

## Childhood Obesity and Exposure to Head Start Services

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October 2, 2007

JEL Classification: I12, I18, J13, H75

Keywords: obesity, Head Start

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Acknowledgements: Financial assistance from the Robert Wood Johnson Foundation (Frisvold) and American Heart Association Fellow-to-Faculty Transition Award (Lumeng) is gratefully acknowledged.

## Abstract

Participation in Head Start is generally associated with improvements in health and human capital; however, there has been little research on the impact of the differences in Head Start services on health outcomes. Using unique, administrative data, we compare the change throughout the year in obesity status of children enrolled in full-day services to those enrolled in half-day services. Regression and matching estimates suggest that participating in full-day Head Start classes leads to a four percentage point reduction in obesity. Estimates based on changes to the supply of full-day classes as a result of the unexpected elimination of a state-provided full-day expansion grant lead to similar conclusions.

## **Introduction**

The link between early childhood conditions and adult outcomes suggests that public investments in the health and human capital of poor youths may significantly improve individual and social welfare. Beginning with the War on Poverty in 1965, the Head Start program has been one of the largest federal investments in the development of disadvantaged children. The program currently provides educational, health, nutritional, and social services to approximately 900,000 children and their families per year at an annual cost of \$7 billion. Participation in Head Start is generally associated with improvements in health and human capital and the benefits of Head Start have exceeded the costs, especially during the initial years of the program (Ludwig and Phillips, 2007).

Significant increases in federal appropriations since the late 1980s have expanded the Head Start program by increasing the enrollment and the number of children who attended full-day classes, as shown in Figure 1.<sup>1</sup> Increases in the availability of Head Start full-day services may better serve the needs of low-income families following the work requirements of the 1996 welfare reform. However, little is known about the marginal impacts of different aspects of the Head Start program, including the impact of full-day attendance compared to part-day attendance on child outcomes. To learn more about the impact of Head Start, Congress mandated that the Department of Health and Human Services study the circumstances under which Head Start achieves the greatest impact. The ensuing randomized evaluation, which is still in the field, has focused on many key domains of development, but neglected the study of child nutrition and obesity.

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<sup>1</sup> Thanks to Kevin Costigan in the Administration for Children and Families and Don Stark at Xtria for providing us with the full-day enrollment figures from the Head Start Program Information Reports.

This research examines the impact of differences in the intensity of Head Start services (full-day attendance compared to half-day attendance) on childhood obesity, a significant public health concern that is associated with a variety of health consequences. The prevalence of childhood obesity has risen dramatically over the past 30 years, nearly tripling (Ogden et al, 2006). Childhood obesity is predictive of obesity during adolescence and young adulthood (Nader et al, 2006; Whitaker et al, 1997) and childhood obesity is associated with various comorbidities including hypertension and other cardiovascular disease risk factors, type 2 diabetes, sleep apnea, and asthma (Ebbeling, Pawlak, and Ludwig, 2002). Additionally, the preschool ages represent an influential developmental stage for determining behavior patterns associated with diet and physical activity (Birch, 1999).

As a result of the comprehensive services of the program, including the nutritional, education, and exercise aspects of the curriculum, participants' weight status can be influenced from Head Start. Previous research suggests that participation in Head Start reduces the likelihood of being obese (Frisvold, 2007; Lumeng and Frisvold, 2007) but has not examined the differential impact of participating in full-day services compared to half-day services. An important difference in the program options is that federal guidelines require that children in half-day classes receive at least 1/3 of the recommended daily allowance of vitamins, minerals, and protein through meals and snacks, while children in full-day classes are provided with twice that amount.

Using unique, administrative data from a Michigan Head Start program from 2001 to 2006, we examine the information of approximately 1800 participants, their families, and Head Start centers. These data include height and weight measured at the beginning and end of the

program year, pre-Head Start family background information from the Head Start application, and program characteristics.

We compare the change in weight status and body mass index (BMI) of children enrolled in full-day services to those enrolled in half-day services. By comparing the outcomes of children within Head Start based on variation in their exposure to the services of the program, we estimate the marginal impact of additional Head Start services as opposed to the average treatment effect of the Head Start program. A benefit of this approach is that it allows for selection on unobserved characteristics to influence the decision to participate in Head Start. We utilize the extensive information on pre-Head Start characteristics to control for nonrandom selection into full day services. Differences in means, regression estimates, and matching estimates suggest that full-day services reduce the rate of obesity at the end of the year by approximately an additional four percentage points more than half-day services.

Additionally, we use the unexpected elimination of a state-provided full-day expansion grant in 2002 to identify the impact of changes to the supply of full-day program slots on childhood obesity. In 2002, 42 percent of children in the data attended full-day Head Start. In response to a state budgetary deficit, full-day expansion grants were eliminated statewide. Following the elimination of the full-day expansion grant, the percent of children attending full-day Head Start fell to 11 percent, as shown in Figure 2. Our results suggest that the 30 percentage point reduction in the supply of full-day services increased the proportion of obese children at the end of Head Start by four percentage points.

## **Background**

Head Start is a comprehensive, national, federally funded program designed to augment the human and health capital of disadvantaged children to better prepare them for subsequent educational experiences. Since its inception in 1965, Head Start has provided services to more than 23 million preschool children (Office of Head Start, 2006a). In 2005, 906,993 children attended Head Start at an average cost of \$7,287 per child. Fifty-two percent of these children were 4 years old and 34 percent were 3 years old. Thirty-one percent of Head Start participants in 2004 were black and 35 percent were white (Office of Head Start, 2006a).

A child is eligible for Head Start if the family's gross annual income, including unemployment compensation and other sources of transfer income, is less than or equal to the poverty line (Office of Head Start, 2006b). A child in a family whose income exceeds the poverty line is eligible for Head Start if the family receives public assistance, if the child is in foster care, or if the child is disabled. Additionally, a child must be at least 3 years old to be eligible for Head Start participation, based on the date used by the community to determine public school eligibility. Once enrolled in Head Start, children may remain in the program until kindergarten or first grade is available in the community.

