Head Start Participation and Childhood Obesity[*]

David E. Frisvold[†]
Emory University

September 9, 2011

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.

JEL Classification: I12, I38, H53, J13

Keywords: obesity, Head Start, early childhood education

---

[*] This research is funded, in part, by the National Institute for Child Health and Human Development, Robert Wood Johnson Foundation, the Household International Research Support program, and the Emory Global Health Institute. I thank Joseph Altonji, Kathryn Anderson, Martha Bailey, Dale Ballou, William Collins, Janet Currie, James Foster, Anthony LoSasso, Jens Ludwig, Robert Margo, Grant Miller, Matthew Neidell, Marianne Simonsen, conference participations at the American Economic Association Annual Conference, the Association for Public Policy Analysis and Management Fall Conference, and the Southern Economic Association Annual Conference, seminar participants at Baylor University, the CNA Corporation, the Government Accountability Office, and University of North Carolina at Greensboro, and the Early Childhood Research Collaborative staff for helpful suggestions. I also thank Nicole Harmon at Xtria for providing me with access to the Head Start Program Information Report data, Ashley Crownover for editorial assistance, and Jennifer Hefner for research assistance.

[†] Emory University, Department of Economics, Atlanta, GA 30322-2240; Phone: 404-727-7833; Fax: 404-727-4639; E-mail: david.frisvold@emory.edu

1. Introduction

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.

This paper examines the impact of Head Start participation on childhood and adolescent obesity. The prevalence of childhood obesity in the United States has risen dramatically in the last 40 years, doubling for children ages 6 to 11 and tripling for children ages 12 to 17 (Dietz, 2004). Childhood obesity is associated with a myriad of health consequences, such as hypertension and other cardiovascular disease risk factors, type 2 diabetes, and obstructive sleep apnea (Ebbeling, Pawlak, and Ludwig, 2002). Given that childhood obesity leads to adult obesity (Nader et al., 2006), that the social costs of adult obesity are driven by diseases linked to childhood obesity (Wolf, 1998), 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.

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. 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. Additionally, the structured time in Head Start may limit children's intake of low-nutrition foods and periods of inactivity. In fact, the Improving Head Start Act of 2007 emphasizes the potential for Head Start to decrease childhood obesity.

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 the early childhood ages.

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 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. This paper adds to the literature on the long-term impacts of Head Start participation and complements the growing literature documenting the reduction in childhood obesity due to participation in Head Start and other school-based intervention programs.

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.

Each Head Start program must actively recruit and inform as many families with eligible children as possible within the program's service region. 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. 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. 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, 2005b) 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. 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). Additionally, Ludwig and Miller (2007) provide evidence that Head Start participation increases the educational attainment of both white and black participants.

Head Start participation also results in health and social benefits. 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, 2005b) and are more likely to be immunized for measles than children who did not attend any form of preschool (Currie and Thomas, 1995). Head Start participation also significantly reduced childhood mortality rates (Ludwig and Miller, 2007). Additionally, black Head Start participants are 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, the National Research Council's *Diet and Health* report, and the Head Start performance standards (Fox et al., 1997). More recently, Whitaker et al. (2009) find that the food provided in Head Start centers nationally is healthier than required by the federal guidelines.

Head Start may also improve the nutritional quality of participants' diet by limiting exposure to poor nutrition. The food consumed outside of Head Start may be less nutritious due to the limited access to healthy food in poor neighborhoods (Morland, Wing, and Diez Roux 2002), which is particularly relevant for predominantly black neighborhoods (Zenk et al., 2005). Additionally, parents and other caregivers are not as knowledgeable about nutrition as the trained specialists who prepare the meals in Head Start (Keane et al. 1996).

The nutritional education provided to the parents and children throughout the program could improve 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).[1]

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. 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

[1] However, the existing research in this area has not examined whether, in fact, the nutritional quality of meals consumed at home changed in response to the nutritional education provided to parents.

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 because of the reduced cost of child care and development services available to families (Becker and Tomes, 1976). 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.[2] Let Y denote these two outcomes, where Y = 1 if the individual is overweight or obese 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), which 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

[2] Dichotomous indicators based on threshold values of BMI that correspond to overweight and obesity are used in this analysis, as opposed to the underlying BMI scale, for primarily two reasons. First, the sections of the BMI distribution associated with overweight and obesity are designed to be medically-salient components of the distribution. Second, the services provided in Head Start potentially could decrease the likelihood of being underweight. Point estimates from a probit model analyzing the probability that an individual is at or below the 5^{th} percentile of BMI (the CDC definition of underweight) suggest that Head Start participation reduces the likelihood of being underweight. Additionally, quantile regression estimates with BMI as the dependent variable demonstrate a positive and statistically significant of Head Start on BMI for the lowest duo-deciles of the BMI distribution. 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 may 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. Thus changes in overweight and obesity are likely to be more relevant for determining the impact of Head Start on the welfare of participants.

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.[3]

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. For example, poverty status and disability status are key eligibility criteria for Head Start participation. 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. Thus, the observable determinants of Head Start participation also influence childhood obesity, and Y_0 is not independent of D. 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 $Pr(Y_0 = 1 \mid$

[3] As is well known, 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.

$X, D = 1) = Pr(Y_0 = 1 \mid X, D = 0)$, then $E(Y_1 - Y_0 \mid X, D = 1) = Pr(Y_1 = 1 \mid X, D = 1) - Pr(Y_0 = 1 \mid X, D = 0)$.

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). Thus, the assumption that $Pr(Y_0 = 1 \mid X, D = 1) = Pr(Y_0 = 1 \mid X, D = 0)$, which states that the probability that a non-Head Start participant is overweight or obese would be the same regardless of whether the child attended Head Start after adjusting for observed individual and family background characteristics (i.e., $Y_0 \perp D \mid X$), is unlikely to hold.

Because parents choose to send their child to Head Start, they may 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.[4]

Another possible cause of selection due to unobserved characteristics is the decisions about which eligible applicants are selected to attend the program. Because children selected by

[4] The statements in this sentence are based on 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 6.

