HEAD START PARTICIPATION AND CHILDHOOD OBESITY

David Frisvold

University of Michigan

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Correspondence: David Frisvold, University of Michigan, School of Public Health, Health Management and Policy, 109 Observatory, SPH-II M2102, Ann Arbor, MI 48109-2029; Phone: 734-936-5347; Fax: 734-936-9813; E-mail: Frisvold@umich.edu

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Abstract

Childhood obesity is a significant public health problem that also has economic consequences. Medical research suggests that nutritional interventions at a young age can influence nutritional behavior and reduce childhood obesity. This paper estimates the impact of one such intervention – Head Start – on childhood overweight and obesity. While Head Start is more commonly known as an educational intervention, a large part of the program includes nutrition services and nutritional education to parents and children. For black children, Head Start participation is shown to reduce the likelihood of being obese in later childhood.

1. Introduction

The prevalence of childhood obesity in the United States has risen dramatically in the last 30 years, doubling for children ages 6 to 11 and tripling for children ages 12 to 17 (Dietz, 2004). This increase is a concern for public health officials due to the association between childhood obesity and a myriad of health consequences, such as hypertension and other cardiovascular disease risk factors, type 2 diabetes, sleep apnea, and asthma (Ebbeling, Pawlak, and Ludwig, 2002). Additionally, childhood obesity is a significant determinant of adult obesity (Whitaker et al., 1997), and adult obesity is linked to an increased risk of various comorbidities (Office of the Surgeon General, 2001, table 1) and premature death (Fontaine et al., 2003; Peeters et al., 2003).

The social costs of obesity are extensive; in 2000, these costs were estimated at $117 billion (Office of the Surgeon General, 2001). This figure is composed of $61 billion in direct costs associated with preventive, diagnostic, and treatment services for obesity, and $56 billion in indirect costs consisting of the value of lost productivity from illness due to obesity, and the value of lost future productivity from premature death. These costs mainly result from type 2 diabetes, coronary heart disease, and hypertension – comorbidities associated with childhood obesity (Wolf, 1998).

Given that childhood obesity leads to adult obesity, that the social costs of adult obesity are driven by diseases linked to childhood obesity, and that social investments in young children are generally more productive than similar investments in adults (Heckman and Masterov, 2004), social programs targeted towards children may be the most effective public policies in reducing obesity and increasing social welfare. Grossman's (1972) health capital model substantiates this idea – health is determined cumulatively, and early childhood investments in health can have a lasting impact. As described in Healthy People 2010, behaviors that prevent obesity – healthful dietary and physical activity behaviors – should be established in childhood (U.S. Department of Health and Human Services, 2000).

To combat the rise in childhood obesity, many public health officials and researchers have advocated reforms in the public school system (e.g., Dietz and Gortmaker, 2001). However, the increase in childhood obesity is evident in children as young as 4 years old (Ogden et al., 1997). Early prevention activities during the preschool years may, in fact, be the most effective (Davis and Christoffel, 1994). This period of time is influential in determining behavior patterns associated with diet and physical activity (Birch, 1999). Dietary intake and physical activity of preschoolers can account for more of the variance in body mass index than whether or not a young child's parents are obese (Klesges et al., 1995). To prevent childhood obesity, Deckelbaum and Williams (2004) suggest that preschool programs provide children with exposure to a variety of foods and flavors, assist in the development of healthy food preferences, encourage appropriate parental feeding practices, monitor the weight of children, and provide child and parent nutritional education. Head Start, the early childhood development program targeted towards disadvantaged youths, is an example of one such program.

As the cornerstone of President Lyndon Johnson's "War on Poverty," Head Start provides a comprehensive array of services to poor and disabled children to better prepare them for subsequent educational experiences. Even though the overall goal is educational, Head Start's planning committee designed the program with a variety of development services, believing that nutrition, physical and mental health, parental involvement, and social services – in conjunction with early childhood education – would contribute to the educational development of participants far more than offering strictly academic instruction. Because of the program's overall goal, most evaluations have focused on educational outcomes; however, based on the menu of services offered, it is reasonable to expect that additional outcomes are influenced by Head Start participation. In particular, Head Start provides nutritious meals that encourage children to try a variety of foods, screens children for nutritional deficiencies and obesity, and emphasizes nutritional education, both for children and for parents. Based on these components of the program and the timing of these services at a critical point in child development, Head Start participation may impact childhood obesity.

Previous research on the efficacy of school-based intervention programs has demonstrated that it is possible to reduce the prevalence of childhood obesity.[1] However, these programs often serve older children than Head Start, offer less comprehensive nutritional services, and do not target disadvantaged children who are at a higher risk of childhood obesity. It is possible then that Head Start, a program not specifically designed to prevent childhood obesity, could result in larger benefits than obesity intervention programs.

This paper estimates the impact of Head Start participation on childhood overweight and obesity using national data from the Panel Study of Income Dynamics and its Child Development Supplement. The key advantages of these data are that height and weight for children are measured, not self-reported, and that family background characteristics are available during early childhood years.

The difficulty that arises in examining the effect of Head Start participation is that selection into Head Start is the result of choices made by parents and administrators. The determinants of these choices may be related to the future outcomes of Head Start participants and, thus, simple estimators such as OLS may lead to inconsistent estimates of the impact of Head Start participation. To examine the potential influence of selection due to observed characteristics and selection due to unobserved characteristics, I initially follow the methodology

[1] See, for example, Story (1999), Gortmaker et al. (1999), and Veugelers and Fitzgerald (2005).

developed by Altonji, Elder, and Taber (2005) to estimate the effect of Head Start participation. Their methodology is based on the bivariate probit model, which is appropriate in this setting because the outcome variables – overweight and obese – are binary and the potentially endogenous variable – Head Start participation – is binary. Their strategy is to use the amount of observed selection as a guide for the extent of unobserved selection. This methodology does not rely on an exclusion restriction in the bivariate probit model and is used to estimate bounds of the impact of Head Start participation. A second approach to estimate the impact of participation in Head Start is then implemented which relies on an exclusion restriction based on program availability. Variation in the relative availability of Head Start, as measured by the number of available slots per eligible child in the local community, is assumed to influence Head Start participation, but not affect overweight and obesity directly.

After selection into Head Start is accounted for, the results suggest that Head Start reduces the probability that a black participant will be obese in later childhood. Given the health and economic consequences of obesity, these results suggest that participation in Head Start can improve the lives of disadvantaged youths and social welfare in ways not previously established.

2. Background on Head Start

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).

Eligibility for Head Start participation is determined primarily by family income. A child is eligible 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, provided that they continue to meet the Head Start eligibility criteria.

Head Start is currently administered through the Office of Head Start in the Administration for Children and Families (ACF) of the Department of Health and Human Services. Head Start appropriations, determined annually as a component of the federal budget, are earmarked for states based on the number of children less than 5 years of age in families with incomes below the poverty line. Based on the allotment of funding across states, Head Start funds are directly provided to local Head Start programs that are awarded grants by the ACF. Grants are awarded to agencies that are able to demonstrate the most cost-effective program with qualified and experienced staff that will adhere to the Head Start Performance Standards, provided that there is a sufficient need for Head Start services in the community (Office of Head Start, 2006b). While grants are awarded for only three years, previously funded agencies are given funding priority. Each grantee must contribute 20 percent of the total costs; however, this requirement can be satisfied from in-kind donations through community partnerships. Head

Start programs are operated through community development agencies, local school districts, private organizations, and Indian Tribes. There were 1,604 grantees that operated 19,800 centers with 49,235 classrooms in 2005 (Office of Head Start, 2006a).

The service area for each Head Start program is defined in its Head Start grant application as either a county or sub-county area (e.g., census tract) – with the exception of rural programs, which often serve multiple counties – and is approved by the Department of Health and Human Services to ensure that the service area does not overlap with other Head Start programs (Office of Head Start, 2006b). Within the service area, each Head Start program must actively recruit and inform as many families with eligible children as possible. To ensure that programs are recruiting as many children as possible, the number of applications for each program must exceed the expected enrollment.

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. Additionally, children with the greatest need for Head Start services should be selected by the program administrators. This selection process ensures that children in families with incomes farthest below the poverty line are most likely to be chosen to enroll in the program, as well as children with more severe disabilities. Children without two parents are more likely to be selected into the program than children from two parent families. Also, children in high risk families are preferentially admitted into the program. Although high risk may be defined differently across programs, this category can include children in families with substance abuse or domestic violence; children in families afflicted by a crisis such as death, separation, terminal illness, or chronic health issues; children referred into Head Start by a community agency; or other special circumstances.

Head Start provides comprehensive child development services to achieve the program's overall goal of improved school readiness. To enhance participants' cognitive skills, Head Start centers implement a curriculum that emphasizes age-appropriate literacy, numeracy, reasoning, problem-solving, and decision-making skills (Office of Head Start, 2006b). Parents are encouraged to assist in creating the center's curriculum and an individualized developmental strategy for their child. Continual assessments are conducted by the program staff to promote each child's progress.

Head Start, however, offers more than simply cognitive activities to increase participants' human capital. For example, Head Start's federal guidelines emphasize nutritional health as an essential component of child development. Nutrition services are provided because malnutrition can dampen educational growth, and nutritional problems such as iron deficiency anemia are often associated with poverty. Increasing nutrition can lead to cognitive improvements and greater educational attainment (Maluccio et al., 2005).

The nutritional aspects of Head Start's services include nutritional screening, providing healthy meals, and nutritional education. Head Start personnel determine the child's nutritional needs through nutritional assessments (height, weight, and hemoglobin/hematocrit testing) and from information about the child's and family's eating habits, and then design and implement a nutritional plan. At the beginning of each day, children who have not received breakfast prior to their arrival at a Head Start center are provided a nutritious breakfast. Children in a full-day program receive meals and snacks that provide one-half to two-thirds of their daily nutritional needs. Meal times provide the opportunity for nutritional education and children are encouraged to try a variety of foods. Parents also receive training, through classes and informal discussion, on food preparation and nutrition.

