Child Care Choices, Food Choices, and Children's Obesity Status

Bidisha Mandal[†]
School of Economic Sciences, Washington State University

Lisa M. Powell
School of Public Health, University of Illinois at Chicago

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[†]Corresponding Author address: Bidisha Mandal, School of Economic Sciences, Washington State University, PO Box 646210, Pullman, WA 99164, bmandal@wsu.edu. This study is supported by a grant from the NSF ADVANCE EXCELinSE External Mentor Program at Washington State University.

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ABSTRACT

We evaluate the effect of differences in child care and food environments on obesity among children in the age group of four to six years. To address non-random selection of children into different child care settings, we first predict market price of child care and market wages, and then examine how these affect choice of child care settings and the amount of time children spend in different settings. Using panel data models, we analyze the role of care settings on frequency of consumption of different types of food items, such as soda, fast food, fruits, vegetables, and juice. Finally, we analyze the effect of food choices on obesity status, with and without controlling for child care environment. We analyze two types of households – single mother households and two-parent households. We find some notable differences in consumption of different types of high-calorie and low-calorie food items across different care settings. Further, higher consumptions of soda and fast food are associated with higher obesity rates among children in single mother households, while higher consumption of 100% juice is associated with higher rates of obesity and higher consumption of vegetables is associated with lower likelihood of obesity among children in two-parent households.

Key Words: *child care choices, soda and fast food consumption, panel data, childhood obesity*

JEL code: C13, D01, I12

I. Introduction

The role of parental investment in child development has been rigorously analyzed across economics, psychology, and sociology literatures. It is well established that the relationship between household income and children's health becomes more pronounced as children grow older (Case et al., 2002; Currie and Stabile, 2003). In the list of top health concerns among children, obesity ranks quite high (University of Michigan Health System, 2010). Although childhood obesity rates have been shown to level-off in recent years, it remains a costly problem as it has both immediate and long-term effects on health and well-being (Centers for Disease Control and Prevention, 2012). In this study, we examine the associations between different types of child care, nutrition intake, and prevalence of obesity among young children (4 to 6 year old) and explore the antecedents of this particular public health issue.

There is an expansive literature on the association between food environment and childhood obesity. Declining real price of food, especially energy-dense foods, along with their access and convenience, are hypothesized to be the key contributors to increasing body weight (Auld and Powell, 2009; Cutler et al., 2003; Drewnowski and Darmon, 2005; and Lakdawalla and Philipson, 2002). Several studies have examined the associations between consumption of energy-dense fast food meals, energy and nutrient intakes, and weight outcomes (for example, Befort et al., 2006; Bowman et al., 2004; and Powell, 2009). Role of sugar-sweetened beverages (primarily soda and juice), another high energy subgroup, are also examined (for example, Berkey et al., 2004; Rajeshwari et al., 2005; and, Welsh et al., 2005). The positive association between 100% juice and obesity rates has received significant attention especially since the late 1990s (for example, Dennison et al., 1997; O'Neil and Nicklas, 2008; and, Wang et al., 2008).

Prior research on the role of parental time inputs and children's obesity status has largely focused on maternal employment behavior primarily due to the rise in dual earner families and single working mothers, and has often found positive relationships between the likelihood of childhood obesity and mothers' market work hours (Anderson et al., 2003; Cawley and Liu, 2007; Fertig et al., 2009; Ruhm, 2008). Researchers explain that this could be because time constraints do not allow working mothers to allocate enough time to children's diet and exercise. On the other hand, working mothers contribute to household income which may allow households to afford better quality investments in child development over the long-run. Benson

and Mokhtari (2011) discuss the role of both parents' employment behavior, and joint economic decision-making in influencing childhood obesity. They find that shared parent-child activities such as reading and physical activities help achieve weight control goals. Additionally, their results indicate that the ratio of hours of work for both parents is important in determining childhood obesity and overweight. Although Bernal and Keane (2011) study child cognitive development and not specifically childhood obesity, they find that negative child care effects are mainly driven by the use of informal care (i.e., care by relatives or by non-relatives in non-center based settings) among single mothers. They find that formal center-based care has no adverse effect on child outcomes. On the other hand, Blau (1999) finds that child care characteristics, such as group size, staff-child ratio, and training, have little association with child development on average. Various studies, however, note that insufficient child care options can be a strong barrier to labor force participation, especially among low-income families (for example, Kimmel and Powell, 2001). However, less is known about how that relates to childhood obesity.

In this paper, we study the mechanism through which children's obesity status may be affected by parent's work status. Specifically, we investigate parents' choice of child care and amount of time spent in care conditional on predicted market wages and predicted market price of paid child care. Next, we examine the role of choice of care on nutrition intake, the effect of nutrition intake on childhood obesity, and the effect of nutrition intake on obesity while controlling for child care choices. We find some notable differences in consumption of different types of high-calorie and low-calorie food items across different care settings. higher consumptions of soda and fast food are associated with higher obesity rates among children in single mother households, while higher consumption of 100% juice is associated with higher rates of obesity and higher consumption of vegetables is associated with lower likelihood of obesity among children in two-parent households.