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 that are not commonly observed in national data sets. 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 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 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(υ) = 0, E(ε) = 0, Var(υ) = 1, Var(ε) = 1, and Cov(υ, ε) = ρ allows for the possibility that the unobserved determinants of Head Start participation are correlated with the unobserved determinants of overweight and obesity.[5] Through Monte Carlo simulation, Bhattacharya, Goldman, and McCaffrey (2006) demonstrate that the bivariate probit model outperforms two-step probit estimators and linear probability model estimators in the estimation of the impact of a binary treatment on a binary outcome, including situations in which the data generating process is non-normal.

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) and the above discussion regarding selection on unobserved characteristics, 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 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

[5] For a discussion of the relationship of the bivariate probit model to the Neyman-Fisher-Cox-Rubin potential outcomes causal model, see Goldman et al. (2001).

observed selection.[6] 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. This strategy is used to develop reasonable bounds on the impact of Head Start participation without the use of an instrument; these bounds guide the interpretation and plausibility of the results generated with the use of an instrument.

A second approach to estimate the impact of participation in Head Start relies on an exclusion restriction, in which Z contains at least one variable not in X, and ρ is estimated. Program availability is an appropriate choice for an instrument because it 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.[7] 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. Therefore, the instrument for Head Start participation is the relative availability of

[6] For a discussion of the assumptions needed for this condition to hold, see Altonji, Elder, and Taber (2005). These assumptions include that the variables in X are a random subset of all characteristics that influence Y, that a large number of variables are included in X, and that the variables in X do not dominate the distribution of D or Y. As described in the next section, a variety of individual and family background characteristics were selected that are related to Head Start participation and childhood obesity from the PSID in this analysis.

[7] 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.

Head Start: the enrollment divided by the number of eligible children in a Head Start service area.[8]

The number of positions 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. 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 (U.S. Code, Title 42, Chapter 105, Subchapter II, § 9835 (a) (4)). Hold harmless clauses in the Head Start Act guarantee that the allotments to the states will not fall below prior funding levels.[9] 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 Administration for Children and Families. While grants are awarded for only three years, previously funded agencies are given funding priority. Grantees include 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 number of funded positions for each grantee does not always fluctuate annually, but increased 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 a 375 percent increase in funding (Office of Head Start, 2006a), which is a 217 percent increase in real funding. Increases in appropriations were first used to maintain the quality of existing programs and to keep pace

[8] 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, 2007). While the discontinuity in funding persisted over time, it did not persist throughout the 1990s (Ludwig and Miller, 2007), and, thus, would not be appropriate for this analysis.

[9] For example, in the Head Start Act that was reauthorized in 1998, the allotments to states in future years could not fall below the 1998 allotment.

with inflation (U.S. Code, Title 42, Chapter 105, Subchapter II, § 9835 (g) (1)). The remaining funds were used to expand the size of the program. The distribution of these funds is driven by the number of eligible children in the community not served by Head Start (U.S. Code, Title 42, Chapter 105, Subchapter II, § 9835 (g) (2) (E)).

The Community Partnership Act of 1974 required the equalization of Head Start funding across states; this goal began to be realized with the funding increases in the late 1970s (Ludwig and Miller, 2007). By 1988, the Head Start program had sufficiently expanded throughout the country so that almost all counties offered Head Start services. 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. Currie and Neidell (2007) report that the expenditure level of Head Start programs has no detectable effect on the observable characteristics of children selected in the program or who chooses to enroll in the program. Thus, expansions to the program from increases in funding are unlikely to be related to childhood overweight and obesity.

One concern about the validity of the relative availability of Head Start in the community as an 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. However, Currie and Neidell (2007) find no evidence that program directors' education, experience, or salary is positively related to children's educational outcomes.

A second 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 fewer other services to this population. Additionally, since the level of enrollment in Head Start is related to the economic conditions of the community, the relative availability of Head Start may also be related to local economic conditions. As shown by Ruhm (2005), economic fluctuations can influence the health behaviors of adults.

To address these concerns about the validity of the instrument, I estimate the determinants of funding and enrollment for Head Start service regions. 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). The unit of measurement for this analysis is the larger of the Head Start service area and the county. Throughout the text, I refer to a Head Start service region and a community interchangeably.

Federal Head Start appropriations are distributed to states in proportion to the number of children less than 5 years of age in families with incomes below the poverty line. Thus, the concerns with the instrument relate to the distribution of funds within states and the conversion of these funds into enrollment opportunities. Column (1) of Table 1 displays the results of a regression of Head Start funding in 2000 on the number of children less than 5 years of age in families with incomes below the poverty line in the community. Each regression also includes a set of state dummy variables, so that the analysis focuses on the determinants of funding and enrollment within states. Data on the amount of funding for each Head Start grantee are from the

Tracking Accountability in Government Grants System (TAGGS). The number of children below age 5 living in poverty is from the Small Area Income and Poverty Estimates of the U.S. Census Bureau. Column (2) adds community characteristics and column (3) adds program quality variables. Community characteristics are derived from the 2000 Census of Population and Housing, Summary File 3 and the National Center for Charitable Statistics' 2000 Business Master File. Program quality variables are from the Head Start Program Information Reports.[10]

Table 1 demonstrates that local Head Start funding is almost completely determined by the number of children less than 5 years of age in families with incomes below the poverty line in the community. Variation in the income-eligible population below age 5 explains 92 percent of the variation in local Head Start funding within states. Community and program quality variables are not statistically significant and do not explain any additional variation in funding.

Table 2 examines the determinants of Head Start enrollment. Similar to the determinants of funding, the number of children less than 5 years of age in families with incomes below the poverty line in the community is the most important determinant of enrollment, explaining 91 percent of the variation in enrollment within states. Again, community and program quality variables are not statistically significant.[11] The exception is the number of health programs in the community, which is significant as the result of an outlier (Harris County, TX).

The results in Tables 1 and 2 suggest that, similar to the state funding formula, the number of income-eligible children is the primary determinant of funding and enrollment at the local level. Thus the availability of Head Start in a service region is not likely to be correlated with the characteristics of the community or the quality of the program. However, to further examine the possibility that community characteristics are correlated with the relative

---

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

[11] Including the education and experience of the health services expert as additional measures of program quality in tables 1 and 2 yield similar findings (that the program quality measures are not statistically significant).

availability of Head Start and also influence overweight and obesity, additional specifications of the bivariate probit model described above are estimated that include measures in both X and Z of the health programs, children's programs, services for the poor, and the economic conditions of the county.