The services provided by Head Start have generally been successful in increasing children's educational outcomes. Head Start participation leads to short-term cognitive benefits (McKey et al., 1985; Currie and Thomas, 1995; U.S. Department of Health and Human Services, 2005) that persist throughout elementary school for white, but not black, participants (Currie and Thomas, 1995). Perhaps because of improvements in non-cognitive skills (e.g. Heckman, 1999; Blau and Currie, forthcoming), Head Start leads to sizeable longer-term educational benefits. However, these benefits accrue for whites, but not blacks. Estimates of the impact of Head Start, in comparison to other preschools, suggest that white Head Start participants are 40 percentage points less likely to be held back a grade in school (Currie and Thomas, 1995), are 22 percentage points more likely to graduate high school (Garces, Thomas, and Currie, 2002), and are 19 percentage points more likely to attend college (Garces, Thomas, and Currie, 2002).

Head Start participation also results in health and social benefits, although these outcomes have received less attention in the literature than cognitive and educational outcomes. Participants are more likely to receive age-appropriate health screenings or dental examinations (Hale, Seitz, and Zigler, 1990; U.S. Department of Health and Human Services, 2005) and are 8 percentage points more likely to be immunized for measles than children who did not attend any form of preschool (Currie and Thomas, 1995). Head Start participation is also associated with a 33 to 75 percent reduction in child mortality rates (Ludwig and Miller, 2005). Additionally, black Head Start participants are 12 percentage points less likely to be arrested for or charged with a crime than other preschool participants (Garces, Thomas, and Currie, 2002). These outcomes from Head Start participation suggest that the comprehensive services provided to increase the educational opportunities of disadvantaged children also lead to comprehensive benefits.

In particular, there are a variety of reasons that exposure to the services in the Head Start program might benefit participants by reducing the likelihood of becoming overweight or obese. One potential pathway is the direct provision of nutritious food. The Head Start nutritional guidelines are consistent with the recommendations of the American Dietetic Association (Briley and Roberts-Gray, 1999). An evaluation of the food provided by Head Start centers and consumed by children through the Child and Adult Care Food Program of the U.S. Department of Agriculture found that breakfasts offered and consumed were generally consistent with the recommendations of Dietary Guidelines for Americans and the National Research Council's *Diet and Health* report (Fox et al., 1997). However, lunches provided to and consumed by Head Start participants exceeded the recommendations for the percent of energy from fat. Overall, Fox et al. (1997) found that the nutrient intake from all meals is consistent with the Head Start performance standards. Bollella et al. (1999) report that the percent of calories from total fat for Head Start participants from meals served at Head Start ranges from 25 to 30 percent, which is consistent with the recommendations of *Dietary Guidelines for Americans 2005* (U.S. Department of Health and Human Services, 2005b). Worobey et al. (2005) finds 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, both Bollella et al. (1999) and Worobey et al. (2005) find that the nutritional intake of Head Start participants is lower quality at home. For example, although most of the day's meals were eaten at Head Start, Worobey et al. (2005) notes that 58 percent of total calories were consumed 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.

Head Start participation might also reduce the probability of being overweight or obese in later childhood if the nutritional education provided to the parents and children improves the nutritional content of the food provided at home. Activities related to nutritional education for Head Start children include preparing, cooking, serving, and shopping for food (Keane et al., 1996). Head Start parents frequently report discussing good nutrition and healthy foods at home with their child (Keane et al., 1996). Additionally, descriptive evidence, provided by parents, suggests that one-third of Head Start parents and children improve their nutritional behaviors as a result of Head Start attendance (Keane et al., 1996).

Additional mechanisms through which Head Start participation might reduce childhood obesity include education, exercise, non-cognitive skills, and pediatric care. As described above, Head Start participation results in short-run increases in cognition and long-run increases in educational attainment for some participants. If cognition or schooling has a causal impact on obesity, then Head Start is likely to benefit participants. Head Start performance standards encourage exercise and the development of gross motor skills (Office of Head Start, 2006b). If Head Start participation increases the amount of exercise relative to the amount that participants would have engaged in had they not enrolled in Head Start, then Head Start participation would reduce the likelihood of being overweight or obese. Further, Head Start participation reduces behavioral problems (U.S. Department of Health and Human Services, 2005b) and behavior problems are related to childhood obesity (Lumeng et al., 2003). Additionally, Head Start ensures that children have access to a continuous source of pediatric care. Increased pediatric care could improve the nutrition of children as physicians counsel parents and children and monitor the height and weight changes of children.

Finally, and more generally, Head Start participation may reduce the marginal cost of the quality of children as a result of the child care services and development services offered to the family at zero monetary cost. As the result of the decrease in marginal cost, parental investments in improving the quality of children would increase.

3. Estimation strategy

The two outcomes of interest used to measure the impact of Head Start participation are overweight and obesity. Let Y denote these outcomes, where $Y = 1$ if the individual is overweight or obese, depending on the outcome, and $Y = 0$ otherwise. Let D be an indicator variable for whether an individual has participated in Head Start. Let Y_1 and Y_0 denote the potential outcomes for an individual if they had participated in Head Start (i.e., if $D = 1$) and if they had not (i.e., if $D = 0$).

The focus of this paper is to estimate the average effect of Head Start participation on overweight and obesity for individuals who participated in Head Start (i.e., the average treatment effect on the treated). This impact of Head Start is defined as $E(Y_1 – Y_0 \mid D = 1)$. This expectation is equal to $\Pr(Y_1 = 1 \mid D = 1) – \Pr(Y_0 = 1 \mid D = 1)$, which is the difference between the probability that an individual who attended Head Start is overweight or obese and the probability that he would have been overweight or obese had he not attended Head Start. The identification problem that arises in estimating this treatment effect is that because Y_1 and Y_0 cannot both be observed for the same individual (i.e., an individual either attended Head Start or did not), the counterfactual outcome $Pr(Y_0 = 1 \mid D = 1)$ is unobservable. Instead, $Y = Y_1 \times D + Y_0 \times (1 - D)$ is observed for each individual.

The probabilities that are easily computable with cross-sectional data are $Pr(Y_1 = 1 \mid D = 1)$ and $Pr(Y_0 = 1 \mid D = 0)$. Under the assumption that $Pr(Y_0 = 1 \mid D = 1) = Pr(Y_0 = 1 \mid D = 0)$, then $E(Y_1 - Y_0 \mid D = 1) = Pr(Y_1 = 1 \mid D = 1) - Pr(Y_0 = 1 \mid D = 0)$, and the impact of Head Start participation could be estimated by comparing the difference in the sample means of overweight and obesity rates for Head Start participants and non-Head Start participants in any nationally representative survey. However, this assumption implies that the outcomes of individuals who did not attend Head Start would be the same as Head Start participants under the hypothesized counterfactual state that these individuals had not attended Head Start (i.e., $Y_0 \perp D$). This assumption is not likely to be correct because of both observable selection and unobservable selection of individuals into the program.

Observable characteristics associated with selection into Head Start are likely to be associated with childhood obesity. As described in the previous section, poverty status and disability status are key eligibility criteria for Head Start participation. Thus, if either poverty status or disability status is correlated with childhood obesity, then the observable determinants of Head Start participation also influence childhood obesity, and Y_0 is not independent of D. Because income constraints influence which foods are available for consumption and cheaper foods are often high in fats and caloric content, poverty status may be related to childhood obesity. Hofferth and Curtin (2005) show that children in families below the poverty line are more likely to be obese than children in families with incomes twice the poverty line. To incorporate observable selection, the impact of Head Start participation becomes $E(Y_1 - Y_0 \mid X, D = 1)$, where X represents observed family and individual characteristics. Under the assumption that $\Pr(Y_0 = 1 \mid X, D = 1) = \Pr(Y_0 = 1 \mid X, D = 0)$, then $E(Y_1 - Y_0 \mid X, D = 1) = \Pr(Y_1 = 1 \mid X, D = 1) - \Pr(Y_0 = 1 \mid X, D = 0)$. This treatment effect could be estimated with a probit model or using propensity score-matching.

The assumption that $\Pr(Y_0 = 1 \mid X, D = 1) = \Pr(Y_0 = 1 \mid X, D = 0)$ states that, after adjusting for observed individual and family background characteristics, the probability that a non-Head Start participant is overweight or obese would be the same regardless of whether the child attended Head Start (i.e., $Y_0 \perp D \mid X$). This assumption is unlikely to hold if unobserved behaviors that are related to childhood obesity influence whether an individual attends Head Start. Given the high degree of selection on observed characteristics associated with Head Start, there is likely to be selection on unobserved characteristics as well (e.g., Altonji, Elder, and Taber, 2005).

