

Expanding Exposure:
Can Increasing the Daily Duration of Head Start Reduce Childhood Obesity?

Supplementary Appendices

Appendix I: Detailed Description of the Head Start Program

This appendix provides a detailed description of the specific Head Start program in Michigan that provided the administrative data set for this research. From 2002 through 2006, 73 distinct classes were offered. Four half-day classes offered in one location were accredited by the National Association for the Education of Young Children in February 2002 and the Head Start grantee is designated as a Quality Program by the Office of Head Start.

All classes are offered and serve residents in an area of Michigan that does not include a major metropolitan area. The geographic location of full-day and half-day does not vary substantially. Many full-day classes are offered at a site that provides only full-day Head Start, but for all sites that offer a full-day class, there is a site in the same zip code that offers a half-day class.

To determine which eligible children are selected to enroll in a full-day class, children are assigned risk points. Children with the most risk points are selected to enroll, up to the number of slots available in full-day classes. Children are assigned three risk points if they are a returning child, disabled, in foster care, if the family income is below the poverty line, if the family receives TANF assistance, if there is a history of domestic violence, if there is a history of substance use, if the child is homeless, if there is a history of death or parental separation in the family, if the child is 5 years old and not ready to attend kindergarten, if a parent or sibling is disabled or chronically ill, if limited English is spoken in the home, if a parent is currently enlisted in the military, if the child was referred by PS Prevention Services, if the family moved two or more times in the past year, or if there are special circumstances. Children are assigned two risk points if the parent is a teenager, if there is only one parent in the family, if the family is socially isolated or there is low support for the family, if the family suffers a financial hardship, if the child does not have health insurance, if the child has a history of using infant mental health services, if the child has a history of depression or mental illness, if there is a family trauma not previously listed, or if a parent is incarcerated. Children are assigned one risk point if the child's mother is currently pregnant, if a person besides a parent has custody of the child, if the family size is six or more, if the parent is 40 years old or older, if the parent did not graduate from high school, if the child will be the first generation from the family to attend Head Start, or if the child was referred by another community agency.

The full-day class operates from 8am to 4pm for 5 days per week for 35 weeks per year. The class size is between 15 and 20 children and there is one teacher and one teacher's assistant in each class, except that there were two teacher's assistants in each class in 2002. Shortly after arrival, children are provided breakfast, which typically consists of a serving of dairy, meat, and fruit. In the morning, children participate in a variety of group activities such as story time. Thirty minutes are schedule for more active events such as "movement activities" and "music and movement." Children are also given 70 minutes of free time to choose their own activities. At noon, children are provided lunch, which typically consists of a serving of dairy, meat, vegetable, and fruit. In the afternoon, children rest for one hour and participate in 45 minutes of

exercise. A snack is provide shortly before the children leave for the day that typically consists of a serving of dairy and meat or a serving of vegetable and meat.

The half-day class operates 8 to 11:30am for morning classes or from 1 to 4:30pm or 12:30 to 4pm for afternoon classes for 4 days per week for 35 weeks per year. The class size is between 15 and 17 children and there is one teacher and one teacher's assistant in each class. For morning classes, shortly after arrival, children are provided breakfast, which typically consists of a serving of dairy, meat, and fruit. Children participate in 15 minutes of exercise and 15 minutes of music time with dancing and singing. Children are also given 60 minutes of free time to choose their own activities. Lunch is provided shortly before the children leave for the day, which typically consists of a serving of dairy, meat, vegetable, and fruit. For afternoon classes, shortly after arrival, children are provided lunch. A snack is provide shortly before the children leave for the day that typically consists of a serving of dairy and meat or a serving of vegetable and meat. The remainder of the schedule for afternoon classes is the same as the schedule for morning classes. In 2006, 10 half-day classes were offered for 7 hours per day for 2 days per week. Children in these classes are excluded from the analysis.