The relative availability of Head Start is measured as enrollment divided by the number of income-eligible children ages 3 and 4 in the service area. Additional specifications of the bivariate probit model are estimated using enrollment divided by the number of all children ages 3 and 4 in the service area or a measure of predicted availability as the instrument for Head Start participation. Predicted enrollment in Head Start is derived from the specification in Table 2, column (6); I predict Head Start enrollment for the year 2000, and enrollment for the additional years is derived from changes in the population of all children in the community and federal changes in Head Start appropriations. 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.[12] 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

[12] For further information about the creation of this variable, see the data appendix.

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. Objective measurements of height and weight are important because self-reported measures of weight are subject to reporting error (Cawley, 2004). 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. Obesity for individuals under age 18 is determined by the Centers for Disease Control and Prevention as having a body mass index above the 95th percentile, and overweight or obese is classified as a body mass index above the 85th percentile. 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/ethnicity (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.[13] Family income, family size, and

[13] 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 all 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.

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.[14]

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.[15]

Community economic characteristics include the percent of the population age 25 years and older who graduated from high school and college, the unemployment rate for the population age 16 and older, median family income, and median rent. These variables are from the 2000 Census of Population and Housing, Summary File 3. 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.

Children included in the sample have complete information on height and weight in the 2002 CDS, Head Start attendance, mother's height and weight, and county of residence at age 3

[14] 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.
[15] Further information about the construction of each variable is available in the data appendix.

or 4. Each child was also a member of a responding family to the PSID at age 3 or 4.[16] These sample restrictions yield 1,887 children. A concern that arises because of the Head Start eligibility criteria is that Head Start children are sufficiently different from other children in the sample that comparisons between a child who attended Head Start and an otherwise similar child who did not attend are not feasible. To address this concern, the propensity score that an individual would attend Head Start is estimated, and children not included in the common support are removed from the analysis sample.[17] 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 is only one criterion for Head Start eligibility. The region of common support based on the propensity score is [0.0086, 0.9065]. This sample restriction removes 555 children with propensity scores below the common support and yields a final analysis sample of 1,332 children.

Table 3 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 3 that Head Start participants are less likely to be the oldest child and

[16] Missing data for the variables other than Head Start attendance, the relative availability of Head Start, mother's BMI, and the dependent variables are imputed using linear regression based on the control variables with non-missing data. Nine missing observations were imputed for family income, 25 for the oldest sibling dummy, 67 for urban/rural, 59 for mothers' education, 1 for disability, 49 for low birth weight, and 4 for race. There were no missing observations for family size, age, gender, whether the father was present, or community characteristics.
[17] The common support is the intersection of the section of the distribution of the propensity score for individuals who attended Head Start that contains positive values and the section of the distribution of the propensity score for individuals who did not that contains positive values.

more likely to have a disability. Additionally, Head Start participants were more likely to be raised in larger families with lower incomes, less educated mothers, overweight mothers, and absent fathers. 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 may differ by race 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 black children by Head Start participation are included in Table 3. Black Head Start participants are less likely to be the oldest child in the household, live in an urban community, and have a father present in the household than other black children; they are more likely to have a disability and to grow up in larger families with less income.

5. Results

Table 4 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 $\Pr(Y_1 - Y_0 \mid X, D = 1) = \Phi(X\beta + D\alpha) - \Phi(X\beta)$ 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.

A correlation parameter of zero is equivalent to a single-equation probit model.[18] 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.

When a positive correlation between the unobserved determinants of obesity and the unobserved determinants of Head Start participation is imposed on the model, the sign of the point estimate becomes negative. A correlation of 0.20 yields a statistically significant reduction in the likelihood of being obese of 7.4 percentage points for all Head Start participants and 7.2 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 children. A correlation of 0.50 leads to a reduction of 21.4 percentage points in the probability of being obese for black Head Start participants, and a correlation of 0.90 leads to a 41.7 percentage point reduction.

Following the methodology of Altonji, Elder, and Taber (2005), when $\rho = Cov(Z\delta, X\beta) / Var(Z\delta)$ and Z is equivalent to X, the amount of unobserved selection is equal to the amount of observed selection. Under this condition, $\rho = 0.36$ for estimating the impact of Head Start participation on overweight for black children and $\rho = 0.82$ for estimating the impact on obesity for black children. For the sample of all children, the corresponding values are 0.10 and 1.47. For overweight, the estimated impact of Head Start participation ranges between 0.034 and -0.026 for all children based on these guidelines for the values of ρ but is not statistically different from zero throughout this range. For black children, the estimated impact of Head Start

[18] Estimates from propensity score-matching methods are similar to the estimates reported in Table 4 for $\rho = 0$.

participation ranges from 0.03 with no unobserved selection to -0.17, where the extent of unobserved selection is equivalent to the amount of observed selection. For obesity, since the bivariate probit model cannot be estimated for values of ρ greater than or equal to one, the estimated impact of Head Start participation for all children ranges between 0.02 and -0.41. For black children, the estimated impact ranges from 0.02 to -0.37. Since most of the 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 5 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 0.065 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, 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 28.3 percentage points (s.e.=0.150) less likely to be obese during the ages of 5 through 19 than black children who did not attend Head Start. The estimate of the correlation coefficient is 0.643 with a standard error of 0.284. The corresponding heteroskedasticity-robust Wald statistic used to test the null hypothesis that the population correlation parameter is zero is

2.485; based on the chi-square distribution with one degree of freedom, the null hypothesis cannot be rejected for a level of significance less than 0.115.

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 6 displays the results of estimates that add community services and economic variables to the bivariate probit models estimated previously. As shown in Table 6, 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.

Panels B and C in Table 6 display the results of bivariate probit models that were estimated using alternative exclusion restrictions to identify the impact of Head Start participation. For Panel B, the number of all children instead of the number of income-eligible children was used as the denominator in creating the relative availability of Head Start. For Panel C, the predicted availability of Head Start in the community was used as the instrument. The results based on these alternate instruments are similar to the results shown in Panel A. Head Start participation reduces the probability of being obese for black children by 0.361 (s.e. = 0.097) and 0.348 (s.e. = 0.109) in Panels B and C, respectively, and the estimate of ρ is statistically significant. The results in Table 6 lend credence to the use of the relative availability of the Head Start program in the community as a valid exclusion restriction.