Approximately 55 percent of eligible children nationwide have the opportunity to participate in Head Start. Each Head Start program must establish a formal selection mechanism for determining which eligible children are admitted into the program. At least 90 percent of participants must come from families with incomes below the poverty line, and at least 10 percent of the enrollment opportunities must be available for children with disabilities. Children with the greatest need for Head Start services – the most disadvantaged – are selected by the program administrators.

Head Start offers two center-based program options for participants; children either attend full-day sessions, which are six hours or more per day, or part-day sessions.<sup>2</sup> For children to be eligible for full-day services, parents are generally required to be working or in training full-time (Brush et al, 1995). Because there are likely to be more children eligible for full-day services than slots for these children, it is common for Head Start programs to use the same formal selection mechanism for determining admittance into Head Start as for determining which children attend full-day services.

Head Start participation is generally associated with improvements in child well-being. Participation in Head Start has led to increases in cognitive development (U.S. Department of Health and Human Services, 2005) and increases in educational attainment (Garces, Thomas, and Currie, 2002; Ludwig and Miller, 2007). Head Start participation is associated with a reduction in behavioral problems (U.S. Department of Health and Human Services, 2005) and criminal activity (Garces, Thomas, and Currie, 2002). Head Start participants are more likely to receive health screenings (Hale, Seitz, and Zigler, 1990), dental examinations (U.S. Department of Health and Human Services, 2005), and immunizations (Currie and Thomas, 1995). Head Start also significantly reduced childhood mortality rates (Ludwig and Miller, 2007). Additionally, Head Start participants are less likely to smoke cigarettes as adults (Anderson, Foster, and Frisvold, 2007) and are less likely to be obese (Frisvold, 2007; Lumeng and Frisvold, 2007).

The substantial benefits from Head Start attendance suggest that the Head Start program has been successful according to a cost-benefit analysis (Ludwig and Phillips, 2007). However,

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<sup>2</sup> Head Start also offers home-based services, combination services that include center-based care and home-based care, family child care, and locally designed program options. In 2004, as reported by the Head Start grantees on the Head Start Program Information Reports, ninety four percent of Head Start attendees attended center-based program options.

the Head Start evaluation literature has generally ignored the heterogeneity in Head Start services, with a few important exceptions.<sup>3,4</sup> Currie and Neidell (2007) find that greater levels of spending on Head Start programs is related to higher reading and vocabulary scores, and that children in programs that spend a greater proportion of expenditures on education and health services are less likely to held back a grade in school and have fewer behavioral problems.

The randomized evaluation of Head Start, the Head Start Impact Study, plans to examine the impact of differences in program quality, teacher characteristics, and program options such as full-day services on child outcomes (U.S. Department of Health and Human Services, 2005). The current reports of this evaluation have focused on differences in impacts on child outcomes for various demographic groups. While the Head Start Impact Study is an important contribution to the understanding of the current impact of this program on child welfare, one limitation of this evaluation is that the health outcomes are measures of access to care and health status that are reported by parents. No objective measure of health is evaluated, and childhood nutrition, a key component of the Head Start services, is not examined.

Exposure to the services in the Head Start program might benefit participants by reducing the likelihood of becoming overweight or obese as a result of the nutritional aspects of Head Start's services, the emphasis on exercise and the development of gross motor skills, increases in non-cognitive skills, and greater access to a continuous source of pediatric care (Frisvold, 2007). One important difference in the Head Start program options that is likely to influence childhood obesity is the intensity of exposure to the nutritional services. The nutritional aspects of Head Start's services include nutritional screening, providing healthy meals, and nutritional education.

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<sup>3</sup> For a discussion of the costs associated with the different Head Start program options, see Besharov, Myers, and Morrow (2007).

<sup>4</sup> Additional related research includes the impact of full-day kindergarten on academic outcomes (DeCicca, 2007) and the impact of length of attendance in a Bolivian preschool program on a variety of child outcomes (Behrman, Cheng, and Todd, 2004).

Head Start personnel determine the child's nutritional needs through nutritional assessments (height, weight, and hemoglobin/hematocrit testing) conducted within the first 45 days of enrollment and from information about the child's and family's eating habits, and then design and implement a nutritional plan. Federal guidelines require that children in a full-day program receive meals and snacks that provide one-half to two-thirds of their daily nutritional needs, while children in a half-day program receive only one-third. Meal times provide the opportunity for nutritional education and children are encouraged to try a variety of foods.

The Head Start nutritional guidelines are consistent with the recommendations of the American Dietetic Association (Briley and Roberts-Gray, 1999), and Fox et al. (1997) found that the nutrient intake from all meals is consistent with the Head Start performance standards. Although the evidence is limited and the sample sizes are small, a 24-hour dietary recall study and national data suggest that Head Start reduces the number of calories consumed by children. Data from the food intake files in What We Eat in America 2003-4, combined with NHANES 2003-4, show that, during dinner and evenings snacks, Head Start participants consume similar levels of calories during the week as on the weekend and consume similar levels of calories during the week as other impoverished children, as shown in Table 1. During the day, Head Start participants consume fewer calories during the week than on the weekend and consume fewer calories than non-Head Start children during the week.

In a 24-hour dietary recall study, Worobey et al. (2005) find that, during the day, children who attend Head Start consumed similar levels of protein, carbohydrate, and fat as middle-income children who attended a private preschool. However, although most of the day's meals were eaten at school, Head Start participants consumed 58 percent of the day's total calories during dinner and evening snacks at home, and in comparison to the middle-income children in

the study, the fat and carbohydrate intake of the Head Start children is 2.5 to 3 times greater after school. Thus, Head Start is likely to improve the nutritional quality of participants' diet by providing nutritious meals and limiting participants' exposure to the poor nutrition offered at home and this impact is likely to be larger for children who are in the Head Start program for a greater period of time during the day.