The difference between morning and afternoon half-day classes within Head Start is whether the child is fed breakfast or an afternoon snack; however, there may also be differences in the morning and afternoon activities of half-day children outside of Head Start. Results based on equation (1) that restrict the sample to children who attended a half-day class show that afternoon attendance reduces obesity by 1.8 percentage points more than morning attendance, but this estimate is not measured precisely (the standard error is 0.018). The year of attendance in Head Start has no impact on whether a child attends a morning or afternoon half-day class. Selection on unobservable characteristics for the comparison of morning and afternoon attendance is not likely to be as severe as the comparison of half and full-day attendance.

The meals served in all classes throughout the program are based on the same menu that is designed by the program's nutrition coordinator. Children are not able to bring in outside food with the exception that pre-packaged food purchased from a store with an ingredients list can be brought in for special occasions such as birthdays. Meals are served family-style in the classrooms and staff members eat with the children. Meals for children in full-day classes are required to provide one-half to two-thirds of the recommended daily allowance of vitamins, minerals, and protein. Meals for children in half-day classes are required to provide at least one-third of the recommended daily allowance of vitamins, minerals, and protein.

Estimates based on the changes in funding for full-day Head Start classes could be influenced by changes in aspects of the program or who attends a full-day class across years. The reduction in state funding that reduced the supply of full-day slots could have influenced the program. The components of the program for both half-day and full-day classes did not change. However, the average salaries of teachers and number of assistant teachers did change as the program reduced costs. In 2002, one teacher and two assistant teachers taught each full-day class. After 2002, one teacher and one assistant teacher taught each full-day class. While the average years of schooling of teachers did not change between 2002 and 2003, the average teachers salary decreased by \$8,560. If the number of assistant teachers or the average teacher's salary influences the effect of the program, then the estimates identified from changes in state funding could overstate the true effect of full-day attendance.

The reduction in the supply of full-day classroom slots in 2003 could influence who attends Head Start. Eighty of the 138 children who attended a full-day class in 2002 were age-eligible to attend Head Start in 2003. However, 69 percent of these children, or 55 children, did

not participate in Head Start in 2003, which is approximately double the percentage of age-eligible children who did not re-enroll in Head Start from 2004 to 2005. Many children likely did not participate in 2003 because full-time employed parents sought alternatives to a half-day Head Start class.

Because the most disadvantaged children are selected, when the supply of full-day slots is greater, relatively less disadvantaged children may be selected. Thus, children who attended a full-day class in 2003 might be more disadvantaged, on average, than children who attended a full-day class in 2002. However, the observed characteristics of full-day children are not statistically different between 2002 and 2003. The unobserved characteristics of full-day children could differ between 2002 and 2003. If this is the case, then the estimates identified from changes in state funding could overstate the true effect of full-day attendance.

To examine the potential influence of changes in the composition of the Head Start program, we predict the change in obesity for the cohort of children who attended Head Start in 2002 that would have occurred if these children had the mean observed characteristics of children who attended Head Start in 2003. We estimate that the impact on obesity for children in 2002 would have been 0.87 percentage points lower than the implied estimate of nearly 18 percentage points if these children had the same observable characteristics as 2003 participants. This result, in combination with the minimal change in the estimate in Table 4 from column (B) to (C) of the impact of attending Head Start in 2002 compared to 2003 when observed characteristics are included, suggests that any shift in the observed characteristics of Head Start participants due to the reduction in the availability of full-day classes is likely to have a small influence on the estimates.

Appendix II: Further Details about the Data

This appendix provides further detail about the data used for this research. The analysis in this paper is based on 1833 observations. Children without valid measures of height and weight at both the beginning and the end of the academic year or who did not attend a typical full-day or half-day class are excluded from the analysis sample. In 2006, 85 children attended class in a unique format for 7 hours per day for 2 days per week; these children are excluded from the analysis. There are 215 children in the sample who left the program prior to the end of the year. There were 146 children who began the program after October. Additionally, 20 observations are excluded due to implausible measurements, which are likely the results of error in recording the measurements in the data set. These implausible measurements are a BMI z-score less than -4 (BMI 4 standard deviations below the age- and sex-specific mean) (4 observations), a height z-score above 4 (2 observations), a change in BMI during the academic year of greater than or less than 5 units (11 observations), and a decrease in height of at least 2 inches (5 observations). The reasons for these implausible measurements are not mutually exclusive.