The positive estimate of ρ in all of the bivariate probit models, which is also statistically significant for the models examining obesity for black children, 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 and is also 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). Thus, the assumption that $Pr(Y_0 = 1 | X, D = 1) = Pr(Y_0 = 1 | X, D = 0)$ is unlikely to be true and the estimates from Table 5 are preferred to the estimates in Table 4 when $\rho=0$.

6. Discussion of the Magnitude

The estimate of the average treatment effect on the treated for black Head Start participants for obesity or $E(Y_1 – Y_0 | D = 1) = Pr(Y_1 = 1 | D = 1) – Pr(Y_0 = 1 | D = 1)$ is approximately -0.3 (varying between -0.28 and -0.36).[19] The sample mean from Table 3 of obesity for black children who attended Head Start is 0.25, which is an estimate of $Pr(Y_1 = 1 | D = 1)$. Thus, the counterfactual estimate $Pr(Y_0 = 1 | D = 1)$, the probability that a black child between the ages of 5 and 19 who attended Head Start would have been obese if they did not attend the program, is approximately 0.55. Clearly, this is a high estimate. However, in comparison to the sizeable impacts on education outcomes, such as a 40 percentage points decreases in the probability of being held back a grade in school (Currie and Thomas, 1995) and

[19] To attempt to determine if this impact 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. The point for the samples of black children ages 6 and older, ages 7 and older, ages 8 and older, ages 9 and older, and ages 10 and older are similar, which suggests that the impact of Head Start participation persists at least through age 10.

a 22 percentage points increase in the probability of graduating high school (Garces, Thomas, and Currie, 2002), the large magnitude is not unexpected. These results are within the bounds shown in Table 5 and are near the upper end of the range, which suggests the degree of selection on unobservables is similar to the degree of selection on observables.

The striking difference in the prevalence of obesity of Head Start participants prior to enrollment compared to national estimates of children with similar incomes, ages, and race suggests that a large degree of selection on unobservables is possible. Measured height and weight data are not available for Head Start participants prior to attendance; however, such data do exist in other samples. The largest sample of children that included measured 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 demonstrates that 27 percent of children are obese upon enrollment in Head Start. Nationwide, 14 percent of children ages 3 through 5 were obese in 2003 and 2004, as estimated in NHANES 2003-2004, and 19 percent of children in families below the poverty line ages 3 through 5 were obese. These statistics suggest 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 in the New York sample, only 8 percent of black children of similar age and family income were obese nationwide, which suggests that there is significant selection present for black Head Start participants.

To further assess the plausibility of an estimated impact of this magnitude, I simulate the potential impact of a change in caloric intake on the rate of obesity, following Cutler, Glaeser, and Shapiro (2003) and Schanzenbach (2005), and compare the decrease in calories required to generate this magnitude to the observed caloric intake of Head Start participants in dietary recall studies. If, as a result of attending Head Start, black children consumed 420 fewer calories less, then the expected prevalence of obesity in the absence of Head Start is equal to the counterfactual estimate of 55 percent.[20] Bollela et al. (1999) provide some evidence on the potential reduction in caloric intake associated with Head Start attendance. In their 24-hour dietary recall study, Head Start children consumed 523 calories from breakfast, lunch, and a snack provided by the program and 954 calories outside of Head Start. Although two-thirds of the day's meals were eaten at Head Start, approximately two-thirds of the day's calories were consumed outside of Head Start. If participating children were not in the Head Start program and consumed all meals outside of Head Start, total caloric intake would have increased. If, for example, caloric intake from dinner and evening snacks provided at home comprised one-half of total daily caloric intake and children consumed 954 calories at other times during the day, then total caloric intake would increase by 431 calories.[21] Additionally, Frisvold and Lumeng (2011) show that the daily caloric intake of Head Start participants during a weekday is 375 calories less than Head Start participants on a weekend and 310 calories less than other low-income children during a weekday, based on NHANES 2003-2004 data.

Additionally, I compare the estimated obesity rate in the absence of Head Start to alternative estimates based on national trends and the pre-enrollment obesity rate from independent samples. Nationally, based on NHANES surveys, the prevalence of obesity for black children in similar age groups as the analysis sample from the PSID more than doubled

[20] Further details about this simulation are available in the appendix.

[21] On average, 42 percent of total daily caloric intake is consumed after 4pm for black children between the ages of 3 and 5 nationally (author's calculations from NHANES 2001-2 and What We Eat in America data). If caloric intake from dinner and evening snacks provided at home comprised 42 percent of total daily caloric intake, then total caloric intake would increase by 794 calories.

from approximately 9 percent between 1988 and 2000 for children ages 3 through 5 to 20 percent in 2001 and 2002 for children ages 6 through 18. If the rate of increase in obesity for the Head Start population would have mirrored the rate of increase in the national population, and the prevalence of obesity for black children upon entering Head Start is 25 percent, as suggested by the New York sample, then it is possible that the prevalence of obesity for black Head Start children would have been approximately 55 percent in the absence of Head Start. Thus, based on the energy accounting and the national trends in obesity, the estimated reduction in the probability of being obese of 0.3 as a result of Head Start participation could be plausible.

7. 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 negative health consequences associated with childhood obesity, this study suggests that Head Start improves the welfare of black participants.

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.

References

Altonji, Joseph, Todd Elder, and Christopher Taber (2005) "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools," *Journal of Political Economy*, 113 (1), 151-184.

Anderson, Patricia M. and Kristin F. Butcher (2006) "Reading, Writing, and Refreshments: Are School Finances Contributing to Children's Obesity?" *Journal of Human Resources*, 41 (3), 467-494.

Barnett, Steven W. and Jason T. Hustedt (2005) "Head Start's Lasting Benefits," *Infants & Young Children*, 18 (1), 16-24.

Bhattacharya, Jayanta, Janet Currie, and Steven J. Haider (2006) "Breakfast of Champions? The School Breakfast Program and the Nutrition of Children and Families," *Journal of Human Resources*, 41 (3), 445-466.

Bhattacharya, Jay, Dana Goldman, and Daniel McCaffrey (2006) "Estimating Probit Models with Self-Selected Treatments," *Statistics in Medicine*, 25, 389-413.

Birch, Leann L. (1999) "Development of Food Preferences," *Annual Review of Nutrition*, 19, 41-62.