II. Description of the Underlying Model

The behavioral model presented in this study follows the work of Kimmel (1992, 1998) and Powell (1997, 2002), which explored the impact of child care costs on the employment behavior of women. We extend the model to investigate the relationship between demand for

different types of child care settings and nutrition intake, and then the associations between nutrition intake and body weight while controlling for different child care settings. We describe it as follows. Parents are assumed to maximize utility, where utility is a function of leisure time, market goods, and quality of child care. The maximization problem is subject to a time constraint, a budget constraint, and a production function for childhood body mass index (BMI). In order to keep the estimation procedure tractable, we replace the parents' maximization problem with the mother's maximization problem in two-parent households. That is, we treat mother's market work time and leisure time as endogenous, and father's market work time and leisure time as exogenous. In the case of one-parent households, although the data allow estimation of both single mother and single father households, due to small sample sizes of single father households, we only consider the case of single mother households. Thus, in one-parent households, the mother maximizes utility as described above.

There are several choices of child care – parental care, paid relative care, unpaid relative care, non-relative care, center care, and Head Start. Moreover, parents may choose any combination of care. For instance, 7.6% of the households used both center care and relative care in the same week. The data used in the current analysis recorded use of child care settings and food choices on a weekly basis, and most children spent almost the entire weekend under parental care. Thus, the maximization of the utility function subject to the constraints yield demand functions for leisure, demand functions for different child care settings, and demand functions for quantity and quality of different types of food. Due to data limitations, we are unable to include demand for other market goods. The demand functions are as follows:

(1) $W_M = f\left(w, P, P_F, X\right)$

(2) $D_{C_j} = f\left(w, P, P_F, X\right)$

(3) $D_{F_k} = f\left(w, P, P_F, X\right)$

where W_M denotes mother's time spent in market work, D_{C_j} denotes amount of children's time spent in j^{th} type of care setting, D_{F_k} denotes frequency of children's consumption of k^{th} type of food, w is the hourly market wage rate, P is the hourly price of child care, and P_F is a vector of food prices. Since parent's leisure time, parent's time spent on caring for child, and time spent

on other household production are not separable, the amount of time a child does not spend in non-parental child care settings or in kindergarten is equivalent to the time spent with parent.

Our primary interest lies in estimating equations (2) and (3) which also requires the estimation of two supporting equations – a wage equation for all parents (irrespective of their labor market status) and a child care price equation (regardless of use of paid child care services). We estimate w and P separately for the two different types of households, using appropriate selection model. The estimation procedure is detailed in section IV.

Finally, using the human capital production framework (Leibowitz, 1974), we express children's BMI production function as:

$$(4) \qquad BMI = f\left(D_{F_k}, D_{C_j}, X, \theta\right)$$

where θ denotes child-specific endowments. Ideally, equations (2), (3) and (4) would be estimated simultaneously due to potential contemporaneous correlation. However, it is intractable due to truncation issues, use of instrumental variable estimation, and computational limitations. Thus, at the cost of loss of efficiency, we estimate the demand for child care, demand for food, prevalence of obesity as separate systems of equations. We discuss our econometric approach in section IV. Note that D_{C_j} may affect BMI indirectly through D_{F_k}, or directly if the amount of time spent in care setting is also correlated with physical and sedentary activities. We investigate both effects.

III. Data

The data are drawn from the Early Childhood Longitudinal Study – Birth Cohort (ECLS-B), a nationally representative sample of about 10,700 children born in the U.S. in 2001, with oversampling from among some minority racial and ethnic groups, twins, and low birth weight children. A large number of children participated in the study in four time periods – at 9 months, 2 year, preschool age, and at kindergarten entry in 2006-2007. However, a smaller set of children who were born later in 2001 entered kindergarten in 2007-2008 school year, and they were asked to respond to a fifth wave of survey. The fifth round also included responses from children who repeated kindergarten. Given the small and selective sample in the fifth wave, the

volatile nature of weight and height at very early ages, and availability of food intake information only in the pre-kindergarten and kindergarten waves, we primarily use data from the third and fourth waves for the analysis.

In each round children's height and weight were measured using a stadiometer and a SECA digital scale, respectively.[1] We calculate gender-age-specific percentiles for BMI using growth charts from the Centers for Disease Control and Prevention (CDC).[2] Children in the 95th or higher percentile are identified as obese by the CDC. We use this measure as our dependent variable in analyzing the role of food choices and child care settings in the prevalence of obesity in early childhood. We do not consider the entire distribution of percentiles for BMI in our analyses because weight and height are quite dynamic in the early ages.

We limit analysis to households with at least one biological parent in our study, which is the majority of the sample (over 99% in the first round of surveys). We separate the households into two types – single mother households and two-parent households. In addition to body weight outcomes, primary variables of interest include use of paid care, child care expenditure, children's time spent in various child care settings, parents' work status, parents' salaries, and frequency of consumption of various types of food items. Other independent variables include race and ethnicity, logarithm of permanent income (i.e. logarithm of income averaged across waves)[3], parent's educational level, parent's age, child's age, number of adults in the household, number of children in the household, respondent parent's self-reported health, urban area residency, and if child was breastfed. In two-parent households, father's education level, age, and if both parents have same work shifts are also considered. Descriptive statistics and variable definitions are presented in Table 1. We use interval regressions to impute a continuous measure for the self-reported household income in set ranges (Stewart, 1983; Violato et al., 2011). We use parents' educational attainment, employment status, age, race, occupation, number of earners in the household, number of adults in the household, number of children in the household, and rural or urban residency as explanatory variables.