Appendix II, Table 1 displays the means and standard deviations of the weight status and individual and family characteristics of the analysis sample and children excluded from the analysis sample. The weight status of the 215 children who left the program prior to the end of the year is not statistically significantly different at the beginning of the year from the weight status of the children in the analysis sample. Children who dropped out of the program are not more or less likely to be enrolled in full-day classes than children in the analysis sample. The 146 children who began the program after October are 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 statistically significantly different from the weight status of the children in the analysis sample.

Appendix II, Table 1: Means (and Standard Deviations) of the Analysis Sample and Children Excluded from the Analysis

	Analysis Sample	Not in Full Day or Half Day	Implausible Measurements	Late Enrollers	Sample Dropouts
Obese: Beginning of the Year	0.173 (0.379)	0.176 (0.383)	0.769 (0.439)	--	0.191 (0.394)
Obese: End of the Year	0.151 (0.358)	0.153 (0.362)	0.133 (0.352)	0.160 (0.368)	--
Overweight: Beginning of the Year	0.337 (0.473)	0.282 (0.453)	0.769 (0.439)	--	0.358 (0.481)
Overweight: End of the Year	0.320 (0.467)	0.294 (0.458)	0.200 (0.414)	0.313 (0.465)	--
Underweight: Beginning of the Year	0.041 (0.199)	0.071 (0.258)	0.000 (0.000)	--	0.054 (0.226)
Underweight: End of the Year	0.045 (0.207)	0.082 (0.277)	0.000 (0.000)	0.035 (0.184)	--
BMI Z-Score: Beginning of the Year	0.564 (1.211)	0.404 (1.297)	1.115 (2.788)	--	0.577 (1.314)
BMI Z-Score: End of the Year	0.535 (1.197)	0.380 (1.297)	0.156 (2.219)	0.557 (1.262)	--
Full-Day attendance	0.231 (0.422)	--	0.167 (0.383)	0.158 (0.366)	0.217 (0.413)
Hispanic	0.066 (0.248)	0.024 (0.152)	0.100 (0.308)	0.042 (0.201)	0.070 (0.256)
Black	0.267 (0.443)	0.000 (0.000)	0.150 (0.366)	0.250 (0.435)	0.215 (0.412)
Black & White	0.083 (0.277)	0.012 (0.108)	0.150 (0.366)	0.111 (0.315)	0.037 (0.190)
Other Race	0.013 (0.113)	0.000 (0.000)	0.100 (0.308)	0.014 (0.118)	0.019 (0.136)
White	0.570 (0.495)	0.965 (0.186)	0.500 (0.513)	0.580 (0.495)	0.657 (0.476)
Female	0.487 (0.500)	0.506 (0.503)	0.400 (0.503)	0.534 (0.501)	0.474 (0.501)
Disabled	0.229 (0.420)	0.282 (0.453)	0.200 (0.410)	0.158 (0.366)	0.223 (0.417)
Family Income (000s)	15515.86 (11174.86)	13033.90 (7726.29)	16227.83 (12245.71)	15291.78 (15002.40)	13056.74 (8941.22)
Family Size	3.977 (1.437)	4.259 (1.641)	3.800 (1.056)	3.801 (1.352)	4.000 (1.488)
Single Parent Family	0.570 (0.495)	0.365 (0.484)	0.350 (0.489)	0.644 (0.481)	0.595 (0.492)
Primary Adult Graduated High School	0.638 (0.481)	0.810 (0.395)	0.850 (0.366)	0.653 (0.478)	0.585 (0.494)
Primary Adult is Employed Full-Time	0.472 (0.499)	0.217 (0.415)	0.350 (0.489)	0.342 (0.476)	0.379 (0.486)
Primary Adult is Employed Part-Time	0.151 (0.359)	0.120 (0.328)	0.100 (0.308)	0.103 (0.305)	0.136 (0.343)
Primary Adult is in School, Disabled, Employed Seasonally, Retired	0.074 (0.262)	0.036 (0.188)	0.100 (0.308)	0.068 (0.253)	0.121 (0.327)
TANF	0.395 (0.489)	0.094 (0.294)	0.200 (0.410)	0.342 (0.476)	0.419 (0.494)
Sample Size	1833	85	20	146	215

Notes: Standard deviations in parentheses. The sample size for specific variables may be less due to missing values; missing values were not imputed in this table. The definitions for the classifications in the column headings are defined in the text in Appendix II.