Blau, David and Janet Currie (forthcoming) "Who's Minding the Kids?: Preschool, Day Care, and After School Care," in Finis Welch and Eric Hanushek (eds.) *The Handbook of Education Economics*, New York: North Holland.

Bollella, Marguerite C., Arlene Spark, Laura A. Boccia, Theresa A. Nicklas, Brian P. Pittman, and Christine L. Williams (1999) "Nutrient Intake of Head Start Children: Home vs. School," *Journal of the American College of Nutrition*, 18 (2), 108-114.

Briley, Margaret E. and Cindy Roberts-Gray (1999) "Position of the American Dietetic Association: Nutrition Standards for Childcare Programs," *Journal of the American Dietetic Association*, 99 (8), 981-988.

Cawley, John (2004) "The Impact of Obesity on Wages," *Journal of Human Resources*, 39 (2), 451-474.

Currie, Janet and Matthew Neidell (2007) "Getting Inside the 'Black Box' of Head Start Quality: What Matters and What Doesn't," *Economics of Education Review*, 26, 83-99.

Currie, Janet and Duncan Thomas (1995) "Does Head Start Make a Difference?" *American Economic Review*, 85 (3), 341-364.

Currie, Janet and Duncan Thomas (2000) "School Quality and the Longer-Term Effects of Head Start," *Journal of Human Resources*, 35 (4), 755-774.

Cutler, David M., Edward L. Glaeser, and Jesse M. Shapiro (2003) "Why Have Americans Become More Obese?" NBER Working Paper 9446.

Davis, K, and Christoffel, K (1994) "Obesity in Preschool and School-age Children: Treatment Early and Often may be Best," *Archives of Pediatric and Adolescent Medicine*, 148 (12), 1257-1261.

Deckelbaum, Richard J. and Christine L. Williams (2001) "Childhood Obesity: The Health Issue," *Obesity Research*, 9, 239S-243S.

Dietz, William H. (2001) "Breastfeeding May Help Prevent Childhood Overweight," *Journal of the American Medical Association*, 285 (19), 2506-2507.

Dietz, William H. (2004) "Overweight in Childhood and Adolescence," *New England Journal of Medicine*, 350 (9), 855-857.

Dietz, William H. and Steven L. Gortmaker (2001) “Preventing Obesity in Children and Adolescents,” *Annual Review of Public Health*, 22, 337-353.
Ebbeling, Cara B., Dorota B. Pawlak, and David S. Ludwig (2002) “Childhood Obesity: Public-Health Crisis, Common Sense Cure,” *Lancet*, 360, 473-482.
Emerson, E. (2005) “Underweight, Obesity, and Exercise among Adults with Intellectual Disabilities in Supported Accommodation in Northern England,” *Journal of Intellectual Disability Research*, 49 (2), 134-143.
Felitti, Vincent J., Robert F. Anda, Dale Nordenberg, David F. Williamson, Alison M. Spitz, Valerie Edwards, Mary P. Koss, and James S. Marks (1998) “Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults,” *American Journal of Preventive Medicine*, 14 (4) 245-258.
Fontaine, Kevin R., David T. Redden, Chenxi Wang, Andrew O. Westfall, David B. Allison (2003) “Years of Life Lost Due to Obesity,” *Journal of the American Medical Association*, 289 (2), 187-193.
Fox, Mary Kay, Frederic B. Glantz, Lynn Geitz, and Nancy Burstein (1997) "Early Childhood and Child Care Study, Nutritional Assessment of the CACFP: Final Report Volume II" Abt Associates Inc.
Garces, Eliana, Duncan Thomas, and Janet Currie (2002) “Longer-Term Effects of Head Start,” *American Economic Review*, 9 (4), 999-1012.
Goldman, Dana P., Jayanta Bhattacharya, Daniel F. McCaffrey, Naihua Duan, Arleen A. Leibowitz, Geoffrey F. Joyce, and Sally C. Morton (2001) “Effect of Insurance on Mortality in an HIV-Positive Population in Care,” *Journal of the American Statistical Association*, 96 (455), 883-894.
Gordon, A., B. Devaney, and J. Burghardt (1995) “Dietary Effects of the National School Lunch Program and the School Breakfast Program,” *American Journal of Clinical Nutrition*, 61 (1), 221S-231S.
Gortmaker, Steven L., Karen Peterson, Jean Wiecha, Arthur M. Sobol, Sujata Dixit, Mary Kay Fox, and Nan Laird (1999) “Reducing Obesity via a School-Based Interdisciplinary Intervention Among Youth,” *Archives of Pediatric and Adolescent Medicine*, 153, 409-418.
Grossman, M., (1972) “On the Concept of Health Capital and the Demand for Health,” *Journal of Political Economy*, 80, 223-255.
Hale, Barbara, Victoria Seitz and Edward Zigler (1990) “Health Services and Head Start: A Forgotten Formula,” *Journal of Applied Developmental Psychology*, 11, 447-458.
Heckman, James J. (1999) “Policies to Foster Human Capital,” NBER Working Paper 7288.
Heckman, James J. and Dimitriy V. Masterov (2004) “The Productivity Argument for Investing in Young Children,” Working Paper 5, Invest in Kids Working Group, Committee for Economic Development.
Hofferth, Sandra L. and Sally Curtin (2005) “Poverty, Food Programs, and Childhood Obesity,” *Journal of Policy Analysis and Management,* 24 (4), 703-726.
Keane, M.J., R.W. O’Brien, D.C. Connell, and N.C. Close (1996) *A Descriptive Study of the Head Start Health Component*, Washington, DC: U.S. Department of Health and Human Services.
Klesges, R.C., L.M. Klesges, L.H. Eck, and M.L. Shelton (1995) “A Longitudinal Analysis of Accelerated Weight Gain in Preschool Children,” *Pediatrics*, 95 (1), 131-132.

Ludwig, Jens and Douglas L. Miller (2007) "Does Head Start Improve Children's Life Chances? Evidence from a Regression Discontinuity Design," *Quarterly Journal of Economics*, 122 (1), 159-208.

Lumeng, J., K. Gannon, J. Cabral, D. Frank, and B. Zuckerman (2003) "The Association between Clinically Meaningful Behavior Problems and Overweight in Children," *Pediatrics*, 112, 1138-1145.