Because parents choose to send their child to Head Start, it is possible that they also make other investments that could influence their child's later health and weight outcomes. For example, in 2005, 27 percent of Head Start staff members were parents of current or former Head Start participants, and over 890,000 parents volunteered with Head Start (Office of Head Start, 2006a). These parents have made a commitment to their children that could lead to a bias towards finding beneficial impacts from Head Start participation estimated through a probit model or using propensity score-matching. However, this does not seem to be the case. The decision to send a child to Head Start is not associated with other parental actions that are investments in children's health. In particular, Head Start children were not more likely to be breastfed as infants, which is linked to a variety of health benefits including lower obesity rates

(Dietz, 2001), or to be properly immunized prior to Head Start attendance, in comparison to non-Head Start children.[2]

Because children selected by program administrators are the most disadvantaged of the Head Start-eligible applicants in the program's service area, it is likely that these individuals are disadvantaged across a variety of dimensions, not simply the observable characteristics that determine Head Start eligibility. If Head Start participants are more disadvantaged than their peers in ways unobservable to an econometrician, and if these sources of disadvantage are related to future health and weight outcomes, then estimated average treatment effects that ignore these unobserved characteristics will be biased against finding a beneficial impact of Head Start participation. A variety of characteristics associated with both Head Start participation and overweight and obesity are likely to be unobserved. For example, the severity, as opposed to the existence, of an individual's disability is an unobserved determinant of Head Start participation, and individuals with more severe disabilities are more likely to be obese (Emerson, 2005). The family environment experienced by a child in a family classified as high risk is another unobserved determinant of Head Start participation. Exposure to childhood emotional, physical, or sexual abuse and household dysfunction in childhood are associated with adverse health behaviors later in life, including severe obesity (Felitti et al., 1998). Therefore, estimates of the impact of Head Start participation that fail to completely account for the disadvantaged characteristics of the program's participants are likely to be biased towards zero.

To assess the influence of observed and unobserved selection on the estimate of the average treatment effect on the treated, I initially follow the methodology of Altonji, Elder, and

[2] The statements in this sentence are based on regression estimates (not shown) from probit models with indicator variables for having been breastfed and having been properly immunized as the outcome variables. The control variables used were the same as those displayed in Table 3.

Taber (2005). Their methodology uses the extent of observed selection as a guide for the amount of unobserved selection.

The probability of Head Start attendance is specified as:

$Pr(D = 1) = Pr(Z\delta + \upsilon > 0)$,

and the probability of being overweight or obese[3] is specified as:

$Pr(Y = 1) = Pr(X\beta + D\alpha + \varepsilon > 0)$,

where Z and X represent observable characteristics that are independent of (υ, ε); δ, β, and α are parameters to be estimated; and υ and ε are random error terms. The assumption that υ and ε are distributed bivariate normal with $E(\upsilon) = 0$, $E(\varepsilon) = 0$, $Var(\upsilon) = 1$, $Var(\varepsilon) = 1$, and $Cov(\upsilon, \varepsilon) = \rho$ allows for the possibility that the unobserved determinants of Head Start participation are correlated with the unobserved determinants of overweight and obesity.

Following the strategy of Altonji, Elder, and Taber (2005), the bivariate probit model is estimated with Z equal to X and with a specified value for the correlation parameter. Based on previous research (e.g., Garces, Thomas, and Currie, 2002), a positive correlation between the unobserved determinants of Head Start participation and the unobserved determinants of overweight and obesity is imposed on the model. The correlation coefficient is specified at varying levels to demonstrate the impact of Head Start participation under differing assumptions about the amount of unobserved selection. Using the amount of observed selection to guide the

[3] Threshold values of BMI that correspond to overweight and obesity are used in this analysis, as opposed to the underlying BMI scale, for a couple reasons. First, the services provided in Head Start potentially could decrease the likelihood of being underweight. Analysis of the probability that an individual is at or below the 5th percentile of BMI (the CDC definition of underweight) using a probit model demonstrates that Head Start participation reduces the likelihood of being underweight. If Head Start participation increases the BMI of children in the lower tail of the BMI distribution and decreases the BMI of children in the upper tail of the BMI distribution, then the conditional mean of BMI that is estimated in a regression is likely to demonstrate no impact of Head Start participation on BMI. However, the resulting estimate would mask two important, but potentially offsetting, changes in the BMI distribution. Second, the sections of the BMI distribution associated with overweight and obesity are designed to be medically-salient components of the distribution. Thus changes in overweight and obesity are more relevant for determining the impact of Head Start on the welfare of participants.

extent of the unobserved selection, the correlation parameter, ρ, can be bounded between zero and $Cov(Z\delta, X\beta) / Var(Z\delta)$, where X = Z. When ρ = 0, there is no unobserved selection and the bivariate probit model is equivalent to estimating two separate probit models; when $\rho = Cov(Z\delta, X\beta) / Var(Z\delta)$, the amount of unobserved selection is equal to the amount of observed selection. After estimating the bivariate probit model with specified values for the correlation parameter, the impact of Head Start participation is $E(Y_1 - Y_0 \mid X, D = 1) = \Phi(X\beta + D\alpha) - \Phi(X\beta)$, where Φ is the cdf of the standard normal distribution.

A second approach to estimate the impact of participation in Head Start is implemented that relies on an exclusion restriction, in which Z contains at least one variable not in X, and ρ is estimated. An appropriate choice for an instrument is a variable that is related to Head Start attendance, but is not directly related to overweight or obesity, which ensures that the variable is contained in Z but not X. Program availability will influence the probability that a child attends Head Start, but is not likely to impact the probability that a child is overweight or obese independent of the association with Head Start attendance. Head Start is not a fully funded program, in the sense that some eligible children who apply for admission are not admitted due to funding constraints. Only about 55 percent of eligible children are able to attend the program.[4] Prior to the selection decisions of the program administrators, the probability that a child who is eligible for Head Start will attend is based on the number of available slots in the local program divided by the number of children in the service region who are eligible. (Throughout this paper I refer to the service region and the community interchangeably. In many

[4] This estimate is based on the author's calculations from data available from the Office of Head Start and the Census Bureau. In 2004, 905,851 children attended Head Start and 4,116,000 children under age 5 lived in families below poverty. Assuming that two-fifths of the children under age 5 are ages 3 or 4 and that income is the only determinant of eligibility, then 1,646,400 children are eligible for Head Start. Thus, about 55 percent of income-eligible children attend Head Start.

cases, this area refers to the county, but it may also refer to multiple counties within a state.) Therefore, the instrument for Head Start participation is the relative availability of Head Start: the enrollment divided by the number of eligible children in a Head Start service area.[5]

The number of funded slots available in a program is determined by the Department of Health and Human Services based on the historical evolution of funding to the local program and changes in the federal appropriations to Head Start. The number of funded positions for each grantee does not always fluctuate annually, but was likely to increase throughout the latter part of the twentieth century when Head Start enrollment changed from 448,464 children in 1988 to 905, 235 children in 2001 due to an over 400 percent increase in funding (Office of Head Start, 2006a). Increases in appropriations are first used to increase the quality of existing programs, and then remaining funds are distributed based on the number of eligible children not served by Head Start, which is commonly driven by changes in the population.[6] Currie and Neidell (forthcoming) report that expenditure levels of Head Start programs has no detectable effect on the observable characteristics of children selected in the program or who chose to enroll in the program. Variation in the number of Head Start openings available to a child in a given year is primarily determined by federal legislation and changes in the population that determine the extent to which the local community was underserved by Head Start – factors that are unlikely to be related to the unobserved determinants of childhood overweight and obesity.

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[5] An additional approach to identify the treatment effect of Head Start participation is to use the discontinuity in program funding that resulted because the Office of Economic Opportunity provided grant writing assistance to the 300 poorest counties, but not other counties, prior to the initial appropriation of Head Start funds (Ludwig and Miller, 2005). While the discontinuity in funding persisted over time, it did not persist throughout the 1990s (Ludwig and Miller, 2005), and, thus, would not be appropriate for this analysis.

[6] By 1988, the Head Start program had sufficiently expanded throughout the country so that almost all counties offered Head Start services. Thus, increases in funding were not likely to add Head Start services to a county that did not offer the program, but instead were likely to increase the number of children that the existing Head Start program was able to serve.

Once concern about the validity of the choice of the instrument is that the amount of Head Start funding, and thus the number of funded slots, is a signal of the quality of the local Head Start program. If better quality program directors are able to obtain additional funds, and better quality program directors administer higher quality programs, then funding and the number of funded slots could be related to child outcomes and childhood obesity. However, Currie and Neidell (forthcoming) find no evidence that program directors' education, experience, or salary is positively related to children's educational outcomes.

Although the relative availability of Head Start in the community likely influences Head Start participation, another concern about the validity of the instrument is that it is correlated with other community characteristics. For example, a community with a low level of funded slots for Head Start relative to the number of eligible children may offer other services that target the Head Start-eligible population to compensate for the under-funding of the program by the federal government. Alternatively, a community that is under-funded may offer few other services to this population. Additionally, since the level of enrollment in Head Start is related to the economic conditions of the community, there is the potential that the relative availability of Head Start is also related to local economic conditions. As shown by Ruhm (2005), economic fluctuations can influence the health behaviors of adults. To allow for the possibility that community characteristics are correlated with the relative availability of Head Start and also influence overweight and obesity, additional specifications of the bivariate probit model described above are estimated that include measures of the health programs, children's programs, and services for the poor in the county, and the economic conditions of the county.

Even after controlling for a variety of community characteristics, it may be possible that the relative availability of Head Start in the community remains correlated with the unobserved determinants of overweight and obesity. To attempt to isolate the exogenous source of variation, I predict Head Start enrollment mainly from changes in the population of all children in the community ages 3 and 4 and changes in Head Start funding. The predicted enrollment is divided by the population of all children in the community ages 3 and 4 to create the predicted availability of Head Start in the community.[7] By dividing the predicted enrollment by all children instead of children in poor families, this alternate instrument is not correlated with changes in local economic conditions.

4. Data

The impact of Head Start participation on childhood overweight and obesity is evaluated using data from the Panel Study of Income Dynamics (PSID) and its Child Development Supplement (CDS). The PSID is a longitudinal study of U.S. households and individuals that began in 1968 with a national sample of approximately 4,800 households. Members of these households, their offspring, and current co-residents have been interviewed on an annual or biennial basis since the inception of the PSID. In 1997, the CDS collected additional information about PSID parents and their children ages 0 to12 years. A total of 2,394 families and 3,563 children were interviewed. In 2002, 2,021 families and 2,907 children ages 5 to 19 years were re-interviewed.