Appendix III: Sample Statistics and Estimates from a Restricted Sample

These estimates in the text are based on the full sample of 1833 observations, which includes children who may not be eligible for full-day classes. In this appendix, we construct a selected sub-sample of the 1833 observations that improves the covariate balance between the full-day and half-day samples. 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. We do not limit the main sample in the text according to the responses to this question due to the large number of missing responses, particularly in later years. 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. This restriction removes 295 children. Additionally, we also exclude 827 children whose primary adult caregiver was not employed full-time. The summary statistics for this restricted sample are shown in Appendix III, Table 1. Restricting the sample to these 780 observations improves the overlap of the full-day and half-day samples; the difference in means is not statistically significant for any family background characteristic. In particular, there is greater similarity in family income and parents' education between full-day and half-day children in this restricted sample. As shown in Appendix III, Table 2, the estimates of equation (1) in the text from this restricted sample with greater covariate balance are similar to the results based on the full sample.

We note that this restricted sample is very similar to the common support. Estimating the probability that children attend full-day Head Start and restricting the sample to individuals with probabilities in the range of [0.1, 0.9] removes only 15 additional observations. The results shown in Appendix III, Table 2 are nearly identical to the results based on this smaller sample of 765 observations.

We also note that an alternative strategy for improving the covariate balance between the full-day and half-day sample yields similar estimates to those shown in Appendix III, Table 2. As opposed to excluding children whose primary adult caregiver was not employed full-time, excluding children with a primary adult caregiver who is unemployed or not in the labor force yields 1131 observations and does not influence the results. This alternative strategy reduces the covariate balance in family characteristics but increases the covariate balance in individual characteristics.

Appendix III, Table 1: Means (and Standard Deviations) of Individual and Family Characteristics by Program Type, Restricted Sample

	All	Full Day	Half Day	p-value
Obese: Beginning of the Year	0.168 (0.374)	0.169 (0.376)	0.167 (0.373)	0.934
Obese: End of the Year	0.146 (0.353)	0.118 (0.323)	0.165 (0.371)	0.047
Overweight: Beginning of the Year	0.341 (0.474)	0.335 (0.473)	0.345 (0.476)	0.822
Overweight: End of the Year	0.319 (0.466)	0.293 (0.456)	0.336 (0.473)	0.236
Underweight: Beginning of the Year	0.031 (0.173)	0.029 (0.167)	0.032 (0.177)	0.783
Underweight: End of the Year	0.033 (0.180)	0.035 (0.184)	0.032 (0.177)	0.824
BMI Z-Score: Beginning of the Year	0.578 (1.116)	0.554 (1.074)	0.594 (1.114)	0.664
BMI Z-Score: End of the Year	0.546 (1.128)	0.470 (1.082)	0.597 (1.157)	0.186
Age (months)	52.368 (6.809)	52.070 (6.782)	52.567 (6.826)	0.592
Hispanic	0.057 (0.228)	0.065 (0.245)	0.051 (0.217)	0.453
Black	0.300 (0.454)	0.350 (0.472)	0.266 (0.438)	0.150
Black & White	0.095 (0.289)	0.134 (0.337)	0.068 (0.249)	0.010
Other Race	0.007 (0.080)	0.010 (0.098)	0.005 (0.065)	0.396
White	0.542 (0.493)	0.442 (0.491)	0.610 (0.483)	0.026
Female	0.499 (0.500)	0.502 (0.501)	0.497 (0.501)	0.883
Disabled	0.222 (0.416)	0.217 (0.413)	0.225 (0.418)	0.842
Family Income (000s)	18.056 (12.376)	18.778 (13.492)	17.572 (11.558)	0.252
Family Size	3.877 (1.427)	3.799 (1.376)	3.929 (1.460)	0.211
Single Parent Family	0.633 (0.482)	0.677 (0.468)	0.604 (0.490)	0.116
Primary Adult Graduated High School	0.701 (0.457)	0.724 (0.447)	0.685 (0.463)	0.307
Primary Adult is Employed Full-Time	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	---
Primary Adult is Employed Part-Time	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	---
Primary Adult is in School, Disabled, Employed Seasonally, Retired	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	---