## **Data**

The data for this analysis were provided by a Head Start grantee in southern Michigan for the program years from 2002 through 2006. Children in this program in full-day classes attended Head Start for eight hours per day for five days per week; children in half-day classes attended Head Start for 3.5 hours per day for four days per week.<sup>5</sup> These data include measured height and weight at the beginning and end of the program year. Additionally, this administrative data set also includes the family background information that is included on the Head Start application and is reported prior to Head Start attendance. This data set is unique because of the multiple measures of height and weight throughout the year combined with program characteristics and detailed family background information.

Head Start children were weighed and measured without shoes during the first 45 days of attendance in the program and at the end of the academic year by their teachers, using the same equipment for each measurement. Additionally, measures of height and weight from pediatric visits are included in the data. Objective measurements of height and weight are more reliable than self-reported measures, which are subject to reporting error (Cawley, 2004). For this analysis, we defined the first measurement in August, September, or October as the beginning of

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<sup>5</sup> In 2006, children in two classrooms attended Head Start for eight hours per day for two days per week; these children were not included in this analysis.

the year measurement and the last measurement in March, April, or May as the end of the year measurement. Height and weight were used to calculate body mass index (BMI), which is correlated with body fat and is recommended by the National Heart, Lung, and Blood Institute for use in clinical practice and epidemiological studies (National Heart, Lung, and Blood Institute, 1998). Dichotomous measures of obese, overweight, and underweight and the continuous measure of BMI z-score were constructed from BMI. Obesity for individuals greater than 24 months old and less than 18 years old is defined by the Center for Disease Control and Prevention as a BMI above the 95<sup>th</sup> percentile of the month of age- and sex-specific BMI distribution. Overweight is classified as a BMI above the 85<sup>th</sup> percentile and underweight is classified as a BMI below the 5<sup>th</sup> percentile.<sup>6</sup> The BMI z-score is calculated by converting the age- and sex-specific BMI distribution into a standard normal distribution.

Children without valid measures of height and weight at both the beginning and the end of the academic year were excluded from the analysis sample. Thus, children who left the program prior to May or began after October were excluded.<sup>7</sup> Additionally, children with implausible measurements were excluded, where implausible measurements included a z-score for BMI, height, or weight less than 4 (BMI, height, or weight measurements 4 standard deviations below the age- and sex-specific mean), a height z-score above 4, a change in BMI during the academic year of greater than or less than 5 units, and a decrease in height of at least 2

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<sup>6</sup> These measures of overweight and obese, which are commonly used in the economics literature, are sometimes referred to in the medical literature as “at risk of overweight” and “overweight.”

<sup>7</sup> There were 215 children in the sample who left the program prior to the end of the year. These children were more likely to be white and living in families with lower incomes with a primary adult who is less likely to be employed full time than children in the analysis sample. The weight status of these 215 children at the beginning of the year is not different from the weight status of the children in the analysis sample. Children who dropped out of the program were not more or less likely to be enrolled in full-day classes than children in the analysis sample. There were 146 children who began the program after October. These children were less likely to have a disability and were less likely to live with a primary adult who was employed full time than children in the analysis sample. These children were less likely to be enrolled in full-day classes than children in the analysis sample. The weight status of these 146 children at the end of the year is not different from the weight status of the children in the analysis sample.

inches. Sample exclusions due to implausible measurements removed less than five percent of the observations. These sample restrictions result in a sample of 1833 observations from 1532 children, since some children enrolled in Head Start for multiple years. Three hundred and twenty seven children with 424 observations attended full-day classes, while 1,205 children with 1,409 observations attended half-day classes.

The proportion of children obese, overweight, and underweight and the mean BMI z-score at the beginning and end of Head Start are shown in Table 2 for children who attended full-day classes and those who attended half-day classes. At the beginning of Head Start, approximately 17 percent of full-day and half-day children were obese. By the end of the program year, only 12 percent of full-day children were obese and 16 percent of half-day children were obese. Overall, the prevalence of obesity decreased 2.3 percentage points by the end of the year, but the decrease for full-day children was 3.8 percentage points higher than for half-day children. The difference-in-difference of means was -3.7 percentage points for the prevalence of overweight; however, this value is not statistically significant. There is little change in the prevalence of underweight for children in either program option. The differences in BMI z-score reflect the changes in obesity. Children in full-day and half-day program options had similar BMI z-scores of approximately 0.5 standard deviations above the mean at the beginning of the year, but the BMI z-score for children in full-day classes decreased by nearly 0.1 standard deviations more than for children in half-day classes.

The comparisons in means in Table 1 suggest that full-day Head Start services led to a significant decrease in obesity compared to half-day services. However, the children who attended full-day services are likely to differ from children in half-day services as a result of the decision rules used by the program to determine the child's placement. To be eligible for full-

day classes, parents must be working full-time (at least 35 hours per week), in training full-time, or in school; however, exceptions are made as needed. The same criteria used to determine Head Start attendance are used by this Head Start grantee to determine which eligible children are selected for full-day classes. Thus, children with in families with a history of domestic violence and substance abuse, with chronically ill parents or siblings, with parents in the military, in limited English homes, who have moved two or more times in the past 12 months, and who do not have access to other programs are more likely to be selected to attended full-day classes. Although not all of the information that is used to determine is available, Table 3 displays the individual and family background characteristics of full-day and half-day children that includes information on employment. The primary adults of children in full-day classes are more likely to be employed full-time than the primary adults of children in half-day classes; as a result, family income is also higher for full-day children.

These differences in family characteristics are likely to be related to childhood obesity. For example, Anderson, Butcher, and Levine (2002) find that maternal employment is related to childhood obesity. However, for these differences to influence the simple comparisons in means then these family background differences must influence the change in obesity, not the level of obesity.