A variety of health, education, and childcare variables are collected in the CDS, but most importantly for this research, Head Start participation was identified and height and weight were measured by the interviewer in 2002.[8] Objective measurements of height and weight are

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[7] For further information about the creation of this variable, see the data appendix and the data appendix tables.
[8] Height and weight were measured without shoes on and with empty pockets. If the child refused to be measured, then height and weight were self-reported by either the child or the parent. In the analysis sample of 2,301 children with non-missing values for height and weight, the height and weight of 22 children were self-reported instead of

important because self-reported measures of weight are subject to reporting error (Cawley, 2000). The outcome variables for this analysis are a binary variable equal to one if the child is overweight or obese and a binary variable equal to one if the child is obese. Overweight for individuals under age 18 is determined by the Centers for Disease Control and Prevention as having a body mass index above the 85th percentile and obesity is classified as a body mass index above the 95th percentile.[9] Body mass index 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).

Individual characteristics included in both X and Z are gender, age, race (white, black, Hispanic, and other race), a dichotomous indicator of low birth weight, a binary variable indicating that the individual is the oldest child, and a binary variable equal to one if the individual is disabled. Mothers' body mass index and its squared term, measured in 1986 prior to children being age-eligible for Head Start attendance, are included. Body mass index measures prior to Head Start attendance are important because current measures of parental BMI could be influenced by the child's Head Start participation.[10] Family income, family size, and mothers' education are averaged over the years when the child was ages 3 through 5. Measures of residence (suburban, urban, and rural) during ages 3 through 5 are also included. Additionally, an indicator variable equal to one if the father was not present during the ages 3 through 5 is included.[11]

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being measured by the interviewer. Removing these 22 children from the sample does not impact the results reported below.

[9] These measures are often referred to in the medical literature as "at risk of overweight" and "overweight."

[10] If the nutritional education provided to parents influences their nutritional behavior, then current measures of body mass index are an outcome of the child's Head Start participation, as opposed to an exogenous determinant of the child's probability of being overweight or obese. The use of 1986 data for mothers' BMI is driven by data constraints; it is the only measure of mothers' BMI in the PSID prior to children's Head Start participation.

[11] Fathers' BMI and education are not included as variables due to the large percent of fathers not present during the ages of 3 through 5, especially for Head Start participants.

The relative availability of Head Start when the child was 3 and 4 years old – the percent of eligible children in the community who attended Head Start – is calculated based on enrollment figures for each Head Start grantee in the Head Start Program Information Reports and the number of children in poverty in the U.S. Census Bureau's Small Area Income and Poverty Estimates. This measure is then linked to the PSID and CDS data through the county identifying codes in the restricted-access PSID geocode file and aggregated to the service region of each Head Start grantee.[12]

Community economic characteristics include the percent of the population age 25 years and older who graduated high school and college, the unemployment rate for the population age 16 and older, median family income, median rent, and the median value of owner-occupied housing units. The extent of other social services in the community is measured as the number of health programs, children's programs, and services for the poor in the county. These variables are based on data from the National Center for Charitable Statistics' 2000 Business Master File of all 501(c)(3) public charities and 501(c)(4) social welfare organizations.

For an individual to be included in the analysis sample, the child must have height and weight information in the 2002 CDS, information about Head Start attendance, have been a member of a responding family to the PSID at age 3 or 4, have information about mother's height and weight, and report the county of residence at age 3 or 4. These sample restrictions yield 1,887 children. A concern that arises because of the Head Start eligibility criteria is that the Head Start (treatment) group is sufficiently different from the non-Head Start (control) group so that regression methods are not able to adequately adjust across these two groups to elicit comparisons between a child who attended Head Start and an otherwise similar child who did not attend. To address this concern, the propensity score that an individual would attend Head

[12] Further information about the construction of each variable is available in the data appendix.

Start is estimated and individuals not included in the common support are removed from the analysis sample. This insures that the Head Start and non-Head Start samples more closely overlap and is preferable to simply restricting the sample based on income classifications, which are only one criterion for Head Start eligibility. The region of common support based on the propensity score is [0.0085, 0.9106]. This sample restriction removes 555 children with propensity scores below the common support and yields a final analysis sample of 1,332 children. Missing data for the other variables are imputed using linear regression based on the control variables with non-missing data.[13]

Table 1 describes the characteristics of the sample and displays the differences between Head Start participants and non-Head Start participants. The sample means, with standard errors in parentheses, are weighted by the 2002 CDS survey weight to be nationally representative of children ages 5 through 19. These data show that Head Start participants are more likely to be overweight and obese than non-Head Start participants. If the assumption $\Pr(Y_0 = 1 \mid D = 1) = \Pr(Y_0 = 1 \mid D = 0)$ was true, then this comparison between sample means would suggest that Head Start worsens the health of participants, although not statistically significantly. However, it is also shown in Table 1 that Head Start participants are less likely to be the oldest child and more likely to have a disability. Additionally, Head Start participants were raised in larger families with lower incomes, with less educated mothers, with mothers with a higher body mass index, and with fathers less likely to be present. These differences in individual and family characteristics highlight the need to control for observable characteristics to determine the impact of Head Start participation.

Head Start participants are also more likely to be black. Because the prevalence of overweight and obesity differs by race and the impact of Head Start participation differs by race

[13] Further information about the treatment of missing data is available in the data appendix.

for educational and social outcomes (Garces, Thomas, and Currie, 2002), the impact of Head Start participation on overweight and obesity is also examined separately for blacks (other races are not examined separately due to inadequate sample sizes). The descriptive statistics of blacks separately are included in Table 1, as well as black Head Start participants and black non-Head Start children. Black Head Start participants are less likely to be the oldest, more likely to have a disability, less likely to have grown up in an urban community, grew up in larger families with less income, and were less likely to have a father present than other blacks.

5. Results

The descriptive statistics in the PSID suggest that former Head Start participants are just as likely or slightly more likely to be overweight or obese during the ages 5 through 19. Measured height and weight are not available for these children prior to Head Start attendance. The largest sample of children that included height and weight prior to Head Start attendance was collected by the New York City Department of Health and Mental Hygiene (2006). In 2004, height and weight information gathered from approximately 16,000 children prior to Head Start attendance in New York City demonstrate that 27 percent of children are obese upon enrollment in Head Start, as shown in Table 2. Nationwide, 13 percent of children ages 3 through 5 were obese in 2003 and 2004, as estimated in NHANES 2003-2004, and 18 percent of children in families below the poverty line ages 3 through 5 were obese. These statistics suggests that Head Start participants are significantly more disadvantaged, in terms of obesity, than other low income children. These differences are even more pronounced for blacks. While 25 percent of black children entering Head Start were obese, only 8 percent of black children with similar ages and incomes were obese nationwide, which suggests that there is significant selection present for black Head Start participants.

Table 3 displays bivariate probit estimates for varying specifications of the correlation parameters to assess the extent of observed and unobserved selection. Because of the sampling design of the PSID, standard errors are adjusted for clustering within households throughout the analysis. The average treatment effect on the treated is estimated as $(Y_1 - Y_0 \mid X, D = 1) = \Phi(X\beta + D\alpha) - \Phi(X\beta)$ and is evaluated for the sample with D = 1 at the mean values of X. The standard error of this treatment effect is computed using the delta method. The correlation parameter is varied from -0.10 to 0.90. As discussed above, previous research suggests that the correlation should be positive.

A correlation parameter of zero is equivalent to a single-equation probit model.[14] These results demonstrate that under the assumption $\Pr(Y_0 = 1 \mid X, D = 1) = \Pr(Y_0 = 1 \mid X, D = 0)$, which is equivalent to assuming that there is not selection on unobserved characteristics, Head Start participation has no statistically significant impact on the probability that an individual is overweight or obese. This result is also true for the sample of black children.

While the point estimates based on a probit model ($\rho = 0$) are positive, any unobserved selection that leads to a positive correlation between the unobserved determinants of obesity and the unobserved determinants of Head Start participation changes the sign of the point estimate to negative. A correlation of 0.20 yields a statistically significant reduction (at the 5 percent significance level) in the likelihood of being obese of 0.071 percentage points for black Head Start participants. Thus, only a small degree of correlation in unobserved characteristics yields a statistically significant impact of Head Start participation on childhood obesity for black

[14] Estimation of the average treatment effect on the treated using propensity score-matching yields similar results to the average treatment effect on the treated based on the estimates reported in Table 3 for $\rho = 0$.

children, which is reflected in the sample of all children. A correlation of 0.50 leads to a reduction of 0.21 percentage points in the probability of being obese for black Head Start participants, and a correlation of 0.90 leads to a 0.42 percentage point reduction.

Following the methodology of Altonji, Elder, and Taber (2005), when $\rho = \frac{Cov(Z\delta, X\beta)}{Var(Z\delta)}$ and Z is equivalent to X, the amount of unobserved selection is equal to the amount of observed selection. Under this condition, ρ = 0.32 for estimating the impact of Head Start participation on overweight for black children and ρ = 0.83 for estimating the impact on obesity for black children. For the sample of all children, the corresponding values are -0.05 and 1.46. For overweight, $-0.05 \leq \rho \leq 0$ for all children, and the estimated impact of Head Start participation is 0.04, but is not statistically different from zero. For the subset of black children, $0 \leq \rho \leq 0.32$ and the estimated impact of Head Start participation ranges from 0.03 with no unobserved selection to -0.15, where the extent of unobserved selection is equivalent to the amount of observed selection. For obesity, $0 \leq \rho \leq 1.46$ for all children; however, the bivariate probit model cannot be estimated for values of ρ greater than or equal to one. These values for ρ suggest that the estimated impact of Head Start participation on childhood obesity ranges between 0.02 and -0.41. For the subset of black children, $0 \leq \rho \leq 0.83$ and the estimated impact of Head Start participation ranges from 0.02 to -0.37. Since the majority of the ranges of plausible estimates for black children are negative and a correlation as low as 0.20 yields a negative and statistically significant estimate, it is likely that Head Start participation reduces the likelihood of being overweight or obese in later childhood for black participants.