TANF	0.417 (0.493)	0.419 (0.494)	0.415 (0.493)	0.955
Sample Size	780	313	467	

Notes: Standard deviations in parentheses. The p-value is calculated from a null hypothesis that the mean for full-day children equals the mean for half-day children, where the standard errors are adjusted to allow for clustering within classrooms. The sample is the sample of children not in need of full-day services with a primary adult caregiver who is employed full-time.

Source: Administrative data provided by a Head Start grantee in Michigan spanning 2002 through 2006.

Appendix III, Table 2: Estimates of the Impact of Full Day Head Start on Weight Status among Different Samples

	Obese	Overweight	Underweight	BMI Z-Score
Full Sample	-0.039 (0.018)	-0.042 (0.026)	0.001 (0.013)	-0.089 (0.075)
Sample Size	1833	1833	1833	1833
Restricted Sample	-0.043 (0.019)	-0.044 (0.029)	0.006 (0.013)	-0.102 (0.075)
Sample Size	780	780	780	780

Notes: Heteroskedasticity-robust standard errors that allow for clustering within classrooms are in parentheses. Estimates are based on separate regressions and are the coefficient estimates for full-day Head Start participation. The dependent variables are the outcomes listed in the column headings. The top rows contain the estimates from Table 2 in the text. The bottom rows contain the estimates from similar specifications using a restricted sample of children not in need of full-day services with a primary adult caregiver who is employed full-time.

Appendix IV: Summary Statistics of ECLS-B Data

In this appendix, we report the summary statistics from the four year old wave of the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B) in the 2005-2006 academic year for full-day and half-day Head Start participants. Height and weight are measured. Eighty percent of the respondents in Head Start were surveyed between August and December 2005, with the remaining Head Start children surveyed between January and June 2006. ECLS-B is a nationally representative survey, although the subpopulation of children who attended Head Start may not be. One disadvantage of the ECLS-B data is that survey weights are not available to create weighted means that are nationally representative of the Head Start population or the full-day and half-day Head Start population, which limits the ability to use the ECLS-B data to determine whether the Michigan data are nationally representative. For example, the low percentage of primary adults, specifically mothers, who are employed full-time in the ECLS-B sample of full-day Head Start participants contrasts with the statements of Brush et al. (1995) that, nationwide, full-day Head Start classes are targeted towards children with parents who are employed full-time. This difference may be due to the sampling of the ECLS-K data, other Head Start programs throughout the country using a different definition of full-time employment than a minimum of 35 hours of work per week, or other Head Start programs throughout the country now offering full-day classes to children with a variety of family backgrounds.

Appendix IV, Table 1: Means (and Standard Deviations) of Individual and Family Characteristics by Program Type, ECLS-B Four Year Old Preschool Wave