### **Empirical Strategy**

The quantity of interest that we seek to determine is the marginal impact of full-day Head Start services compared to half-day services. In other words, we are interested in estimating the average treatment effect of full-day services, not the average treatment effect of Head Start participation overall. Also, we are interested in the average treatment effect, not the average

treatment effect on the treated, of full-day services, since we are interested in the potential impact of full-day services on all children in Head Start.

A benefit of comparing children who received full-day services to those who received half-day services is that it allows for selection on unobserved characteristics to influence the decision to participate in Head Start (Behrman, Cheng, and Todd, 2004). However, it is important to consider the selection of children into the different program options. We explore regression-based and matching methods to control for selection on observable characteristics into full-day and half-day classes.

The weight status of child  $i$  in period  $t$  ( $W_{i,t}$ ) is specified as:

$$W_{i,t} = \beta_0 + \beta_1 FD_i + \beta_3 X_{i,t-1} + \beta_4 W_{i,t-1} + \varepsilon_{i,t} \quad (1)$$

where FD indicates full-day attendance, X includes individual and family characteristics that are determined prior to Head Start enrollment,  $\varepsilon$  is the error term, and  $\beta$  represents the parameters to be estimated. The specific variables in X are age in months at the end of the year measurement, binary measures of race/ethnicity (Hispanic, black, black and white, other) and sex, whether the child has a disability, the log of family income, family size, whether there is only one parent in the family, whether the primary adult in the family graduated from high school, dichotomous indicators of the primary adult's employment status (full-time; part-time; seasonal, retired, in school, or disabled), and whether the family receives benefits from the Temporary Assistance for Needy Families (TANF) program.<sup>8</sup> Heteroskedasticity-robust standard errors are estimated for all regression estimates.<sup>9</sup> For the dichotomous outcome variables, obese, overweight, and underweight, the above equation is estimated using a probit specification and the reported

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<sup>8</sup> The primary adult is the mother for 94 percent of the sample. Including a dichotomous measure of whether the primary adult is the mother does not influence the results.

<sup>9</sup> Clustering the standard errors to account for the repeated observations of the approximately 20 percent of the sample with multiple years of Head Start attendance has little influence on the standard errors. For example, the standard error for the baseline regression estimate for obesity in Table 4 changes from 0.0157 to 0.0159.

coefficients are average partial effects for the full-day attendance binary variable. For BMI z-score, the above equation is estimated by OLS.

One limitation of the regression estimator is that, because missing potential outcomes are imputed using the estimated regression function, the results are sensitive to differences in the distribution of explanatory variables of full-day (treated) children and half-day (controls) children (Imbens, 2004). Given the mean differences shown in Table 3 in the family background characteristics of full-day and half-day children, regression estimates may not be robust to different specifications.

An alternative strategy is to use matching. Matching estimators impute the missing potential outcomes only of the nearest neighbors of the opposite group (Imbens, 2004). However, matching estimators are not necessarily  $\sqrt{N}$ -consistent (Abadie and Imbens, 2002). Thus, we use the bias-adjusted nearest neighbor matching with replacement procedure developed by Abadie and Imbens (2002) to estimate the population average treatment effect. This procedure is implemented using a minimum of three matches per observation. The same control variables used in the regression estimates are used as the matching variables and the distance metric used to match observations is the diagonal matrix formed by the inverses of the variances of the control variables. Heteroskedasticity-robust standard errors are used for all matching estimates.

Two assumptions ensure that matching estimators identify the average treatment effect (Imbens, 2004). The first assumption is that treatment assignment is independent of the potential outcomes conditional on the explanatory variables, which is known as assuming selection on observables or unconfoundedness. This assumption is not directly verifiable. The second

assumption is that the probability of receiving the treatment conditional on the explanatory variables is bounded away from zero and one.

To improve the overlap between the full-day and half-day sample children who are not likely to be eligible for full-day classes are removed from the sample. Children in families who specify on the application form that the children are not in need of full-day/full-year care are not included in the sample; this restriction removes 295 children.<sup>10</sup> Four hundred and sixty four children whose primary adult was not in the labor force or unemployed were also excluded. The propensity score for the remaining 1131 observations was estimated and 3 observations not in the common support were excluded. The sample was further trimmed to include only observations with propensity scores in the range of [0.1, 0.9].<sup>11</sup> This final exclusion removes 29 observations. The resulting sample size of the selected subsample is 1099 observations, consisting of 383 full-day observations and 716 half-day observations.

The means and standard deviations of this selected sample are shown in Table 3. The differences in means between the full-day sample and the half-day sample as a percentage of the square root of the sample variances for both groups (Rosenbaum and Rubin, 1985) are also shown. Restricting the sample to these 1099 observations improves the overlap of the full-day and half-day samples; the standardized difference in means decreases for nearly every family background variable. The difference between full-day and half-day children in whether the primary adult is employed full-time is substantially reduced; however, a difference between the two samples remains.<sup>12</sup>

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<sup>10</sup> Approximately 39 percent of children had non-missing responses to this question on their application. There were no missing responses in 2002, but there were few non-missing responses in 2004, 2005, and 2006.

<sup>11</sup> Crump et al (2006) show that the set of observations with propensity scores in the interval [0.1, 0.9] approximates the optimal subsample for estimating the average treatment effect under a wide range of distributions.

<sup>12</sup> An alternative strategy to trimming the sample that keeps only children with a primary adult who is employed full-time prior to estimating the propensity score instead of dropping children with a primary adult who is unemployed or not in the labor force yields similar regression and matching estimates.

An alternative strategy is also implemented that relaxes the assumption of selection on observables. In the spring of 2002, budgetary problems and the resulting decrease in funds to education programs throughout the state led to the unexpected elimination of a state-funded full-day expansion grant. Two features of the elimination of this grant are important to note. First, the elimination of this grant was unanticipated. The full-day expansion grant began in 2002 and had been provided to the Head Start grantee for what was expected to be at least 3 years. It was not until 2004 that this Head Start program reallocated program resources to offer more full-day slots to better meet the demands of the low-income working parents in the community. Second, the elimination of this grant was not specific to or targeted at this Head Start program, but instead was part of a statewide budget cut to education programs.

