
| One Sibling (%) | -0.367*** | -0.048*** | -0.036*** | -0.003 |
| | (0.076) | (0.009) | (0.008) | (0.003) |
| Two Siblings (%) | -0.505*** | -0.068*** | -0.056*** | -0.007** |
| | (0.081) | (0.010) | (0.008) | (0.003) |
| Three Siblings (%) | -0.632*** | -0.079*** | -0.061*** | -0.006 |
| | (0.096) | (0.012) | (0.010) | (0.004) |
| Four or More Siblings (%) | -0.872*** | -0.124*** | -0.089*** | -0.011** |
| | (0.118) | (0.015) | (0.012) | (0.005) |

| | | | | |
|---|---|---|---|---|
| Large or Mid-size Suburb (%) | 0.008 | 0.005 | 0.000 | -0.000 |
| | (0.067) | (0.009) | (0.007) | (0.003) |
| Large or Small Town, or Rural (%) | 0.324*** | 0.028** | 0.022** | -0.002 |
| | (0.105) | (0.012) | (0.010) | (0.004) |
| Observations | 48,870 | 48,870 | 48,870 | 48,870 |
| R-squared | 0.240 | 0.065 | 0.055 | 0.040 |

Notes: Robust standard errors, clustered at child level, are in parentheses. *, **, *** indicate that the coefficient is statistically significant at 0.10, 0.05, and 0.01 levels, respectively.