Maluccio, John A., John Hoddinott, Jere R. Behrman, Reynaldo Martorell, Agnes Quisumbing, and Aryeh D. Stein (2005) "The Impact of an Experimental Nutritional Intervention on Education into Adulthood in Rural Guatemala," mimeo.

McKey, Ruth Hubbell, Larry Condelli, Harriet Ganson, Barbara J. Barrett, Catherine McConkey, Margaret C. Plantz (1985) *The Impact of Head Start on Children, Families and Communities: Final Report of the Head Start Evaluation, Synthesis and Utilization Project*, Washington, D.C.: CSR, Incorporated.

Morland, Kimberly, Steve Wing, and Ana Diez Roux (2002) "The Contextual Effect of the Local Food Environment on Residents' Diets: The Atherosclerosis Risk in Communities Study," *American Journal of Public Health*, 92 (11), 1761-1767.

National Heart, Lung, and Blood Institute (1998) "Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults—the evidence report," *Obesity Research*, 6 (S2), 51S–209S.

New York City Department of Health and Mental Hygiene (2006) "Obesity in Early Childhood: More Than 40% of Head Start Children in NYC Are Overweight or Obese," *NYC Vital Signs*, 5 (2), 1-2.

Office of Head Start (2006a) *2006 Head Start Program Fact Sheet*, Washington, DC: U.S. Department of Health and Human Services.

Office of Head Start (2006b) *Head Start Program Performance Standards and Other Regulations*, Washington, DC: U.S. Department of Health and Human Services.

Office of the Surgeon General (2001) *The Surgeon General's Call to Action to Prevent Overweight and Obesity*, Rockville, MD: U.S. Department of Health and Human Services.

Ogden, Cynthia L., Richard P. Troiano, Ronette R. Breifel, Robert J. Kuczmarski, Katherine M. Flegal, and Clifford L. Johnson (1997) "Prevalence of Overweight Among Preschool Children in the United States, 1971 Through 1994," *Pediatrics*, 99 (4), 1-7.

Peeters, Anna, Jan J. Barendregt, Frans Willekens, Johan P. Mackenbach, Abdullah Al Mamun, Luc Bonneux (2003) "Obesity in Adulthood and Its Consequences for Life Expectancy: A Life-Table Analysis," *Annals of Internal Medicine*, 138, 24-32.

Ruhm, Christopher (2005) "Healthy Living in Hard Times," *Journal of Health Economics*, 24 (2), 341-363.

Schanzenbach, Diane Whitmore (2005) "Do School Lunches Contribute to Childhood Obesity?" Harris School Working Paper 05.13.

Story, M. (1999) "School-based Approaches for Preventing and Treating Obesity," *International Journal of Obesity*, 23 (S2), S43-S51.

U.S. Department of Health and Human Services (2000) *Healthy People 2010*, Washington, DC: U.S. Government Printing Office.

U.S. Department of Health and Human Services (2005a) *Dietary Guidelines for Americans 2005*, Washington, DC.

U.S. Department of Health and Human Services, Administration for Children and Families (2005b), *Head Start Impact Study: First Year Findings,* Washington, DC.

Veugelers, Paul J. and Angela L. Fitzgerald (2005) "Effectiveness of School Programs in Preventing Childhood Obesity: A Multilevel Comparison," *American Journal of Public Health*, 95 (3), 432-435.

Whitaker, RC, JA Wright, MS Pepe, KD Seidel, WH Dietz (1997) "Predicting Obesity in Young Adulthood from Childhood and Parental Obesity," *New England Journal of Medicine*, 337, 869-873.

Wolf, A. (1998) "What is the Economic Case for Treating Obesity?" *Obesity Research*, 6 (S1), 2S-7S.

Zenk, Shannon N., Amy J. Schulz, Barbara A. Israel, Sherman A. James, Shuming Bao, and Mark L. Wilson (2005) "Neighborhood Racial Composition, Neighborhood Poverty, and the Spatial Accessibility of Supermarkets in Metropolitan Detroit," *American Journal of Public Health*, 95 (4), 660-667.

Table 1: The Determinants of Local Head Start Funding

		Outcome: Head Start Funding		
	Mean	(1)	(2)	(3)
Income-eligible population below age 5 (000s)	3458.48	1.026	0.883	0.886
	(8039.92)	(0.049)	(0.070)	(0.069)
Community Variables				
Pct. High School Graduate (× 100)	79.078		-19.218	-19.090
	(7.950)		(22.873)	(23.649)
Pct. College Graduate (× 100)	19.502		28.078	27.657
	(8.597)		(24.745)	(25.076)
Unemployment Rate (× 100)	5.985		-54.686	-59.955
	(2.205)		(48.382)	(50.474)
Median Family Income (000s)	44.690		-66.871	-65.644
	(10.849)		(37.930)	(37.996)
Median Rent	488.073		-1.133	-1.003
	(137.834)		(2.664)	(2.689)
No. of Children's Programs	18.761		30.176	28.093
	(29.996)		(34.020)	(33.929)
No. of Health Programs	16.036		24.738	26.323
	(24.915)		(37.883)	(37.917)
No. of Services for the Poor	6.619		-5.700	-6.148
	(10.993)		(81.245)	(81.934)
Program Quality				
Director's Education = BA	0.393			-78.027
	(0.465)			(155.050)
Director's Education = Graduate Degree	0.457			6.847
	(0.473)			(190.767)
Director's Years of Experience	9.718			15.867
	(8.270)			(13.690)
Bachelor's Degree * Experience	-0.044			-7.853
	(5.204)			(17.009)
Graduate Degree * Experience	-0.223			20.57
	(5.288)			(18.388)
Constant		169.391	4,093.41	3,794.34
		(346.056)	(1842.53)	(1844.810)
Observations		984	977	968
R-squared		0.92	0.92	0.92
Mean of Dependent Variable (Funding in 000s)	3950.87			
	(8862.12)			

Notes: The first column lists the means and standard deviations (in parentheses) of the explanatory variables. For the remaining columns, heteroskedasticity-robust standard errors are in parentheses. The unit of observation is the larger of the Head Start service region or the county. Thus the program quality variables are averages across one or more programs. The interaction terms are calculated at the mean-centered value for Director's experience. Explanatory variables not shown include state dummy variables. See data appendix for further information about the definitions of these variables.