Figure 2 displays the percent of Head Start children attending full-day classes each year and the change in the proportion of obese children within each year from 2002 to 2006. As shown in the figure, the trend of the change in the proportion of obese children closely follows the trend of the percent of full-day children. To further analyze the impact of the exogenous shock to the supply of full-day slots, the weight status of child  $i$  in period  $t$  ( $W_{i,t}$ ) is specified as:

$$W_{i,t} = \delta_0 + \delta_1 YEAR_{2002} + \delta_2 YEAR_i + \delta_3 X_{i,t-1} + \delta_4 W_{i,t-1} + \eta_{i,t} \quad (2)$$

where  $YEAR_{2002}$  is a binary variable equal to one in 2002,  $YEAR$  is specified as either a linear year variable or a set of year dummy variables,  $\eta$  is random error,  $\delta$  represents the parameters to be estimated, and all other variables remain as specified in equation (1). When  $YEAR$  is specified as a linear year variable,  $\delta_1$  represents the deviation in weight status from the linear cohort trend as a result of the expansion of full-day Head Start classes. When  $YEAR$  is specified as a set of dummy variables denoting the years 2004, 2005, and 2006,  $\delta_1$  represents the difference in weight status in 2002 compared to 2003. The results from this cohort-based

empirical strategy estimate a different parameter of interest from the regression and matching estimators. Instead of an estimate of the average treatment effect of full-day Head Start compared to half-day Head Start, this strategy estimates the average treatment effect of full-day Head Start that results because of a change in the supply of full-day slots.

## **Results**

Table 4 displays the estimates of the impact of full-day services on weight status. The first row of numbers repeats the comparisons of means reported in Table 2. The baseline regression estimates display the regression results for the entire sample. These results are very similar to the comparisons of means. Participation in full-day services leads to a 3.3 percentage point larger decrease in obesity and a 3.9 percentage point larger decrease in overweight than participation in half-day services. These changes in overweight and obesity are reflected in the BMI z-score estimates.<sup>13,14</sup> The results using the selected sample with greater overlap between the full-day sample and the half-day sample are similar, although slightly larger, to the results from the entire sample.

Table 4 also displays the bias-adjusted nearest neighbor matching with replacement estimates for the entire sample. These results demonstrate a larger impact of full-day services on childhood obesity; participation in full-day services leads to a 5.7 percentage point larger decrease in obesity than participation in half-day services. The estimate for overweight is near zero and not statistically significant. The estimate for BMI z-score is smaller and less precisely estimated than the regression estimate. The matching estimates for the selected sample are

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<sup>13</sup> These results are not sensitive to the inclusion of additional variables that reflect family needs for additional assistance. Specifically, the additional variables measure whether job training, literacy, mental health, transportation, clothing, emergency, food, and housing services and crisis assistance are needed for the family.

<sup>14</sup> The results for BMI z-score are similar to results obtained using age-adjusted BMI, where the 50<sup>th</sup> percentile of the sex- and age in months-specific distribution is subtracted from BMI.

similar to the unadjusted mean differences and the regression estimates. These results suggest that full-day participation decreases obesity by four percentage points.

Table 5 displays the estimates of the impact of full-day Head Start classes for individuals whose attendance in the full-day program was influenced by the change in the availability of full-day classroom slots from the unanticipated elimination of the state full-day expansion grant.<sup>15</sup> These results show that the reduction in obesity is four percentage points larger in 2002 when compared to the linear trend and when compared to 2003.<sup>16</sup> Estimates from specifications controlling for covariates are similar to estimates from specifications not controlling for covariates, which suggests that these results are not driven by changes in the demographics or family background of full-day participants across cohorts.<sup>17</sup> The estimated impacts on overweight and BMI z-score are negative as well, but these results are not statistically significant. Overall, these estimates suggest that the decrease the percent of children attending full-day from 42 percent in 2002 to 11 percent in 2003 increased obesity by four percentage points.

## **Conclusion**

This paper estimates the impact of full-day Head Start services on childhood weight status. An important difference between the two program options is the quantity of meals served. Additionally, full-day classes potentially limit children's exposure to foods with limited

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<sup>15</sup> The results in Table 5 are estimates of a different parameter than the estimates in Table 4. Table 4 displays estimates of the average treatment effect, while Table 5 displays reduced-form estimates of the local average treatment effect.

<sup>16</sup> The linear trend for obesity has a slope of -0.004.

<sup>17</sup> County economic variables are available from the U.S. Census Bureau's Small Area Income and Poverty Estimates for 2002 through 2004. Restricting the sample to the years 2002 through 2004 slightly increases the absolute value of the coefficient estimates reported in Table 5. Including the log of the median income has no impact on the coefficient estimates. Also including the percent of children in poverty further increases the absolute value of the coefficient estimates and the estimates for overweight and BMI z-score become statistically significant.

nutritional value available outside of Head Start. Our results demonstrate attending full-day Head Start classes leads to a substantially larger reduction in childhood obesity of four percentage points than attending half-day classes. To better understand the magnitude of this impact, following Cutler, Glaeser, and Shapiro (2003) and Schanzenbach (2005), we simulate the potential impact of a change in caloric intake on the rate of obesity.<sup>18</sup> This simulation suggests that the estimated four percentage point change in obesity can be explained by a change in caloric intake of 20 calories per day.<sup>19</sup>

Our results suggest that expansions to the Head Start program that increase the availability of full-day services have the potential to reduce the prevalence of childhood obesity for low-income children. Given the health consequences of obesity, if this impact persists throughout childhood, then the benefits of expansions to the intensity of Head Start services could be substantial. As additional results from the Head Start Impact Study are released that examine the impact of full-day services on cognitive and behavioral outcomes, further information will be known to better assess the implications of and tradeoffs between expansions to the intensity and the breadth of the Head Start program.