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[1] The ECLS-B is sponsored by the U.S. Department of Education. For more information see http://nces.ed.gov/ecls/birth.asp

[2] The SAS program for calculating percentile for body mass index-for-age is available at http://www.cdc.gov/nccdphp/dnpao/growthcharts/resources/sas.htm

[3] Replacing permanent income with current income does not change any of our result. For the purpose of aggregation, household incomes are measured in 2001 dollars.

Parents reported children's weekly consumption of fruits, vegetables, soda, fast food, 100% juice (hereafter juice), milk, salty snacks, and sweet snacks beginning in the pre-school wave (wave 3). Based on results from preliminary analysis, we only consider estimating demand for fruits, vegetables, soda, fast food, and juice in equation (3). Responses for frequency of consumption were categorized into never in past seven days, 1-3 times in past seven days, 4-6 times in past seven days, once/day, twice/day, thrice/day, and four or more times per day. We use this as a continuous measure to ease discussion of our results. Using a categorical measure, instead, does not change our conclusions.

Child care settings are classified as parental care, unpaid relative care, paid relative care, non-relative care, center care, and Head Start. Parents may continue to use child care services even as children enter kindergarten as wrap-around care, and they may use any combination of care arrangements. The amount of time spent in various care arrangements and in wrap-around care arrangements after school is measured in number of hours spent in each setting per week. Not surprisingly, non-parental care was more common in single mother households. The predominant type of care in two-parent households with non-working mothers was parental care, although 40% of these households also used center care for approximately 14 hours/week in waves 3 and 4. Center care was more common among single mother households and two-parent households with both parents working with half of either household type using this care setting for approximately 23 hours/week. As expected, use of Head Start was more common among single mother households. The Head Start program was specifically established to provide comprehensive education and health services to low-income children, and the average imputed household income of single mother households was $16,155.24 compared to $71,269.02 among two-parent households with both parents working and $59,415.34 among two-parent households with non-working mothers in the sample. In waves 3 and 4 and between one-parent and two-parent households, the average hourly out-of-pocket cost per child ranged from $2.27 to $2.44 in paid relative care, from $2.20 to $3.93 in center care, and from $2.60 to $3.98 in non-relative care, with two-parent households always spending more per hour.[4] The average out-of-pocket cost for Head Start was similar across the two types of households at $0.27/hour.

[4] A relatively small number of households reported using non-parent care, such as center care and non-relative care, at zero out-of-pocket cost. This is not typical, but possible if the cost is covered by employer in certain cases, or through alimony, or other sources not captured in the survey data. The amount paid by others is not available in the current dataset.

Finally, in estimating demand for different food types we include external data on food prices from the Council for Community and Economic research (formerly known as the American Chamber of Commerce Researchers Association) Cost of Living Index reports from 2005 to 2007. These reports contain quarterly information on prices across more than 300 U.S. cities. We merge the price data and the ECLS-B panel data based on residential zip code and year of survey. Prices are available for a McDonald's Quarter-Pounder with cheese, a thin crust regular cheese pizza at Pizza Hut and/or Pizza Inn, fried chicken (thigh and drumstick) at Kentucky Fried Chicken and/or Church's Fried Chicken, bananas, lettuce, potatoes, canned sweet peas, canned peaches, frozen corn, T-bone steak, ground beef, sausage, frying chicken, canned chunk light tuna, whole milk, eggs, margarine, grated parmesan cheese, white bread, corn flakes, shortening, sugar, coffee, frozen orange juice, and soft drinks.

IV. Estimation Summary

The primary estimating equations are the demand for child care services (tobit models), the demand for different types of food (tobit models), and the likelihood of obesity (logit models). We model reduced-form demand equations for different types of child care settings as functions of market prices of child care and market wages, along with other exogenous household and child care characteristics. Demand equations for different food types are modeled as functions of price of various food items, time spent in different care settings, and other household- and individual-level independent variables. In general, body weight outcome is simply a function of calories in and calories out, controlling for health endowments. However, in the absence of any information regarding children's physical activity, we model the likelihood of obesity as a function of the usual demographics, food intake, and time spent in different care settings. The latter two groups of variables are added to explore if they add any explanatory power to the models of obesity which are functions of food intake only. For instance, physical and sedentary activities could differ across care settings.

Child care expenditures are observed only when parents use paid child care services (regardless of labor supply), and salaries are observed when mothers participate in labor force (fathers' salaries are always observed in two-parent households and considered exogenous).