Table 2: The Determinants of Local Head Start Enrollment

	Outcome: Head Start Enrollment					
	(1)	(2)	(3)	(4)	(5)	(6)
Income-eligible population below age 5 (000s)	0.181	0.039	0.150	0.035	0.151	0.035
	(0.007)	(0.017)	(0.010)	(0.015)	(0.010)	(0.015)
Local Head Start Funding (000s)		0.138		0.131		0.131
		(0.016)		(0.014)		(0.014)
Community Variables						
Pct. High School Graduate (× 100)			-2.982	-0.523	-4.221	-1.745
			(3.703)	(2.422)	(3.910)	(2.398)
Pct. College Graduate (× 100)			4.717	1.001	4.642	1.041
			(4.035)	(2.447)	(4.325)	(2.485)
Unemployment Rate (× 100)			3.171	5.371	-0.496	7.385
			(9.076)	(6.510)	(9.517)	(6.284)
Median Family Income (000s)			-8.132	0.145	-7.131	1.353
			(5.449)	(3.130)	(5.771)	(3.087)
Median Rent			-0.344	-0.302	-0.479	-0.344
			(0.408)	(0.191)	(0.445)	(0.193)
No. of Children's Programs			5.199	0.757	4.356	0.680
			(4.102)	(2.287)	(4.109)	(2.306)
No. of Health Programs			11.824	9.021	12.61	9.180
			(6.707)	(3.908)	(6.829)	(3.951)
No. of Services for the Poor			-12.088	-10.623	-11.695	-10.856
			(14.017)	(6.807)	(14.256)	(6.881)
Program Quality						
Director's Education = BA					28.316	39.527
					(29.200)	(22.720)
Director's Education = Graduate Degree					34.179	33.518
					(29.231)	(23.916)
Director's Years of Experience					1.711	-0.304
					(2.482)	(1.784)
Bachelor's Degree * Experience					-0.021	0.950
					(3.204)	(2.296)
Graduate Degree * Experience					5.434	2.726
					(3.474)	(2.405)
Constant	119.23	95.38	574.59	133.47	636.24	142.09
	(54.93)	(34.53)	(287.80)	(175.27)	(300.53)	(175.97)
Observations	1032	984	1024	977	975	968
R-squared	0.91	0.96	0.92	0.97	0.93	0.97
Mean and (Standard Deviation) of Dependent Variable (Enrollment in 000s): 694.697 (1397.157)						

Notes: Heteroskedasticity-robust standard errors are in parentheses. The unit of observation is the larger of the Head Start service region or the county. Thus the program quality variables are averages across one or more programs. The interaction terms are calculated at the mean-centered value for Director’s experience. Explanatory variables not shown include state dummy variables. See data appendix for further information about the definitions of these variables.

Table 3: Descriptive Statistics

	All	Head Start	No Head Start	Black	Head Start	No Head Start
Overweight	0.352	0.381	0.344	0.386	0.409	0.369
	(0.019)	(0.043)	(0.021)	(0.030)	(0.054)	(0.034)
Obese	0.201	0.210	0.199	0.239	0.248	0.232
	(0.016)	(0.036)	(0.017)	(0.028)	(0.048)	(0.032)
Head Start	0.197	1.000	0.000	0.416	1.000	0.000
	(0.016)			(0.032)		
Black	0.293	0.619	0.213	1.000	1.000	1.000
	(0.016)	(0.044)	(0.015)			
White	0.614	0.306	0.690	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	0.050	0.000	0.000	0.000
	(0.010)	(0.021)	(0.011)			
Female	0.502	0.445	0.516	0.454	0.418	0.480
	(0.020)	(0.044)	(0.022)	(0.031)	(0.053)	(0.036)
Age	12.393	12.235	12.432	12.744	12.915	12.621
	(0.142)	(0.274)	(0.164)	(0.197)	(0.298)	(0.262)
Low Birth Weight	0.072	0.076	0.071	0.101	0.099	0.101
	(0.009)	(0.015)	(0.010)	(0.013)	(0.018)	(0.018)
Oldest	0.334	0.248	0.356	0.283	0.245	0.310
	(0.018)	(0.032)	(0.021)	(0.026)	(0.036)	(0.035)
Disability	0.199	0.290	0.177	0.147	0.237	0.083
	(0.017)	(0.042)	(0.018)	(0.023)	(0.049)	(0.015)
Urban	0.288	0.313	0.281	0.459	0.388	0.510
	(0.016)	(0.037)	(0.018)	(0.030)	(0.050)	(0.036)
Rural	0.261	0.270	0.259	0.158	0.177	0.144
	(0.017)	(0.037)	(0.019)	(0.020)	(0.035)	(0.023)
Family Income	34.545	21.430	37.757	27.113	19.962	32.216
	(0.703)	(1.407)	(0.756)	(1.131)	(1.933)	(1.366)
Family Size	4.163	4.438	4.095	4.330	4.571	4.158
	(0.049)	(0.135)	(0.049)	(0.100)	(0.176)	(0.106)
Father Not Present	0.401	0.674	0.333	0.691	0.797	0.615
	(0.020)	(0.040)	(0.021)	(0.025)	(0.040)	(0.032)
Mother’s Education	12.407	11.845	12.544	12.008	11.968	12.036
	(0.076)	(0.173)	(0.084)	(0.140)	(0.227)	(0.178)
Mother’s BMI	24.637	25.683	24.381	26.860	26.566	27.069
	(0.201)	(0.381)	(0.232)	(0.378)	(0.409)	(0.570)
No. of Children’s Programs	51.963	49.309	52.613	67.130	56.838	74.475
	(3.200)	(5.181)	(3.775)	(5.500)	(7.127)	(7.934)
No. of Health Programs	45.159	45.210	45.146	58.391	52.616	62.513
	(2.495)	(4.659)	(2.888)	(4.002)	(6.381)	(5.126)
No. of Services for the Poor	19.382	20.678	19.065	26.897	24.600	28.536
	(1.071)	(2.542)	(1.180)	(1.967)	(3.584)	(2.201)
Community Median Income	46.376	46.290	46.397	47.465	46.995	47.805
	(0.400)	(1.040)	(0.428)	(0.857)	(1.388)	(1.086)
Community Unemployment	0.059	0.065	0.059	0.068	0.069	0.068
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Community Median Rent	522.4	517.8	522.3	549.6	538.5	557.4
	(5.06)	(12.07)	(5.57)	(8.34)	(14.65)	(9.87)
Community Pct. College Grad.	0.222	0.234	0.219	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	0.802	0.781	0.786	0.777