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<sup>18</sup> Further details about this simulation are provided in the appendix.

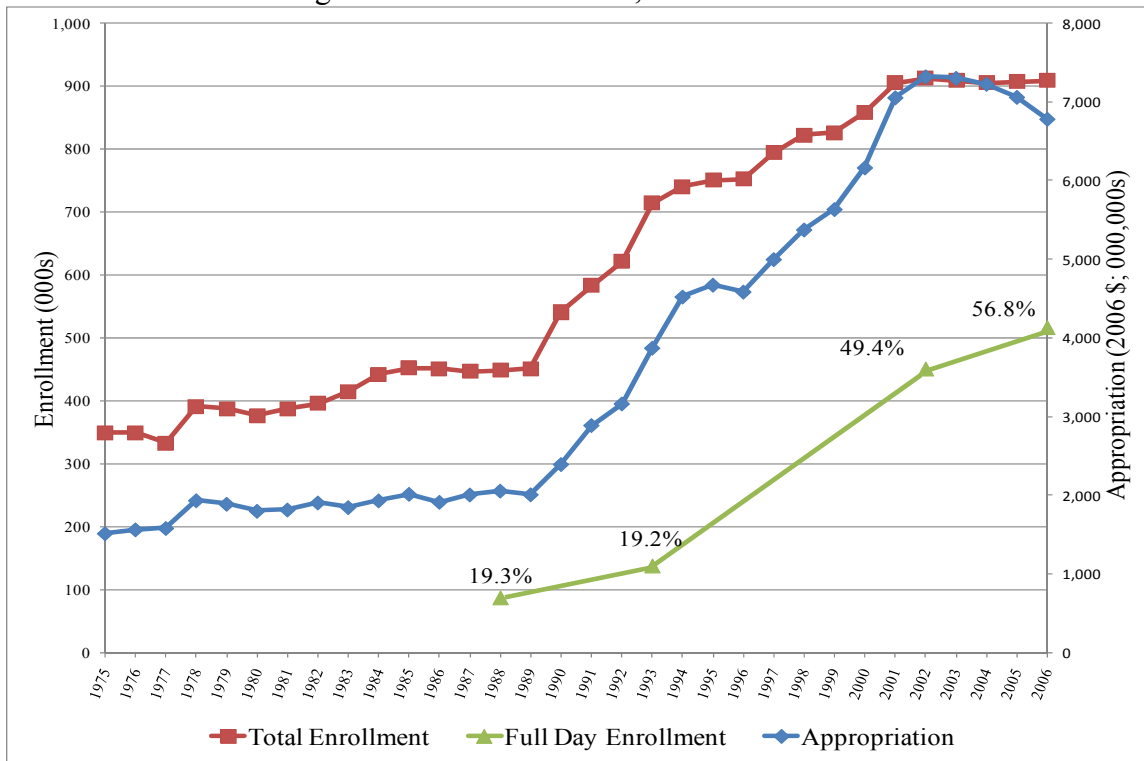
<sup>19</sup> Cutler, Glaeser, and Shapiro (2003) attribute the increase in adult obesity from the 1970s through the 1990s to an imbalance of approximately 100 to 150 calories per day. Schanzenbach (2005) attributes the increase in obesity of 2 to 4 percentage points from the National School Lunch program to an excess intake of 40 to 120 calories per day.

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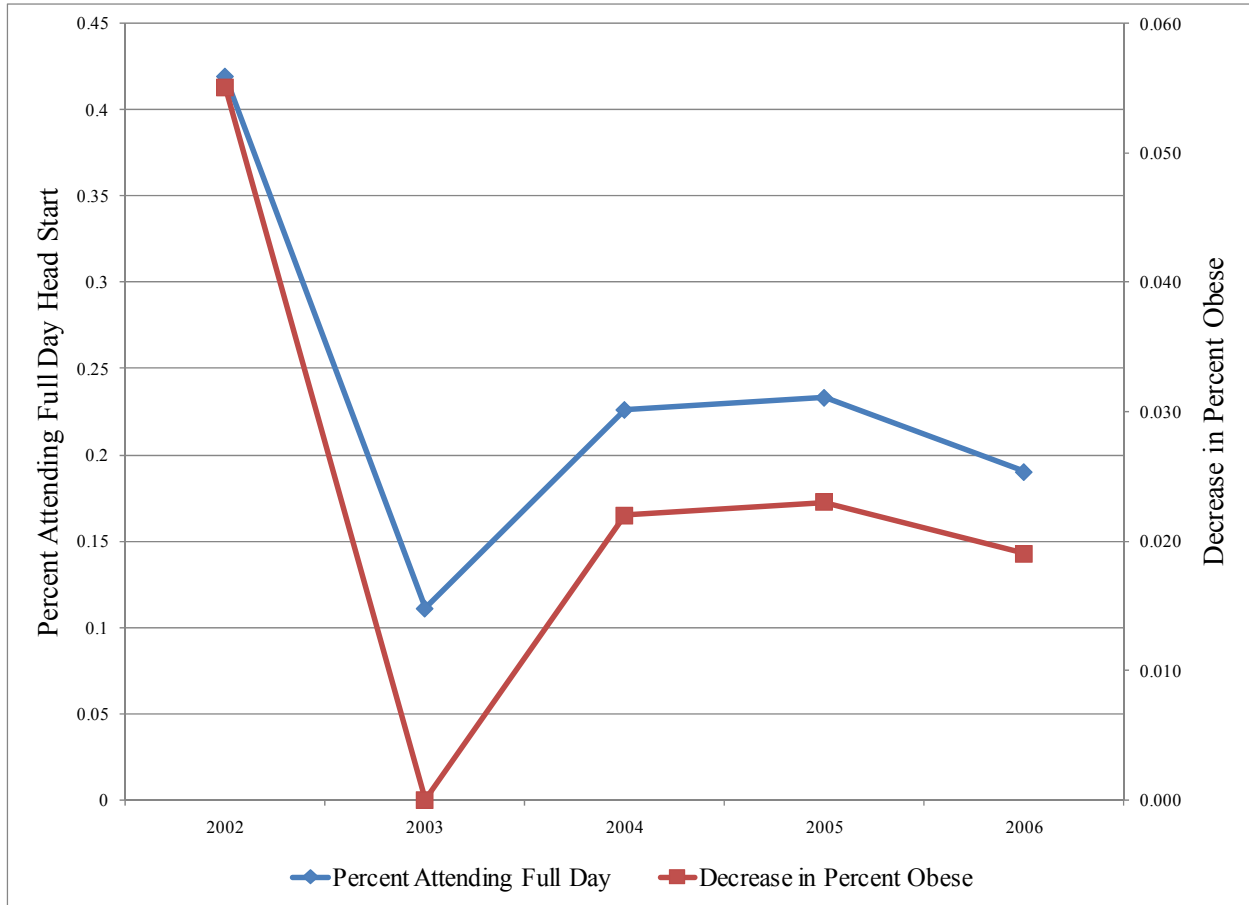
Figure 1: Head Start Funding and Enrollment Trends, 1975-2006