	All	Full Day	Half Day
Obese: Beginning of the Year	0.191 (0.394)	0.201 (0.401)	0.185 (0.388)
Overweight: Beginning of the Year	0.378 (0.485)	0.375 (0.485)	0.380 (0.486)
Underweight: Beginning of the Year	0.030 (0.170)	0.037 (0.188)	0.025 (0.156)
BMI Z-Score: Beginning of the Year	0.733 (1.198)	0.699 (1.243)	0.757 (1.167)
Age (months)	53.264 (4.070)	53.228 (4.111)	53.287 (4.045)
Hispanic	0.260 (0.439)	0.204 (0.404)	0.297 (0.457)
Black	0.322 (0.467)	0.538 (0.499)	0.177 (0.382)
Black & White	0.068 (0.252)	0.047 (0.211)	0.082 (0.275)
Other Race	0.120 (0.326)	0.076 (0.265)	0.151 (0.358)
White	0.230 (0.421)	0.136 (0.343)	0.294 (0.456)
Female	0.482 (0.500)	0.493 (0.501)	0.475 (0.500)
Disabled	0.311 (0.463)	0.275 (0.447)	0.335 (0.472)
Family Income	20.475 (18.256)	19.110 (15.244)	21.391 (19.983)
Family Size	4.771 (1.630)	4.739 (1.697)	4.792 (1.584)
Single Parent Family	0.422 (0.494)	0.507 (0.501)	0.365 (0.482)
Primary Adult Graduated High School	0.704 (0.457)	0.716 (0.451)	0.695 (0.461)
Primary Adult is Employed Full-Time	0.352 (0.478)	0.406 (0.492)	0.316 (0.465)
Primary Adult is Employed Part-Time	0.156 (0.363)	0.149 (0.356)	0.161 (0.368)
TANF	0.283 (0.451)	0.307 (0.462)	0.268 (0.443)
Sample Size	1100	450	650

Notes: Statistics are calculated from the 4 year old wave in 2005-2006 and are not weighted. Sample sizes are rounded to the nearest 50.

Appendix V: Caloric Intake Simulation

Following Cutler, Glaeser, and Shapiro (2003) and Schanzenbach (2009), we simulate the potential impact of a change in caloric intake on the rate of obesity using the equation:

$$K = a + (B + E) \times Weight + .1K, \quad (A1)$$

where K is caloric intake in kilocalories, a and B are estimates that determine the Basal Metabolic Rate (BMR), E is energy expenditure from physical activity, and $Weight$ is measured in kilograms. This equation equates calories consumed with calories expended in the steady-state. Energy is used to keep the body alive ($BMR = a + B \times Weight$), in physical activity ($E \times Weight$), and to consume calories (the thermic effect of food is $.1K$).

The change in weight from a change in caloric intake, holding physical activity constant, is:

$$\Delta Weight = .9 * \Delta K / (B + E). \quad (A2)$$

The values of B are based on Schofield's (1985) estimates of BMR in megajoules per 24 hours, which vary according to age and gender. For children age 3 to 10 years, B is 0.095 for boys and 0.085 for girls. These constants are then multiplied by 238.8915 to convert the units to kilocalories.

E is measured by how strenuous an activity is multiplied by the amount of time engaged in the activity. The strenuousness of an activity is measured as the ratio of the activity metabolic rate to the resting metabolic rate. The energy expenditure for sitting quietly is 1.0 MET and all other activities are measures of energy expenditure relative to sitting quietly. As opposed to adults, the energy expenditure from physical activity for children at these ages has not been well-studied. If we assume that energy expenditure from physical activity is independent of weight, then E would not enter in to equation (A2). However, this assumption would lead to an underestimate of the change in calories that might generate the estimated impact of full-day Head Start participation. We instead assume that average energy expenditure throughout the day is 1.5 METs and the $E = 1.5 \times 24$. This assumption is based on MET levels for adults and that preschool-aged children sleep for 12 hours per day, watch television for 3 hours per day, spend 2 hours eating (1.5 METs), engage in low energy expenditure activities (2 METs) for 5 hours, and engage in moderate energy expenditure activities (4 METs) for 2 hours.

To generate the simulations in this paper, the additional weight is added to the individuals in the sample based on their gender and age at the end of the year. Using the new weight, body mass index is calculated and then whether the individual is underweight, overweight, or obese and the BMI z-score is determined. The estimated four percentage point change in obesity of full-day Head Start compared to half-day Head Start implies that the counterfactual estimate of the proportion of full-day Head Start children who would be obese at the end of the year is the sample mean of 12 percent plus 4 percent (or 16 percent). An increase of 20 calories per day is predicted to increase the proportion obese to 16 percent.