Table 4 displays the bivariate probit estimates that identify the impact of Head Start participation by using the relative availability of Head Start to instrument for participation in the program. The relative availability of Head Start has a positive and statistically significant impact on whether a child participates in Head Start. The average treatment effect on the treated is a reduction of 0.05 percentage points in the probability of being overweight for all individuals, although this estimate is not statistically different from zero and the estimate of ρ is also not statistically significant. For black children, the point estimate suggests that Head Start participation reduces the probability of being overweight by 0.14 percentage points, but neither this estimate nor the estimate of ρ is statistically significant.

The estimate of the impact of Head Start participation on childhood obesity for all children is also not statistically different from zero. However, black Head Start participants, on average, are 0.292 percentage points (s.e.=0.153) less likely to be overweight during the ages of 5 through 19 than black children who did not attend Head Start. The estimate of the correlation coefficient is 0.663 with a standard error of 0.287. The corresponding heteroskedasticity-robust Wald statistic used to test the null hypothesis that the population correlation parameter is zero is 2.308; based on the chi-square distribution with one degree of freedom, the null hypothesis cannot be rejected for a level of significance less than 0.119. While this is not statistically significant at conventional levels, the size of the correlation estimate suggests that there is a relationship between υ and ε and the bivariate probit model should not be rejected in favor of the probit estimates. The positive estimate of ρ means that the unobserved characteristics that influence Head Start participation are positively correlated with the unobserved determinants of being obese. This statement is consistent with the claim that the children who are selected into the program are the most disadvantaged of the eligible children in both observed and unobserved characteristics.[15] Thus, the assumption that $Pr(Y_0 = 1 \mid X, D = 1) = Pr(Y_0 = 1 \mid X, D = 0)$ is unlikely to be true.

Although the relative availability of Head Start in the community is highly correlated with Head Start participation, a concern about the validity of the instrument is that it is correlated with other community characteristics that are related to childhood overweight and obesity. Panel A in Table 5 displays the results of estimates that add community services and economic variables to the bivariate probit models estimated previously. The community services variables include the number of health programs, children's programs, and services for the poor in the community. The community economic variables measure the population age 25 years and older who graduated high school and college, the unemployment rate for the population age 16 and older, median family income, median gross rent, and the median value of owner-occupied housing units in the community. As shown in Table 5, the point estimate of the impact of Head Start participation becomes more negative when adding community variables for all estimates except for the estimate for overweight for all children. The estimates for obesity are statistically significant at the 5 percent level for all children and the sub-sample of black children; however, only the estimate of ρ for the sub-sample of black children is statistically significant.

Given that the sample mean for black Head Start participants for obesity is approximately 0.2, the estimated average treatment effect on the treated of -0.33 implies that, in the absence of the program, black children who attended Head Start would have a probability of being obese of approximately 0.5. While this counterfactual estimate may seem excessively high, as shown in Table 2, the prevalence of obesity for black children ages 3 through 5 was 8 percent between 1988 and 1994 and the prevalence of obesity for black children ages 6 through 18 was 20 percent

[15] The notion that the children who are selected into the program are the most disadvantaged of the eligible children in both observed and unobserved characteristics is consistent with previous research that has evaluated the impact of Head Start participation on educational and social outcomes (e.g., Garces, Thomas, and Currie, 2002).

in 2001 and 2002. Thus the prevalence of obesity for black children during the ages and in the year that obesity is measured as an outcome in this analysis sample is more than double the prevalence of obesity for black children during the Head Start-eligible ages during the early years of this analysis sample. If the prevalence of obesity for black children upon entering Head Start is 25 percent, as suggested by the data displayed in Table 2, and the rate of increase in obesity for the Head Start population would have mirrored the rate of increase in the national population had Head Start children not attended the program, then it is possible that the prevalence of obesity for black Head Start children would have been approximately 0.5 in the absence of Head Start.

Panels B and C in Table 5 estimate bivariate probit models with and without community characteristics using the predicted availability of Head Start in the community to identify the impact of Head Start participation. Using this alternate instrument increases the estimated average treatment effect on the treated. The estimated impact of Head Start participation on overweight for black children doubles and becomes statistically significant; however the estimate of ρ is not statistically significant and exceeds the bounds previously estimated.

After accounting for observed and unobserved selection, Head Start is estimated to reduce the likelihood of being obese in later childhood for black participants. Previous research that has evaluated the impact of Head Start participation found that the benefits, in terms of cognitive achievement, do not persist, at least for blacks. To attempt to determine if the benefit of Head Start participation for black children persists into later childhood, I estimate bivariate probit models for different age groups, increasing the age of the youngest children in the sample by one year with each successive model. As shown in Table 6, the estimated impact of Head Start participation on obesity is statistically significant for the samples of black children ages 6 and older, ages 7 and older, ages 8 and older, and ages 9 and older. When the sample is restricted to black children ages 10 and older, the estimated impact is no longer statistically significant. These results suggest that the impact of Head Start participation does not persist beyond age 10.

One potential explanation for why the impact of Head Start participation does not persist is the nutrition offered in the schools attended after Head Start. Head Start children, especially black Head Start children, attend low quality schools after Head Start (Currie and Thomas, 2000). These schools may also be under financial pressure. Anderson and Butcher (2005) document that schools under financial pressure are more likely to make junk foods available through vending machines or school stores, are more likely to grant a soft drink manufacturer exclusive rights to supply their soft drink to students, and are more likely to allow soda or snack food advertising. The authors demonstrate that these food policies, particularly the availability of junk food, lead to an increase in children's body mass index. Additionally, participation in the National School Lunch Program and the School Breakfast Program leads to the consumption of a higher percentage of calories from fat and saturated fat (Gordon, Devaney, and Burghardt, 1995) and is positively related to obesity (Schanzenbach, forthcoming). Thus, the food policies and the quality of the school food of the subsequent schools attended by black Head Start participants could counteract the benefits of the Head Start program.

An additional explanation for why the benefits of Head Start participation do not persist is that Head Start provides nutritious foods, which may compensate for the lack of access to healthy foods in poor, black neighborhoods.[16] The increase in nutritional access would provide short-term benefits to children and these benefits would begin to fade away after this access

[16] Although the national figures for Head Start suggest that many races and ethnicities are present in the program, at the local level there is a high degree of racial segregation, which reflects the racial composition of the local communities.

ends. Among poor neighborhoods, distance to supermarkets is much greater for predominantly black neighborhoods than predominantly white neighborhoods (Zenk et al., 2005) and access to supermarkets positively influences dietary patterns (Morland, Wing, and Diez Roux, 2002). Supermarkets provide better availability and selection of nutritious foods and higher quality foods at a lower cost than smaller food providers (Zenk et al., 2005). Among the most impoverished neighborhoods, the nearest supermarket to predominantly black neighborhoods is slightly over one mile farther away than the nearest supermarket to predominantly white neighborhoods (Zenk et al., 2005). Within a 3-mile radius of the most impoverished neighborhoods, there were approximately two and a half fewer supermarkets for predominantly black neighborhoods than predominantly white neighborhoods (Zenk et al., 2005). Thus, for black Head Start participants, access to healthy foods would be limited without the availability of Head Start. This explanation suggests that the provision of nutritious foods provides substantial benefits to Head Start participants.

6. Conclusion

This paper estimates the impact of Head Start participation on childhood overweight and obesity for individuals ages 5 through 19. Because of the comprehensive services, including nutrition and nutritional education provided to parents and children, Head Start participation is predicted to affect childhood overweight and obesity. Estimates of the impact of Head Start participation for varying degrees of unobserved selection suggest that if the extent of unobserved selection is equal to one-quarter of the amount of observed selection, then Head Start would reduce the likelihood of being obese for black participants. Plausibly exogenous variation in the relative availability of Head Start in the local community is used to identify the average treatment effect for Head Start participants. The results demonstrate that Head Start did in fact significantly reduce the probability that a black participant would become obese in later childhood. In light of the innumerable negative consequences associated with obesity, Head Start considerably improves the welfare of black participants.

This finding is noteworthy because many of the educational benefits of Head Start participation that have been previously estimated demonstrate a positive impact of the program for whites, but not blacks. Thus, Head Start participation can influence outcomes for all of the participants, not just whites. Additionally, based on this previous research that demonstrates racial differences in the impact of Head Start participation, these results suggest that the influence on childhood obesity results from the nutritional services in the program, not because Head Start improved educational outcomes that had secondary health benefits. It is likely that the reduction in childhood overweight and obesity from Head Start participation results from the provision of nutritious foods, in addition to the parent and child nutritional education. Further research, however, is needed to more completely discern the importance of the different pathways through which Head Start's services reduce childhood obesity to better guide the structure of the Head Start program and the design of public policies to reduce the prevalence of childhood obesity.