Notes: The total federal appropriation to the Head Start program was converted in to 2006 dollars using the Consumer Price Index for All Urban Consumer annual data. The percent values on the chart represent full day enrollment as a percent of total enrollment.

Sources: Total enrollment and total federal appropriation are from the 2007 Head Start Program Fact Sheet. Full day enrollment figures are from the Head Start Program Information Reports.

Figure 2: Change in Percent Obese and Percent of Head Start Children Attending Full Day by Year



Notes: The decrease in the percent obese is plotted on the positive y axis so that the value of 0.055 on the graph means that the proportion of obese children at the end of the year is 5.5 percentage points less than the proportion of obese children at the beginning of the year.

Source: Administrative data provided by a Head Start grantee in Michigan from 2001 through 2006.

Table 1: Comparisons of Caloric Intake Throughout the Day of Head Start Participants on a Weekday and Weekend and Other Low-Income Children on a Weekday

	Head Start, Weekday	Head Start, Weekend	Not in Head Start, Weekday
Calories during the Day (8am - 5pm)	929 (62)	1314 (121)	1248 (85)
Calories during the Morning (8am - 12pm)	435 (57)	552 (67)	621 (54)
Calories during the Afternoon (12pm - 5pm)	494 (45)	762 (93)	627 (50)
Calories during the Evening/Night (5pm - 12am)	614 (70)	679 (91)	653 (48)
Total Calories	1635 (101)	2010 (159)	1945 (105)
Sample Size	20	16	84
Weighted Sample Size	296,937	148,584	1,800,000

Notes: Standard errors in parentheses. Estimates are for children 36 through 71 months old in families below the poverty line and are weighted by the Day 1 survey weights in the What We Eat in America file. The NHANES data do not identify whether Head Start participation was full-day or half-day.

Sources: NHANES 2003-4, What We Eat In America 2003-4.

Table 2: Mean Differences in Weight Status Throughout the Year by Program Type

	Half Day	Full Day	Full - Half
<b>Proportion Obese</b>			
Beginning of the Year	0.174 (0.010)	0.172 (0.018)	-0.002 (0.021)
End of the Year	0.160 (0.010)	0.120 (0.016)	-0.039** (0.020)
Change	-0.014* (0.008)	-0.052*** (0.017)	-0.038** (0.017)
<b>Proportion Overweight</b>			
Beginning of the Year	0.334 (0.013)	0.344 (0.023)	0.010 (0.026)
End of the Year	0.326 (0.012)	0.300 (0.022)	-0.027 (0.026)
Change	-0.008 (0.011)	-0.045** (0.022)	-0.037 (0.023)
<b>Proportion Underweight</b>			
Beginning of the Year	0.044 (0.005)	0.033 (0.009)	-0.011 (0.011)
End of the Year	0.046 (0.006)	0.040 (0.010)	-0.006 (0.011)
Change	0.002 (0.006)	0.007 (0.011)	0.005 (0.013)
<b>BMI Z-Score</b>			
Beginning of the Year	0.562 (0.033)	0.568 (0.054)	0.005 (0.067)
End of the Year	0.555 (0.033)	0.470 (0.053)	-0.084 (0.066)
Change	-0.008 (0.021)	-0.097** (0.043)	-0.089* (0.045)
Sample Size	1409	424	1833

Notes: Standard errors in parentheses.

Source: Administrative data provided by a Head Start grantee in Michigan from 2001 through 2006.

\* Statistically significant at 10 percent.

\*\* Statistically significant at 5 percent.

\*\*\* Statistically significant at 1 percent.

Table 3: Means (and Standard Deviations) of Individual and Family Characteristics by Program Type