Therefore, child care market prices and market wages are constructed from reported child care expenditures and salaries with appropriate selection model. In a system of four equations, we estimate the joint likelihood of mothers' labor force participation and likelihood of paying for child care, wages conditional on labor force participation, and child care expenditures conditional on paying for care. In other words, denoting reservation price of child care by P_R and reservation wage rate by w_R, the system of equations is:

(5) $$I_P^* = P - P_R\left(R, TS, w, X\right)$$

(6) $$I_w^* = w - w_R\left(R, TS, MD, P, X\right)$$

(7) $$P = f\left(S_{state}, w_{CC}, R, \text{X}\right)$$

(8) $$w = f\left(E, X\right)$$

There are two decision rules. Parents use paid care, denoted by $I_P = 1$, if $P < P_R$. And, mothers participate in labor force if $w > w_R$, denoted by $I_w = 1$. Reservation prices of child care and reservation wages are functions of several variables. The vector R includes state regulations regarding child care settings, the vector TS includes state tax credits and subsidies that are likely to affect both labor supply and demand for child care, MD denotes Medicaid expenditure per enrollee in the state of residence, the vector E includes variables indicating the economic environment in the state of residence (average hourly wage rate, women's earnings as a percentage of men's earnings[5], and unemployment rate), S_{state} denotes the percentage of the total state and federal funding for Child Care and Development Block Grant (CCDBG) that is covered by the state of residence, w_{CC} is the average hourly wage rate of education administrators from preschools and child care centers in the state of residence, and X consists of a number of individual- and household-level covariates (mother's education, child's age, race and ethnicity, number of children and number of adults in the household, urban residency, and whether household lives in own home, rental house or apartment, or in other housing situation. Thus, w (the individual-level wage rate) in equation (5) is instrumented by E, while P (hourly cost of child care at the household-level) in equation (6) is instrumented by S_{state} and w_{CC}. Appendix A

[5] The Bureau of Labor Statistics does not publish gender specific average hourly wage rates by state over multiple years, although such data are available at the national level. Thus, we use time series data on state average hourly wage rates and women's earning as a percentage of men's earning in each state to proxy market wages faced by women in our sample from 2001 to 2007.

presents all state-level data used in this study. data on a number of state-level child care regulations and economic characteristics. The economic environment variables and average wage rates of child care providers are obtained from the Bureau of Labor Statistics. Data on state-specific maximum earnings an applicant can retain and still be eligible for Temporary Assistance for Needy Families (TANF) are obtained from the Urban Institute's Welfare Rules Database. Earned Income Tax Credit (EITC) information is obtained from Tax Credits for Working Families website. Medicaid expenditures are available from the Centers for Medicare and Medicaid Services. CCDBG data are available from the U.S Department of Health and Human Services and Administration for Children and Families. State regulations regarding food menus and screen time are obtained from Benjamin et al. (2008, 2009). Information on state tax credits for child care is obtained from Maag (2005). State-specific education requirements for child care centers are obtained from the National Association of Child Care Resource and Referral Agencies. State-level children-to-staff ratio by age categories in child care centers are obtained from Inter-university Consortium for Political and Social Research, University of Michigan.

We estimate the four equations, equations (5)-(8), simultaneously. We estimate these equations for each wave and separately for each household type. A less intensive estimation procedure has been used by Kimmel (1998) and Powell (1997). However, in their data use of paid child care was observed among working mothers only, and hence child care expenditure was observed only among working mothers who used paid child care services and required use of two selection correction terms as regressors in the final child care price equation. In addition, they estimated wages and child care prices in two separate selection models. The results for each of these equations are consistent with those usually described in the literature and are not presented here.[6]

We use predicted care price and wage rates to estimate their effects on amount of time spent in different care settings. Random effects tobit models of reduced-form demand equations of amount of time spent in paid relative care, unpaid relative care, non-relative care, center care and Head Start are estimated. Covariates include number of hours in kindergarten in a week in wave 4, child's age, race and ethnicity, number of children and adults in the household, grandparents' education levels (both sets of grandparents in two-parent households), urban

[6] They are available from corresponding author upon request.

residency, housing situation (own home, rent or other), state-level child care regulations, tax credits and subsidies related to child care, and Medicaid expenditures per enrollee. Censored regression is used because amounts of time spent in various care types are non-negative and have upper limit of 120 hours/week during weekdays. We estimate random effects tobit models, as fixed effects censored models are known to produce biased and inconsistent estimates (Honoré, 1992). The predicted values of amount of time spent in different care settings are positively and significantly correlated with the corresponding observed data, indicating good model fit. A limitation of using the predicted values instead of the observed data in subsequent models, however, is that we do not have sufficient instruments to distinguish between prices of different types of non-parental paid care. In other words, equations (5)-(8) are estimated assuming there is only one market price for child care irrespective of type of care. While in the survey data we observe that on an average, cost of care per hour across all households is ordered from a relatively low $0.27/hour in Head Start, $2.39/hour in paid relative care, and a relatively high $3.65/hour in non-relative care and center care.

Next, we use tobit models to estimate the effect of amount of time spent in different care settings on consumption of various food types. The covariates include food prices, number of hours spent in kindergarten in wave 4, number of hours child watched television/day during weekdays, child's age, race and ethnicity, number of children in the household, number of adults in the household, urban residency, and logarithm of household permanent income.