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Table 1: Descriptive Statistics

	All	Head Start	No Head Start	Black	Head Start	No Head Start
Overweight	0.352	0.381	0.345	0.386	0.409	0.370
	(0.019)	(0.043)	(0.021)	(0.030)	(0.054)	(0.035)
Obese	0.200	0.210	0.198	0.239	0.248	0.233
	(0.016)	(0.036)	(0.017)	(0.028)	(0.048)	(0.032)
Head Start	0.196	1.000	0.000	0.417	1.000	0.000
	(0.016)			(0.032)		
Black	0.292	0.619	0.212	1.000	1.000	1.000
	(0.016)	(0.044)	(0.015)			
White	0.616	0.306	0.691	0.000	0.000	0.000
	(0.019)	(0.041)	(0.019)			
Hispanic	0.045	0.036	0.047	0.000	0.000	0.000
	(0.010)	(0.020)	(0.011)			
Other Race	0.047	0.039	0.049	0.000	0.000	0.000
	(0.010)	(0.021)	(0.011)			
Female	0.504	0.445	0.518	0.453	0.418	0.478
	(0.020)	(0.044)	(0.022)	(0.031)	(0.053)	(0.036)
Age	12.395	12.235	12.435	12.742	12.915	12.618
	(0.141)	(0.274)	(0.163)	(0.198)	(0.298)	(0.263)
Low Birth Weight	0.072	0.076	0.071	0.099	0.099	0.099
	(0.009)	(0.015)	(0.010)	(0.013)	(0.018)	(0.018)
Oldest	0.335	0.247	0.356	0.279	0.243	0.303
	(0.018)	(0.032)	(0.021)	(0.026)	(0.036)	(0.035)
Disability	0.198	0.290	0.175	0.148	0.237	0.083
	(0.017)	(0.042)	(0.018)	(0.023)	(0.049)	(0.015)
Urban	0.290	0.313	0.284	0.458	0.388	0.509
	(0.016)	(0.037)	(0.018)	(0.030)	(0.050)	(0.036)
Rural	0.261	0.270	0.259	0.158	0.177	0.145
	(0.017)	(0.037)	(0.019)	(0.020)	(0.035)	(0.023)
Family Income	34.537	21.430	37.739	27.011	19.964	32.056
	(0.702)	(1.407)	(0.755)	(1.129)	(1.933)	(1.361)
Family Size	4.162	4.438	4.095	4.329	4.571	4.155
	(0.049)	(0.135)	(0.049)	(0.100)	(0.176)	(0.106)
Father Not Present	0.400	0.674	0.333	0.692	0.797	0.617
	(0.020)	(0.040)	(0.021)	(0.025)	(0.040)	(0.032)
Mother’s Education	12.418	11.845	12.558	12.006	11.968	12.034
	(0.077)	(0.173)	(0.085)	(0.140)	(0.227)	(0.179)
Mother’s BMI	24.617	25.683	24.356	26.863	26.566	27.075
	(0.201)	(0.381)	(0.232)	(0.378)	(0.409)	(0.571)
No. of Children’s Programs	52.043	49.309	52.711	67.115	56.838	74.471
	(3.195)	(5.181)	(3.767)	(5.510)	(7.127)	(7.957)
No. of Health Programs	45.153	45.210	45.139	58.324	52.616	62.410
	(2.491)	(4.659)	(2.883)	(4.008)	(6.381)	(5.139)
No. of Services for the Poor	19.415	20.678	19.107	26.842	24.600	28.446
	(1.069)	(2.542)	(1.177)	(1.969)	(3.584)	(2.205)
Community Median Income	46.381	46.290	46.403	47.465	46.995	47.802
	(0.403)	(1.040)	(0.432)	(0.857)	(1.388)	(1.089)
Community Unemployment	0.059	0.064	0.058	0.068	0.069	0.067
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Community Housing Price	99.537	96.198	100.353	103.538	99.002	106.785
	(1.761)	(3.820)	(1.981)	(2.843)	(4.500)	(3.702)
Community Median Rent	0.522	0.518	0.523	0.550	0.539	0.557
	(0.005)	(0.012)	(0.006)	(0.008)	(0.015)	(0.010)

Community Pct. College Grad.	0.222	0.234	0.220	0.242	0.245	0.240
	(0.003)	(0.008)	(0.004)	(0.006)	(0.010)	(0.008)
Community Pct. High School	0.800	0.794	0.801	0.781	0.786	0.777
Graduate	(0.002)	(0.006)	(0.003)	(0.005)	(0.008)	(0.006)
Relative Availability	0.428	0.466	0.419	0.443	0.461	0.430
of Head Start	(0.008)	(0.020)	(0.009)	(0.014)	(0.026)	(0.015)
Predicted Availability	0.085	0.100	0.081	0.102	0.109	0.097
of Head Start	(0.002)	(0.007)	(0.002)	(0.006)	(0.011)	(0.005)
Sample Size	1332	346	986	800	286	514
Sample Size for Predicted Availability	1021	274	747	607	219	388

Notes: Weighted means with standard errors in brackets. The sample in the second column includes all children in the 2002 Child Development Supplement to the Panel Study of Income Dynamics (PSID) with information on Head Start attendance, body mass index, mother's body mass index, and county of residence at age 3 or 4 within the common support of the Head Start and no Head Start distributions. The sample in the third and fourth columns is the subset of individuals who attended Head Start and who did not. The sample in the fifth columns is the subset of black individuals. The sample in the sixth and seventh columns is the subset of black individuals who attended Head Start and who did not. See text or data appendix for further information about the definitions of these variables.

Sources: PSID, PSID Geocode file, Child Development Supplement to the PSID, Head Start Program Information Reports, and U.S. Census Bureau Small Area Income and Poverty Estimates, Administration for Children and Families.

Table 2: Prevalence Estimates of Overweight and Obesity

	Data Source and Year	Overweight	Obese
3 – 5 year olds	NHANES 2003-2004	0.19	0.13
Low Income 3 – 5 year olds		0.22	0.18
Black		0.14	0.08
White		0.15	0.13
Head Start (prior to enrollment)	NYC Dept of Health & Mental Hygiene, 2004	0.42	0.27
Black		0.38	0.25
White		0.27	0.12
3 – 5 year olds	NHANES III, 1888-1994	0.14	0.09
Black		0.14	0.08
White		0.12	0.07
6 – 18 year olds	NHANES 2001-2002	0.25	0.16
Black		0.27	0.20
White		0.22	0.14

Table 3: Bivariate Probit Estimates of the Impact of Head Start Participation for Varying Degrees of Unobserved Selection

	ρ = -0.1	ρ = 0	ρ = 0.1	ρ = 0.2	ρ = 0.3	ρ = 0.4	ρ = 0.5	ρ = 0.6	ρ = 0.7	ρ = 0.8	ρ = 0.9
Outcome: Overweight											
Sample: All Children											
ATT	0.054	0.035	-0.026	-0.086	-0.146	-0.204	-0.261	-0.316	-0.369	-0.419	-0.463
	(0.034)	(0.034)	(0.034)	(0.033)	(0.032)	(0.031)	(0.029)	(0.027)	(0.024)	(0.022)	(0.019)
Head Start	0.146	0.097	-0.072	-0.241	-0.409	-0.578	-0.745	-0.910	-1.072	-1.228	-1.371
	(0.091)	(0.095)	(0.095)	(0.094)	(0.092)	(0.090)	(0.087)	(0.083)	(0.078)	(0.072)	(0.064)
Sample: Black Children											
ATT	0.089	0.031	-0.029	-0.088	-0.147	-0.205	-0.262	-0.317	-0.370	-0.420	-0.465
	(0.038)	(0.039)	(0.039)	(0.038)	(0.037)	(0.036)	(0.034)	(0.032)	(0.029)	(0.026)	(0.022)
Head Start	0.253	0.086	-0.081	-0.248	-0.414	-0.580	-0.745	-0.908	-1.068	-1.220	-1.359
	(0.109)	(0.109)	(0.109)	(0.108)	(0.106)	(0.103)	(0.100)	(0.096)	(0.090)	(0.083)	(0.075)
Outcome: Obese											
Sample: All Children											
ATT	0.068	0.020	-0.027	-0.074	-0.120	-0.167	-0.214	-0.262	-0.310	-0.359	-0.408
	(0.030)	(0.030)	(0.029)	(0.028)	(0.028)	(0.027)	(0.026)	(0.025)	(0.024)	(0.023)	(0.020)
Head Start	0.241	0.072	-0.096	-0.264	-0.431	-0.597	-0.761	-0.923	-1.082	-1.236	-1.381
	(0.105)	(0.105)	(0.104)	(0.103)	(0.101)	(0.098)	(0.095)	(0.091)	(0.086)	(0.080)	(0.073)
Sample: Black Children											
ATT	0.070	0.023	-0.024	-0.071	-0.118	-0.166	-0.214	-0.263	-0.314	-0.365	-0.416
	(0.033)	(0.033)	(0.033)	(0.032)	(0.032)	(0.032)	(0.031)	(0.030)	(0.029)	(0.026)	(0.024)
Head Start	0.248	0.080	-0.087	-0.253	-0.419	-0.585	-0.749	-0.911	-1.070	-1.225	-1.371
	(0.117)	(0.117)	(0.117)	(0.115)	(0.113)	(0.111)	(0.107)	(0.102)	(0.097)	(0.090)	(0.082)

Notes: Heteroskedasticity-robust standard errors in parentheses allow for clustering within households. ATT is the average treatment effect on the treated evaluated at the mean values of the conditioning variables in the Head Start sample. The estimates are based on bivariate probit models with the specified value for rho. Explanatory variables not shown include race, gender, age, low birth weight, oldest, disability status, urban/rural, family income, family income squared, family size, whether the father was present in the family, mother's education, mother's body mass index, and mother's body mass index squared.