	Entire Sample				Selected Sample			
	All	Full Day	Half Day	Diff / S.D.	All	Full Day	Half Day	Diff / S.D.
Age (months)	52.297 (6.932)	52.226 (6.941)	52.319 (6.931)	-0.01	52.241 (6.884)	52.125 (6.941)	52.303 (6.858)	-0.03
Hispanic	0.066 (0.245)	0.069 (0.253)	0.065 (0.243)	0.02	0.067 (0.247)	0.074 (0.261)	0.063 (0.240)	0.04
Black	0.266 (0.439)	0.341 (0.471)	0.244 (0.427)	0.21	0.311 (0.460)	0.348 (0.473)	0.291 (0.452)	0.12
Black & White	0.083 (0.274)	0.113 (0.314)	0.075 (0.260)	0.13	0.092 (0.286)	0.120 (0.322)	0.077 (0.264)	0.15
Other Race	0.013 (0.111)	0.012 (0.108)	0.013 (0.112)	-0.01	0.008 (0.090)	0.013 (0.114)	0.006 (0.075)	0.08
White	0.572 (0.491)	0.465 (0.495)	0.604 (0.485)	-0.28	0.522 (0.495)	0.445 (0.493)	0.563 (0.492)	-0.24
Female	0.487 (0.500)	0.519 (0.500)	0.478 (0.500)	0.08	0.489 (0.500)	0.501 (0.501)	0.482 (0.500)	0.04
Disabled	0.229 (0.420)	0.203 (0.403)	0.237 (0.425)	-0.08	0.220 (0.415)	0.206 (0.405)	0.228 (0.420)	-0.05
Family Income (ln)	9.397 (0.738)	9.555 (0.707)	9.349 (0.741)	0.28	9.484 (0.720)	9.576 (0.687)	9.434 (0.732)	0.20
Family Income (000s)	15.392 (10.891)	17.671 (12.566)	14.706 (10.241)	0.26	16.591 (11.729)	17.903 (12.749)	15.899 (11.090)	0.17
Family Size	3.977 (1.437)	3.849 (1.369)	4.016 (1.455)	-0.12	3.855 (1.402)	3.822 (1.361)	3.873 (1.424)	-0.04
Single Parent Family	0.570 (0.495)	0.634 (0.482)	0.550 (0.498)	0.17	0.628 (0.484)	0.648 (0.478)	0.617 (0.486)	0.06
Primary Adult Graduated High School	0.639 (0.479)	0.723 (0.445)	0.614 (0.486)	0.23	0.703 (0.455)	0.742 (0.436)	0.682 (0.463)	0.13
Primary Adult is Employed Full-Time	0.473 (0.499)	0.768 (0.422)	0.384 (0.486)	0.84	0.706 (0.455)	0.813 (0.389)	0.649 (0.477)	0.38
Primary Adult is Employed Part-Time	0.151 (0.358)	0.121 (0.326)	0.161 (0.367)	-0.12	0.202 (0.401)	0.131 (0.337)	0.240 (0.426)	-0.28
Primary Adult is in School, Disabled Employed Seasonally, Retired	0.074 (0.261)	0.061 (0.240)	0.077 (0.267)	-0.06	0.091 (0.288)	0.055 (0.228)	0.111 (0.313)	-0.20
TANF	0.395 (0.489)	0.401 (0.491)	0.393 (0.488)	0.02	0.401 (0.490)	0.413 (0.493)	0.396 (0.489)	0.03
Sample Size	1833	424	1409		1099	383	716	

Notes: Standard deviations in parentheses. Diff/S.D. is the differences in means between the full-day sample and the half-day sample as a percentage of the square root of the sample variances for both groups (Rosenbaum and Rubin, 1985).

Source: See Table 2.

Table 4: Estimates of the Impact of Full Day Head Start on Weight Status

	Obese	Overweight	Underweight	BMI Z-Score	N
Unadjusted Differences	-0.038** (0.017)	-0.037 (0.023)	0.005 (0.013)	-0.089* (0.045)	1833
Regression Estimates					
Baseline Estimates	-0.033** (0.016)	-0.039* (0.022)	0.004 (0.012)	-0.089* (0.048)	1833
Selected Sample	-0.041** (0.017)	-0.045* (0.025)	0.007 (0.012)	-0.106** (0.053)	1099
Matching Estimates					
Baseline Estimates	-0.057*** (0.016)	0.010 (0.026)	-0.011 (0.012)	-0.023 (0.059)	1833
Selected Sample	-0.040** (0.018)	-0.033 (0.028)	-0.002 (0.014)	-0.095 (0.064)	1099

Notes: The unadjusted differences are the mean differences in weight status throughout the year by program type shown in Table 2. The regression coefficients for obese, overweight, and underweight are average partial effects from a probit model. Heteroskedasticity-robust standard errors are in parentheses for regression and matching estimates. Additional control variables used in the regression estimates are age in months at the end of the year measurement, binary measures of race/ethnicity (Hispanic, black, black and white, other) and sex, whether the child has a disability, the log of family income, family size, whether there is only one parent in the family, whether the primary adult in the family graduated from high school, dichotomous indicators of the primary adult's employment status (full-time; part-time; seasonal, retired, in school, or disabled), whether the family receives benefits from the Temporary Assistance for Needy Families (TANF) program, and weight status at the beginning of the year. Matching estimates are population average treatment effects from bias-adjusted nearest neighbor with replacement matching.

Source: See Table 2.

\* Statistically significant at 10 percent.

\*\* Statistically significant at 5 percent.

\*\*\* Statistically significant at 1 percent.

Table 5: Estimates of the Impact of Full Day Head Start on Weight Status

	Obese	Overweight	Underweight	BMI Z-Score
Year 2002 Deviation from Linear Trend				
Without Covariates	-0.039** (0.020)	-0.025 (0.030)	0.011 (0.019)	-0.078 (0.061)
With Covariates	-0.044** (0.019)	-0.040 (0.030)	0.010 (0.018)	-0.076 (0.063)
Year 2002 Comparison to 2003				
Without Covariates	-0.041** (0.017)	-0.027 (0.027)	0.013 (0.018)	-0.074 (0.055)
With Covariates	-0.044*** (0.017)	-0.036 (0.027)	0.017 (0.018)	-0.077 (0.056)
Sample Size	1918			

Notes: Heteroskedasticity-robust standard errors are in parentheses. The coefficients for obese, overweight, and underweight are average partial effects from a probit model. All estimates control for weight status at the beginning of the year. Covariates include age in months at the end of the year measurement, binary measures of race/ethnicity (Hispanic, black, black and white, other) and sex, whether the child has a disability, the log of family income, family size, whether there is only one parent in the family, whether the primary adult in the family graduated from high school, dichotomous indicators of the primary adult's employment status (full-time; part-time; seasonal, retired, in school, or disabled), whether the family receives benefits from the Temporary Assistance for Needy Families (TANF) program

Source: See Table 2.

\* Statistically significant at 10 percent.

\*\* Statistically significant at 5 percent.

\*\*\* Statistically significant at 1 percent.