The final set of estimating equations involves logit models. We estimate both fixed effects and random effects models, and use a Hausman specification test to conclude that random effects estimates are unbiased and consistent, but more efficient due to the inclusion of time-invariant covariates. The dependent variable is children's obesity status. Specifically, we estimate two sets of models. First, we test the effect of food intake on obesity status. Second, we test the effect of both food intake and the role of different care settings on obesity status. The later model is estimated to understand if differences in care settings might capture information regarding differences in physical activities and add to the explanatory power. Covariates include child's age, race and ethnicity, mother's education level (as well father's education level in two-parent household), logarithm of household permanent income, number of hours spent in kindergarten in wave 4, number of hours spent in viewing television, if child was breastfed during infancy, and child's birth weight.

V. Results

Child care choices

Table 2 presents the effect of predicted price of child care services and predicted market wages on the choice of amount of time spent in different care settings in a week in the pre-kindergarten and kindergarten waves. Estimates are obtained from random effects tobit models of reduced-form demand equations of time spent in different types of care settings. Regressors include predicted price of care, predicted wage rate, and other individual and household characteristics.

In both types of households, increase in wages is associated with increase in use of center care and decrease in use of Head Start. The negative relationship between Head Start usage and wages is perhaps because higher earners are less likely to be eligible for Head Start. We do not find any statistically significant relationship between wages and use of either paid or unpaid relative care settings in two-parent households, while in one-parent households use of paid relative care increases and use of unpaid relative care decreases with increase in wages. There could be two reasons for the negative relation between unpaid relative care and market wages. First, some relatives may want to re-enter labor market when it becomes more lucrative and are less available to provide child care services for free. The second reason could be that with increase in purchasing power parent might want to pay for child care that is subject to more regulations. We note that in two-parent households, increase in wages is also associated with greater use of non-relative care.

Demand for time in different care settings seems to be generally inelastic to child care price in pre-kindergarten and kindergarten waves. The only exceptions are demand for Head Start in both households, and center in two-parent households. Amount of time spent in Head Start decreases in both households with increase in child care market price; while amount of time in center care decreases only in two-parent households indicating more flexibility in use of one of the more common form of paid cares when in this type of households.

Food choices

We model consumption of different types of food items as function of child care settings and other individual-level characteristics. We consider three high energy-dense items – fast food, soda, and juice, and two low energy-dense items – fruits and vegetables. The results are presented in Table 3. We note the small R^2 values, indicating low explanatory power of the models which could be because of the young age of the sample under consideration.

Food intake is aggregated across home and child care environments. In other words, the ECLS-B surveys did not inquire about food consumption separately at home, at school, or in other different locations. Thus, we use amounts of time spent in different environments (instead of categorical measure of care settings) to obtain the effect of child care choices in food consumption behavior. Sum of amounts of time spent in different settings including parental care equal to one hundred and twenty hours during the weekdays. Effects of amount of time spent in different non-parental care settings on food choices are discussed in comparison to the effect of amount of time in parental care.

In single mother households longer amount of time in non-relative and center cares is associated with lower consumption of soda, while soda consumption is higher in relative care in two-parent households. In both types of households, higher consumption of fast food is observed when greater amount of time is spent in paid relative care. Higher consumption of fruits and vegetables are noted among children who spend longer time in Head Start. Higher consumption of vegetables among children in one-parent households could also be attributed to longer amount of time in center care. On the other hand, consumption of juice is higher among children in two-parent households who spend longer duration in center care. Food habits seem to improve in wave 4 with a large number of children spending more time in kindergarten. Consumption of soda decreases among children in one-parent households, while consumption of fast food decreases among children in two-parent households. Consumption of juice also decreases.

Childhood obesity

In the final set of estimation, we analyze the prevalence of childhood obesity. In Table 4, we present odds ratios from random effects logit models of obesity status as a function of child care and food choices along with the usual covariates. Columns (1) and (3) show odds ratios from models without controlling for child care environment; and, columns (2) and (4) show odds

ratios from models while controlling for child care environment. In the absence of data on physical activity, the second set of models which include controls for child care environment are analyzed in order to understand if these controls capture information additional to food environment alone. We find that prevalence of obesity is operating through the food consumption patterns and not directly through choice of care settings, especially in one-parent households. Again, in the second set of model, effects of amount of time spent in different non-parental care settings on obesity are discussed in comparison to the effect of amount of time in parental care.

Higher consumption of soda and fast food emerges as significant factors in explaining higher obesity rates among children in single mother households, while higher consumption of juice is associated with higher propensity of obesity in two-parent households. Higher consumption of vegetables is associated with lower rates of obesity among children in two-parent households. Only among children in two-parent households do we notice any direct effect of child care settings on obesity. We find that those who spend longer amount of time in center care compared to in parental care are less likely to be obese. Additionally, likelihood of obesity falls significantly among children in two-parent households as they spend more time in kindergarten.

VI. Conclusion

We show that wage effects are stronger than price effects in parents' choices of care settings for their children. This is an important finding, since we then show that strong associations exist between choice of care settings and frequency of consumption of certain food items among pre-school and kindergarten aged children. Finally, we show that prevalence of childhood obesity is directly related to food consumption patterns, and not directly through choice of care settings in single mother households. Higher consumption of soda and fast food in single mother households, and higher consumption of juice in two-parent households are the primary factors in explaining likelihood of obesity. We use random effects logit models to obtain these results, and use Hausman specification tests to show that the estimates are unbiased, consistent, and efficient.