Table 4: Bivariate Probit Estimates of the Relationship between Head Start Participation and Overweight/Obesity

	All		Black		All		Black	
Dependent Variable	Head Start	Overweight	Head Start	Overweight	Head Start	Obese	Head Start	Obese
ATT	-0.050		-0.140		-0.248		-0.292	
	(0.195)		(0.316)		(0.219)		(0.153)	
Head Start		-0.138		-0.397		-0.879		-1.004
		(0.546)		(0.899)		(0.740)		(0.478)
Relative Availability	0.617		0.548		0.593		0.507	
of Head Start	(0.212)		(0.244)		(0.228)		(0.237)	
Black	0.700	0.159			0.690	0.337		
	(0.124)	(0.135)			(0.121)	(0.182)		
Hispanic	0.206	0.351			0.213	0.133		
	(0.261)	(0.349)			(0.252)	(0.309)		
Other Race	0.008	0.206			0.025	0.073		
	(0.271)	(0.242)			(0.261)	(0.266)		
Female	-0.077	0.018	-0.094	0.184	-0.088	-0.044	-0.093	0.093
	(0.089)	(0.069)	(0.105)	(0.095)	(0.086)	(0.076)	(0.102)	(0.100)
Age	-0.032	0.008	-0.02	0.001	-0.031	0.002	-0.022	-0.008
	(0.015)	(0.012)	(0.018)	(0.017)	(0.015)	(0.018)	(0.018)	(0.017)
Low Birth Weight	0.126	-0.131	0.211	-0.219	0.143	-0.096	0.218	-0.189
	(0.134)	(0.132)	(0.143)	(0.174)	(0.130)	(0.146)	(0.140)	(0.178)
Oldest	0.172	-0.044	0.199	-0.014	0.195	0.016	0.221	-0.006
	(0.098)	(0.085)	(0.119)	(0.121)	(0.101)	(0.094)	(0.115)	(0.111)
Disability	0.582	-0.001	0.537	0.214	0.551	0.148	0.529	0.362
	(0.128)	(0.134)	(0.158)	(0.195)	(0.131)	(0.179)	(0.153)	(0.162)
Urban	-0.102	-0.059	-0.134	-0.092	-0.101	-0.208	-0.137	-0.292
	(0.115)	(0.097)	(0.127)	(0.123)	(0.113)	(0.099)	(0.126)	(0.114)
Rural	0.223	0.129	0.204	0.357	0.249	0.154	0.229	0.340
	(0.142)	(0.118)	(0.197)	(0.184)	(0.154)	(0.126)	(0.202)	(0.173)
Family Income	-0.034	0.011	-0.036	0.01	-0.034	-0.003	-0.036	-0.007
	(0.012)	(0.011)	(0.012)	(0.017)	(0.012)	(0.014)	(0.012)	(0.012)
Family Income ^{2}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Family Size	0.106	-0.084	0.094	-0.072	0.106	-0.079	0.092	-0.084
	(0.038)	(0.039)	(0.041)	(0.055)	(0.038)	(0.061)	(0.041)	(0.055)
Father Not Present	0.142	0.044	0.145	0.159	0.146	0.047	0.138	0.100
	(0.114)	(0.094)	(0.130)	(0.121)	(0.113)	(0.108)	(0.125)	(0.129)
Mother’s Education	-0.029	-0.013	-0.016	-0.020	-0.037	-0.014	-0.024	0.006
	(0.027)	(0.022)	(0.033)	(0.027)	(0.030)	(0.024)	(0.035)	(0.029)
Mother’s BMI	0.071	0.129	0.087	0.154	0.066	0.131	0.077	0.162
	(0.042)	(0.044)	(0.047)	(0.049)	(0.042)	(0.035)	(0.047)	(0.040)
Mother’s BMI ^{2}	-0.001	-0.001	-0.001	-0.002	-0.001	-0.001	-0.001	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	-1.478	-2.609	-1.237	-2.832	-1.308	-2.490	-0.945	-2.756
	(0.819)	(0.757)	(0.978)	(0.982)	(0.855)	(0.924)	(1.026)	(1.003)
ρ	0.141		0.292		0.578		0.663	
	(0.314)		(0.528)		(0.449)		(0.287)	
Observations	1332		800		1332		800	

Notes: Heteroskedasticity-robust standard errors in parentheses allow for clustering within households. ATT is the average treatment effect on the treated evaluated at the mean values of the conditioning variables in the Head Start sample.

Table 5: Alternative Specifications of the Impact of Head Start Participation

	Overweight		Obese	
	All	Black	All	Black
Panel A: Including Community Services and Economic Variables				
ATT	-0.027	-0.248	-0.345	-0.328
	(0.234)	(0.563)	(0.180)	(0.105)
ρ	0.103	0.483	0.773	0.738
	(0.381)	(0.984)	(0.357)	(0.189)
Head Start	-0.077	-0.71	-1.198	-1.128
	(0.661)	(1.642)	(0.562)	(0.322)
Observations	1332	800	1332	800
Panel B: Using Predicted Availability of Head Start				
ATT	-0.221	-0.500	-0.410	-0.448
	(0.218)	(0.116)	(0.089)	(0.163)
ρ	0.432	0.963	0.906	0.941
	(0.374)	(0.346)	(0.169)	(0.292)
Head Start	-0.627	-1.460	-1.395	-1.471
	(0.634)	(0.363)	(0.254)	(0.434)
Observations	1021	607	1021	607
Panel C: Using Predicted Availability of Head Start and Including Community Services and Economic Variables				
ATT	-0.208	-0.495	-0.419	-0.436
	(0.271)	(0.206)	(0.072)	(0.072)
ρ	0.401	0.944	0.910	0.928
	(0.464)	(0.553)	(0.137)	(0.114)
Head Start	-0.593	-1.451	-1.428	-1.459
	(0.787)	(0.655)	(0.208)	(0.196)
Observations	1021	607	1021	607

Notes: Heteroskedasticity-robust standard errors in brackets allow for clustering within households. ATT is the average treatment effect on the treated evaluated at the mean values of the conditioning variables in the Head Start sample. Head Start is the estimated coefficient for Head Start from a bivariate probit model. The community services and economic variables include the number of health programs, the number of children's programs, the number of services for the poor, the percent of the population age 25 years and older who graduated high school and college, the unemployment rate for the population age 16 and older, median family income, median gross rent, and the median value of owner-occupied housing units in the Head Start service region. Panels B and C use the predicted availability of Head Start as an instrument instead of the relative availability of Head Start. Explanatory variables not shown are the same as those displayed in Table 4.

Table 6: Estimates of the Impact of Head Start Participation on Obesity for Black Children for Different Age Specifications

	Age ≥ 6	Age ≥ 7	Age ≥ 8	Age ≥ 9	Age ≥ 10
ATT	-0.316	-0.336	-0.336	-0.386	-0.349
	(0.141)	(0.128)	(0.125)	(0.117)	(0.354)
ρ	0.705	0.734	0.736	0.825	0.708
	(0.262)	(0.239)	(0.238)	(0.239)	(0.746)
	0.092	0.070	0.070	0.118	0.555
Head Start	-1.080	-1.132	-1.134	-1.286	-1.189
	(0.432)	(0.386)	(0.379)	(0.347)	(1.117)
Observations	783	745	685	614	550

Notes: Heteroskedasticity-robust standard errors in brackets allow for clustering within households. ATT is the average treatment effect on the treated evaluated at the mean values of the conditioning variables in the Head Start sample. Head Start is the estimated coefficient for Head Start from a bivariate probit model. Explanatory variables not shown are the same as those displayed in Table 4.

Data Appendix

This appendix provides a detailed explanation of the creation of variables used for this analysis.

Relative Availability of Head Start: The relative availability of Head Start is defined as the number of children who attend Head Start divided by number of eligible children in the local community. The local community is defined as the county or a group of counties commonly served by the same Head Start grantee(s). The regions that each grantee in each state served were obtained from the websites of the state's Head Start Association, the state's Head Start Collaboration Office, or through personal communication with a staff member in either of these groups.

The number of children who attend Head Start in each county in the U.S. is determined from the Head Start Program Information Reports, available from Xtria, from 1988 until 2001. These data are reported by each Head Start grantee annually. The number of children who actually attended the centers managed by each grantee is aggregated to the county level. Attendance figures from Early Head Start Centers and Parent Child Centers were not included because these centers served parents and children ages 0 through 3. American Indian/Alaskan Native programs and Migrant programs were also not included because these programs can have a much larger service region than other programs, and these programs serve a relatively small number of children. The address of each grantee is provided in the Program Information Reports, but not the county identifier. Each Head Start grantee was assigned a county code by linking the reported zip code with the Federal Information Processing Standards county codes using geographic data available from the Missouri Census Data Center. Remaining missing county codes were then determined based on the county of the grantee in other years, the county of the reported city, or by looking up the county that corresponds to the zip code using the Melissa Data Geocoder Lookup. The number of children who attend Head Start in each county was then aggregated to the service region to form the numerator in this variable.

The number of eligible children is derived from the Small Area Income and Poverty Estimates (SAIPE) of the U.S. Census Bureau. Eligibility is estimated based on poverty, which underestimates the true number of children eligible. However, at least 90 percent of children who attend Head Start in each program must be living in poverty, and measures of other eligibility criteria are not available annually for each county nationwide. In the SAIPE data, the number of children under age 5 in poverty is available for each state, but not for each county. For each county, the number of poor children under age 5 is the difference between the estimate of people ages 0 through 17 in poverty and the estimate of related children ages 5 through 17 in families in poverty. This difference is close to the number of children under age 5 in poverty, but is slightly incorrect because the figure for children ages 5 through 17 is based on related children in families. The degree to which this difference overestimates the number of poor children under age 5 is determined from the state level data. Each county estimate is then divided by this correction factor. The number of eligible children in each county is then defined as the number of children age 3 or 4 in poverty or two-fifths of the number of children under age 5 in poverty. County-level estimates are only available in 1989, 1993, and 1995-2001 from the SAIPE data. Estimates for the remaining years were determined through linear interpolation. The number of eligible children in each county was then aggregated to the service region to form the denominator in this variable.