At least as far as childhood obesity is concerned, after accounting for differences in food choices, child care choices have little impact on the prevalence of obesity among pre-school and kindergarten age children in two-parent households and no impact in single mother households. In two-parent households, children are less likely to be obese with greater use of center care compared to parental care, and once they begin kindergarten. In this dataset, it is difficult to immediately attribute differences in food intake to differences in care choices itself because food intake is aggregated across home and child care environments. Certain strong statistical differences are worth mentioning though.

In single mother households lower consumption of soda is seen among children who spend longer duration time in non-relative and center cares, while higher consumption is seen among children in two-parent households who spend longer duration of time in relative care. These comparisons are made with respect to time spent in parental care. Fast food consumption is higher with longer period of time in paid relative care. Fruit and vegetable consumptions are higher among children who spend longer duration of time in Head Start. Consumption of juice decreases as children begin to spend longer time in kindergarten. Consumptions of soda among children in one-parent households and of fast food among children in two-parent households also decrease as they begin kindergarten.

In conclusion, even among children six years old and younger, differences in food choices are observed and these consumption patterns contribute to differences in obesity rates. We do not find any direct effect of differences in care settings on differential obesity rates in single mother households. Yet, the role of care settings on food choices may be important for diet quality and cannot be completely ignored given some notable findings.

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Table 1: Descriptive statistics – ECLS-B, pre-kindergarten and kindergarten waves

Variables	Definition	Mean (SD) or Percentage	
		One-parent household	Two-parent household
N	Total cross-sectional sample size in third and fourth waves	2200	8400
Obese	Child's body mass index, adjusted for age and gender, is in the 95th percentile of growth chart	20.52%	14.62%
Child's age	Average age (months) of child	58.55 (7.22)	58.22 (7.25)
Male	Male child	50.29%	51.31%
Parent's education	Educational attainment of mother in one-parent households, and of both parents in two-parent households; measured on a 1 (8th grade or below) to 9 (doctorate or professional degree) scale; e.g.: mean 4.5 is equivalent to 'some college'	3.80 (1.57)	M: 4.77 (2.00) F: 4.71 (2.14)
Parent's age	Mother's age (years) in one-parent households, and both parents' age in two-parent households	29.66 (6.39)	M: 33.56 (6.20) F: 36.17 (7.02)
Parent's work hours	Number of hours parents work in a week among employed individuals	38.41 (10.73)	M: 34.66 (13.01) F: 46.18 (11.28)
Parent's salary	Parents' weekly salaries ($/week) among employed individuals	516.15 (441.9)	M: 694.1 (771.2) F: 1191.7 (1384.3)
Log(income) ‡	Logarithm of household income (in 2001 dollars)	9.69 (0.97)	10.74 (0.84)
Number of adults †	Total number of members residing in the household who are 18 years of age or older	1.66 (1.02)	2.21 (0.62)
Number of children	Total number of members residing in the household who are less than 18 years old	2.47 (1.32)	2.57 (1.13)
Parent's health	Respondent parent's self-reported health, measured on a scale of 1 (excellent) to 5 (poor). In 95% households, respondent parent is the mother	2.41 (1.00)	2.17 (0.95)
Urban	If household resides in an urban area or urban cluster	81.20%	81.24%
Breastfed	If child was breastfed	52.99%	73.43%
Race and ethnicity:	Child's race and ethnicity		
White non-Hispanic	Child is white non-Hispanic	25.57%	46.93%
Black non-Hispanic	Child is black non-Hispanic	38.34%	8.86%
Hispanic	Child is Hispanic	20.92%	19.70%
Asian non-Hispanic	Child is Asian non-Hispanic	2.25%	13.20%
Multi race non-Hispanic	Child is multiracial and non-Hispanic	8.21%	8.05%
Other races non-	Child belongs to any other race and is non-Hispanic	4.71%	3.26%