The number of children who attend Head Start is divided by the number of income eligible children for each service region and constrained to be greater than or equal to zero and less than or equal to one. This value represents the probability that an income eligible child will attend Head Start in the region before the selection decisions of the local Head Start administrators. This variable in then linked to Head Start attendance and other variables in the PSID by the county of residence, available from the restricted-access Geocode file of the PSID, and corresponding region code for each year between 1988 and 2001. The final value of this variable is then defined as the average number of children who attend Head Start divided by the number of income eligible children in the child's region of residence at ages 3 and 4.

Some of the data used in this analysis are derived from Sensitive Data Files of the Panel Study of Income Dynamics, obtained under special contractual arrangements designed to protect the anonymity of respondents. These data are not available from the author. Persons interested in obtaining PSID Sensitive Data Files should contact the PSID staff through the Internet at PSIDHelp@isr.umich.edu.

Predicted Availability of Head Start: The predicted availability of Head Start in the community is the predicted Head Start enrollment divided by the population of all children ages 3 and 4 in the community. To predict Head Start enrollment, first, I estimate the relationship between Head Start enrollment in the community and Head Start funding, population, community services and economic variables, and Head Start program characteristics. This relationship is estimated for the year 2000, the only year with community services and economic variables, which are drawn from U.S. Census data. The predicted availability of Head Start for 2000 is derived from these estimates. Then I estimate the relationship between changes in enrollment and changes in the population and funding using a fixed-effects model using data from 1992 to 2003. Information about the funding for each Head Start grantee is available mainly from 1992 forward and was provided by the Administration from Children and Families. Based on the estimates of the fixed-effects model and the actual changes in population and funding, I predict the change in enrollment from 2000 for each year. The coefficient estimates for each of these equations are displayed in Data Appendix Tables A1 and A2.

Head Start: Determination of Head Start participation is based on three sets of questions asked of PSID and CDS respondents. In 1995, the responding family member was asked, for each individual ages 5 through 40 in the family, if each family member attended Head Start. In 1997, in the CDS, each primary caregiver was asked if the child participated in any intervention program, such as Head Start, Early Start (a family intervention program for children below age 7), or Fair Start (a Canadian child development program). Also, in the CDS in 1997, primary caregivers were asked about the childcare history, which included Head Start. In the CDS in 2002, primary caregivers were asked to update the childcare history from 1997 forward. For each question, Head Start participation was determined. For each of these questions about Head Start participation, possible sources of misreporting were corrected; the child was defined as having not participated in Head Start if participation began before age 2 (Early Head Start, not Head Start), if the family income – averaged across ages 3, 4, and 5 – was greater than twice the poverty line (adjusted for family size) and the child was not disabled, or if the child did not live in the U.S. at age 3 or 4 (Fair Start, not Head Start). Then Head Start participation was determined from the 1995 PSID question, the CDS intervention question, and the CDS childcare questions. If all three groups of questions agreed, then Head Start participation was easily determined. If two out of the three groups of questions agreed, then Head Start participation was coded based on the questions in agreement. If two out of the three groups of questions were missing, then Head Start participation was coded based on the non-missing question. The remaining cases were those in which no information was available from the 1995 question and the responses to the intervention and childcare questions differed. The responses to these questions could differ if the parent did not view Head Start to be a form of childcare, but instead a form of preschool or an intervention program, which would align the weighted response of Head Start participation with other reported estimates in the literature. These remaining cases were counted as participating in Head Start.

Overweight/Obese: Height and weight were measured by the CDS interviewer in 2002. Body mass index is then determined as weight in kilograms / (height in meters)^{2}. Based on the age- and gender-specific cutoffs specified in Cole et al. (2000), a child is defined as overweight (or obese) if their body mass index is greater than or equal to the appropriate threshold level.

Race: Individuals are categorized as either white, black, Hispanic, or another race according to the reports of the primary caregiver in the CDS. A child's race is then specified by a set of binary variables for each racial group.

Low Birth Weight: Birth weight in ounces is provided by the primary caregiver in the CDS. Low birth weight is defined as less than 88 ounces.

Oldest: This dichotomous variable is equal to one if the child is the firstborn child of the mother.

Disability: This dichotomous variable is equal to one if the primary caregiver in the 1997 CDS reports that a doctor or health professional has ever said that the child had a speech impairment, hearing difficulty, difficulty seeing, retardation, emotional disturbance, orthopedic impairment, developmental delay, learning disability, or autism. This corresponds with the Head Start Bureau's definition of a disability.

Urban/Rural: Based on the Beale-Ross urban-rural codes from the years in which the child was 3, 4, and 5 years old, residence is coded as urban if the family resides in a metropolitan area with a population of one million or more or a fringe county of such a metropolitan area. Residence in a rural location is coded dichotomously if, according to this categorization, the family's residence is completely rural.

Family Income: Family income is defined as the total family income averaged over the years in which the child was 3, 4, and 5 years old. Total family income includes the taxable and transfer income of all household members. Income is converted into 2001 prices using the Consumer Price Index (for all urban consumers, the U.S. city average).

Family Size: Family size is defined as the total number of individuals in the family unit averaged over the years in which the child was 3, 4, and 5 years old.

Father Not Present: This dichotomous variable is defined as one if the father or a stepfather was not part of the family unit when the child was 3, 4, or 5 years old.

Mother's Education: These variables represent the years of schooling completed by the mother (female parental figure) averaged over the years in which the child was 3, 4, and 5 years old. The median years of schooling completed for each category were used to convert years of schooling into a continuous variable.

Mother's BMI: These variables are the body mass index of the child's mother (female parental figure) in 1986. Height and weight are self-reported and then converted into body mass index using the formula: BMI = weight in kilograms / (height in meters) ^{2}.

Age: This variable is the age in years, constructed by dividing the age in months by twelve, of the child in 2002 as reported by the child's primary caregiver.

Female: This dichotomous variable is equal to one if the child is female.

Community Programs: Three variables are used to measure the number of community programs. Distinct variables measure the number of health programs, children's programs, and services to the poor. These variables are constructed by counting the number of 501(c)(3) public charities and 501(c)(4) social welfare organizations in the county, and then aggregating this number to the service region for the Head Start grantee. These data are available in the National Center for Charitable Statistics' 2000 Business Master File. The categorization of the social program is based on IRS activity codes. Health programs are defined as services or programs with the following activity codes: health clinic (154), aid to the handicapped (160), community health planning (165), and mental health care (166). Children's programs are defined as services or programs with the following activity codes: Boys Club, Little League, etc. (321), YMCA, YWCA, YMHA, etc. (324), care and housing of children (326), prevention of cruelty to children (327), combat juvenile delinquency (328), youth development (330), youth development (347), other youth organization or activities (349). Services for the poor are based on the following activity code: supplying money, goods, or services to the poor (560).

Community Economic Variables: These variables include the percent of the population age 25 years and older who graduated high school and college, the unemployment rate for the population age 16 and older, median family income, median rent, and the median value of owner-occupied housing units. These variables are gathered for each county from the 2000 Census of Population and Housing, Summary File 3, and then aggregated to the service region for each Head Start grantee.

Missing data for the variables other than Head Start attendance, the relative availability of Head Start, and the dependent variables are imputed using linear regression based on the control variables with non-missing data. Eleven missing observations were imputed for family income, 34 for the oldest sibling dummy, 77 for urbanicity, 75 for mothers' education, 1 for disability, 58 for birth weight, and 5 for race.

Data Appendix Tables

Data Appendix Table A1: The Relationship between Head Start Enrollment and Funding, Population, Community Characteristics, and Program Characteristics in 2000

	Coefficient	Standard Error
Funding (ln)	0.604	(0.039)
Population Age 3 & 4 (ln)	0.284	(0.026)
Community Pct. High School Graduate	-0.156	(0.243)
Community Pct. College Graduate	-0.224	(0.236)
Community Unemployment	1.627	(0.750)
Community Median Income	-0.002	(0.003)
Community Median Rent	-0.894	(0.202)
Community Housing Price	0.001	(0.000)
No. of Children's Programs	-0.002	(0.001)
No. of Health Programs	0.004	(0.001)
No. of Services for the Poor	0.003	(0.003)
Grantee is Community Action Agency	0.031	(0.021)
Grantee is School	0.040	(0.031)
Grantee is Government Agency	0.040	(0.048)
Director's Education = High School	0.020	(0.040)
Director's Education = AA	-0.033	(0.033)
Director's Education = Graduate Degree	0.001	(0.020)
Director's Years of Experience	0.003	(0.001)
Constant	-4.663	(0.447)
Observations	978	

Notes: Heteroskedasticity-robust standard errors in parentheses. The dependent variable is the natural log of funded enrollment in the community, where the community is defined as the Head Start service region.

Data Appendix Table A2: The Relationship between Head Start Enrollment and Funding and Population from 1992 to 2003

	Coefficient	Standard Error
Funding (ln)	0.316	(0.020)
Population Age 3 & 4 (ln)	0.111	(0.022)
Year = 1992	-0.132	(0.016)
Year = 1993	-0.128	(0.012)
Year = 1994	-0.062	(0.009)
Year = 1995	-0.015	(0.008)
Year = 1996	-0.007	(0.008)
Year = 1997	-0.036	(0.007)
Year = 1998	-0.025	(0.006)
Year = 1999	-0.005	(0.005)
Year = 2001	-0.061	(0.007)
Year = 2002	-0.044	(0.008)
Year = 2003	-0.034	(0.008)
Constant	0.513	(0.305)
Observations	11736	
Communities	1005	

Notes: Heteroskedasticity-robust standard errors in parentheses. The dependent variable is the natural log of funded enrollment in the community, where the community is defined as the Head Start service region. Additional explanatory variables include community fixed effects.