Hispanic			
TV viewing	Number of hours child watches television each day during weekdays	2.54 (2.55)	2.07 (2.17)
Pay care	If pay out-of-expenses for child care services	50.59%	58.33%
Child care expenditure	Out-of-pocket child care expenditure per child ($/hour), observed when pay for care	2.88 (4.48)	4.56 (5.62)
Time in child care:	Average amount of time spent in care arrangement(s) in a week during wave 3 and after school in wave 4		
Unpaid relative care	Average non-zero hours in unpaid relative care	21.54 (16.19)	17.24 (14.45)
Paid relative care	Average non-zero hours in paid relative care	22.78 (18.32)	18.20 (14.28)
Non-relative care	Average non-zero hours in non-relative care	22.48 (14.79)	19.16 (14.37)
Center care	Average non-zero hours in center care	23.65 (14.10)	19.18 (13.47)
Head start	Average non-zero hours in Head Start	24.56 (12.74)	21.40 (11.87)
In school	If child entered kindergarten in wave 4	74.07%	73.42%
Kindergarten hours	Amount of time child spent in kindergarten in wave 4, if child in kindergarten	30.77 (7.24)	28.07 (8.55)
Consumption of:	Frequency of consumption of eight types of food was recorded in waves 3 and 4. Responses were categorized as 0=never in past seven days, 1=one to three times in past seven days, 2=four to six times in past seven days, 3=once per day, 4=twice per day, 5=thrice per day, 6=four or more times per day.		
Soda	Includes pop (for example, Coke), sports drinks (for example, Gatorade), or fruit drinks that are not 100% fruit juice (for example, Kool-Aid)	1.93 (1.67)	1.44 (1.49)
Fast-food	Includes meal and snack from fast food restaurant with no wait service (for example, McDonald's) and respondents were asked to consider eating out, carry out, and delivery meals	1.09 (1.02)	0.92 (0.85)
Fruits	Includes fresh fruit, canned fruits, frozen fruits, dried fruits, or other fruits such as applesauce	3.12 (1.51)	3.11 (1.40)
Vegetables	Includes all vegetables served as a salad, stir fry, soup, or stew, excluding French fries and other fried potatoes	3.01 (1.47)	2.91 (1.38)
Juice	Includes 100% fruit juice such as orange juice, apple juice, and grape juice, but excluding punch, Sunny Delight, Kool-Aid, sports drinks, or other fruit-flavored drinks	3.08 (1.67)	2.79 (1.65)
Salty snacks	Includes potato chips, corn chips, pretzels, popcorn, crackers, and other similar salty snack food	1.92 (1.37)	1.65 (1.21)
Sweet snacks	Includes candy, Fruit Roll-ups, ice cream, cookies, cakes, brownies, and other similar sweet items	2.19 (1.42)	2.21 (1.31)
Milk	Includes all types of milk, including cow's milk and soy milk	3.93 (1.52)	3.98 (1.42)

‡ A continuous measure of income was first imputed from the categorical values using interval regression models, and then converted to a logarithmic scale.

Note: Sample sizes have been rounded to the nearest 50 to comply with the rounding rules for publishing ECLS-B data.

Table 2: Effect of child care price on choice of amount of time spent in different care settings, pre-kindergarten and kindergarten waves – Estimated coefficients from random effects tobit models

Independent variables	Amount of time spent in				
	Paid relative care	Unpaid relative care	Non-relative care	Center care	Head Start
One-parent households:					
Predicted care price ($/hour)	2.064 (1.03)	1.159 (0.78)	0.758 (0.40)	– 0.596 (– 0.53)	– 6.908*** (– 3.68)
Predicted wage (in '00 $/week)	0.028*** (3.56)	– 0.019*** (– 3.07)	0.013 (1.19)	0.043*** (10.80)	– 0.022*** (– 3.70)
Two-parent households:					
Predicted care price ($/hour)	1.263 (1.48)	0.721 (0.93)	– 0.593 (– 0.71)	– 0.256 (– 0.71)	– 7.514*** (– 8.49)
Predicted wage (in '00 $/week)	0.003 (0.71)	0.002 (0.47)	0.012*** (2.93)	0.012*** (6.58)	– 0.020*** (– 3.00)

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

Note: *t*-statistics in parentheses; bootstrap standard errors estimated. Individual-level and state-level covariates described in the text are included in the estimations but not shown here.

Table 3: Food choices as functions of time spent in different care settings – Estimated coefficients from random effects tobit models

Independent variables	Dependent variable (Quantity of consumption of)				
	Soda	Fast food	Juice	Fruits	Vegetables
One-parent households:					
Amount of time spent in:					
Paid relative care	– 0.0002 (– 0.06)	0.004 (2.01)**	0.001 (0.21)	0.0001 (0.04)	– 0.002 (– 0.73)
Unpaid relative care	0.005 (1.49)	0.003 (1.27)	0.001 (0.35)	– 0.002 (– 0.77)	0.002 (0.78)
Non-relative care	– 0.015 (– 3.09)***	– 0.002 (– 0.78)	0.004 (1.02)	0.001 (0.33)	– 0.003 (– 0.86)
Center care	– 0.007 (– 2.21)**	– 0.0007 (– 0.36)	– 0.001 (– 0.53)	0.002 (0.93)	0.004 (1.82)*
Head-start	0.0003 (0.08)	0.003 (1.36)	0.003 (0.92)	0.005 (1.88)*	0.005 (1.98)**
Kindergarten	– 0.009 (– 2.29)**	– 0.002 (– 0.85)	– 0.007 (– 1.82)*	0.003 (0.88)	– 0.0001 (– 0.04)
Pseudo R^2	0.014	0.011	0.011	0.005	0.007
Two-parent households:					
Amount of time spent in:					
Paid relative care	0.013 (4.48)***	0.004 (2.62)**	– 0.0003 (– 0.11)	– 0.003 (– 1.67)*	– 0.0001 (– 0.06)
Unpaid relative care	0.011 (3.88)***	0.002 (1.06)	– 0.0004 (– 0.15)	0.00001 (0.01)	0.002 (0.78)
Non-relative care	0.003 (1.21)	– 0.001 (– 0.87)	0.002 (1.03)	– 0.003 (– 1.62)	– 0.002 (– 0.88)
Center care	0.001 (0.76)	– 0.001 (– 1.47)	0.003 (1.86)*	0.0003 (0.27)	0.002 (1.51)
Head Start	0.004 (1.51)	– 0.001 (– 0.50)	0.004 (1.52)	0.006 (3.06)***	0.007 (4.03)***
Kindergarten	0.0001 (0.09)	– 0.002 (– 1.89)*	– 0.005 (– 2.58)**	– 0.001 (– 0.85)	0.0001 (0.10)
Pseudo R^2	0.022	0.011	0.014	0.005	0.003

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

Note: *t*-statistics in parentheses. Individual-level and state-level covariates described in the text are included but not shown here. Comparison category is the amount of time child spends in parental care. The dependent variables are predicted quantities of consumption, and are treated as continuous variables. The primary independent variables are predicted amount of time spent in different care settings. Predicted values were obtained from system of reduced-form demand equations.

Table 4: Effects of time spent in different care settings and food choices on obesity status – Odds-ratios from random effects logit models

Variables	One-parent households		Two-parent households	
	(1)	(2)	(3)	(4)
Consumption frequency of:				
Soda	1.158 (2.11)**	1.164 (2.17)**	1.069 (1.62)	1.068 (1.59)
Fast food	1.281 (2.27)**	1.282 (2.25)**	1.100 (1.45)	1.096 (1.39)
Fruits	0.927 (– 0.94)	0.926 (– 0.94)	1.010 (0.21)	1.011 (0.23)
Vegetables	0.880 (– 1.55)	0.879 (– 1.55)	0.908 (– 2.06)**	0.909 (– 2.04)**
Juice	0.960 (– 0.57)	0.956 (– 0.62)	1.107 (2.72)***	1.110 (2.77)***
Amount of time in:				
Paid relative care		1.010 (0.89)		1.008 (0.90)
Unpaid relative care		1.007 (0.74)		1.007 (0.75)
Non-relative care		1.015 (0.98)		0.997 (– 0.37)
Center care		0.999 (– 0.03)		0.989 (– 2.18)**
Head-start		1.002 (0.24)		0.990 (– 1.31)
Kindergarten	1.002 (0.39)	1.004 (0.49)	0.995 (– 1.37)	0.990 (– 2.33)**
Pseudo R^2	0.042	0.043	0.039	0.040
Hausman test: χ^2 (p-value)	16.35 (0.23)	18.43 (0.36)	11.22 (0.67)	13.80 (0.74)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ Note: *t*-statistics in parentheses. Covariates described in the text. Dependent variable is whether child is obese or not.

Appendix A: State-level characteristics

State-level variables	Definition	Mean (SD) or Percentage
CCDBG	State's share of the total (state and federal) funding for Child Care and Development Block Grant (CCDBG) from 2001 to 2007	43.29%
Child caregiver wage rate	Average hourly wage rate of education administrators from preschool and child care center from 2001 to 2007	19.92 (3.46)
Medicaid	Annual Medicaid expenditure per enrollee from 2001 to 2007 ($)	6032.48 (1950.10)
Child care regulations:		
Children-to-staff ratio	State regulations, as of 2005, regarding the number of children for every staff member for 3-year and 5-year old children are used for waves 3 and 4, respectively	3-year: 11.50 (2.15) 5-year: 16.36 (4.21)
Education	If state-level minimum education requirement for lead/master teacher in a center was at least a High School Diploma or GED, as of 2007	28.75%
Training	Number of annual on-going training requirement for lead/master teacher in a center, as of 2007	12.91 (7.59)
Health	Other health or safety training requirement, as of 2007	88.69%
Menu posted – child care centers	If there was a state regulation regarding menus in child care centers be posted or made available to parents, as of 2007	78.45%
Menu posted – family child care homes	If there was a state regulation regarding menus in family child care homes be posted or made available to parents, as of 2007	41.27%
Food menu – child care centers	If there was a state regulation regarding menus in child care centers reflect the food served, as of 2007	31.56%
Food menu – family child care homes	If there was a state regulation regarding menus in family child care homes reflect the food served, as of 2007	40.67%
Screen time – child care centers	If there was a state regulation regarding television and other screen time in child care centers, as of 2007	33.34%
Screen time – family child care homes	If there was a state regulation regarding television and other screen time in family child care homes, as of 2007	22.66%
Tax credits, subsidies:		
Full or partial refundable credits	If state offered a refundable child care credit or a credit that was refundable for at least low-income families, as of 2004	31.97%
Non-refundable tax credits	If state offered child care credits that were non-	16.28%

	refundable, as of 2004	
Deductions	If state offered a deduction of child care expenses, as of 2004	2.78%
TANF	Maximum earnings an applicant can retain and still be eligible for Temporary Assistance for Needy Families (TANF) from 2001 to 2007 ($/month)	734.07 (300.50)
EITC	States with Earned Income Tax Credit (EITC) as of 2007	6.23%
Economic environment:		
Wage rate	Average hourly wage rate from 2001 to 2007 inclusive of all occupations	8.69 (0.75)
Women's earnings	Women's earnings as a percentage of men's earning from 2001 to 2007	78.11 (3.84)
Unemployment rate	Rate of unemployment from 2001 to 2007	5.17 (1.14)