Graduate	(0.002)	(0.006)	(0.003)	(0.005)	(0.008)	(0.006)
Relative Availability	0.429	0.466	0.420	0.442	0.461	0.430
of Head Start	(0.008)	(0.020)	(0.009)	(0.014)	(0.026)	(0.015)
Relative Availability	0.105	0.134	0.098	0.139	0.153	0.129
of Head Start (all)	(0.003)	(0.009)	(0.003)	(0.008)	(0.014)	(0.008)
Predicted Availability	0.081	0.108	0.074	0.106	0.119	0.096
of Head Start	(0.003)	(0.010)	(0.003)	(0.008)	(0.016)	(0.007)
Sample Size	1332	346	986	802	286	516
Sample Size for						
Predicted Availability	1300	342	958	784	282	502

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 propensity score of 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 4: 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	0.095	0.034	-0.026	-0.087	-0.146	-0.205	-0.262	-0.317	-0.370	-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	0.264	0.095	-0.074	-0.243	-0.411	-0.580	-0.746	-0.911	-1.073	-1.229	-1.372
	(0.095)	(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	0.252	0.086	-0.081	-0.248	-0.415	-0.581	-0.746	-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)	(0.074)
Outcome: Obese											
Sample: All Children											
ATT	0.068	0.020	-0.027	-0.074	-0.121	-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)	(0.026)	(0.024)	(0.023)	(0.020)
Head Start	0.241	0.071	-0.096	-0.265	-0.432	-0.598	-0.762	-0.924	-1.083	-1.237	-1.381
	(0.105)	(0.105)	(0.104)	(0.103)	(0.101)	(0.099)	(0.095)	(0.091)	(0.086)	(0.080)	(0.073)
Sample: Black Children											
ATT	0.069	0.022	-0.025	-0.072	-0.119	-0.166	-0.214	-0.264	-0.314	-0.365	-0.417
	(0.033)	(0.033)	(0.033)	(0.033)	(0.032)	(0.032)	(0.031)	(0.030)	(0.029)	(0.027)	(0.024)
Head Start	0.246	0.078	-0.088	-0.255	-0.421	-0.586	-0.750	-0.912	-1.072	-1.226	-1.372
	(0.117)	(0.117)	(0.117)	(0.116)	(0.114)	(0.111)	(0.107)	(0.103)	(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 5: 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	-0.065		-0.142		-0.249		-0.283	
	(0.195)		(0.305)		(0.210)		(0.150)	
Head Start		-0.183		-0.401		-0.880		-0.973
		(0.548)		(0.867)		(0.708)		(0.475)
Marginal Effect		*-0.068*		*-0.151*		*-0.223*		*0.278*
Relative Availability of Head Start	0.615		0.546		0.593		0.510	
	(0.212)		(0.242)		(0.226)		(0.236)	
Black	0.699	0.167			0.689	0.336		
	(0.124)	(0.134)			(0.121)	(0.176)		
Hispanic	0.210	0.349			0.211	0.133		
	(0.260)	(0.347)			(0.251)	(0.309)		
Other Race	0.010	0.206			0.024	0.072		
	(0.270)	(0.240)			(0.260)	(0.265)		
Female	-0.078	0.007	-0.093	0.181	-0.086	-0.043	-0.091	0.094
	(0.089)	(0.069)	(0.105)	(0.094)	(0.086)	(0.076)	(0.102)	(0.100)
Age	-0.032	0.008	-0.020	0.000	-0.031	0.002	-0.022	-0.008
	(0.015)	(0.012)	(0.018)	(0.017)	(0.015)	(0.017)	(0.018)	(0.017)
Low Birth Weight	0.122	-0.140	0.201	-0.241	0.136	-0.106	0.207	-0.207
	(0.133)	(0.132)	(0.142)	(0.172)	(0.130)	(0.145)	(0.140)	(0.178)
Oldest	0.169	-0.044	0.192	-0.015	0.190	0.029	0.211	-0.005
	(0.097)	(0.085)	(0.115)	(0.119)	(0.099)	(0.092)	(0.112)	(0.109)
Disability	0.584	0.023	0.542	0.223	0.553	0.148	0.534	0.362
	(0.127)	(0.134)	(0.158)	(0.192)	(0.131)	(0.174)	(0.153)	(0.162)
Urban	-0.101	-0.048	-0.137	-0.096	-0.100	-0.204	-0.139	-0.295
	(0.115)	(0.097)	(0.127)	(0.122)	(0.112)	(0.099)	(0.126)	(0.115)
Rural	0.221	0.133	0.199	0.357	0.248	0.159	0.221	0.340
	(0.142)	(0.117)	(0.196)	(0.183)	(0.153)	(0.124)	(0.200)	(0.172)
Family Income	-0.033	0.012	-0.036	0.012	-0.039	-0.001	-0.035	-0.006
	(0.012)	(0.011)	(0.012)	(0.016)	(0.012)	(0.014)	(0.012)	(0.012)
Family Income ^{2}	0.038	-0.066	0.099	-0.050	0.044	0.011	0.093	0.072
	(0.187)	(0.105)	(0.184)	(0.131)	(0.186)	(0.102)	(0.184)	(0.104)
Family Size	0.105	-0.081	0.094	-0.072	0.106	-0.075	0.091	-0.085
	(0.038)	(0.039)	(0.041)	(0.054)	(0.038)	(0.058)	(0.040)	(0.054)
Father Not Present	0.141	0.047	0.143	0.159	0.144	0.050	0.135	0.101
	(0.114)	(0.094)	(0.130)	(0.121)	(0.113)	(0.107)	(0.126)	(0.129)
Mother's Education	-0.029	-0.012	-0.016	-0.020	-0.036	-0.014	-0.023	0.006
	(0.027)	(0.022)	(0.032)	(0.027)	(0.030)	(0.024)	(0.035)	(0.029)
Mother's BMI	0.071	0.130	0.087	0.154	0.065	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}	-0.107	-0.141	-0.134	-0.176	-0.099	-0.149	-0.119	-0.188
	(0.066)	(0.074)	(0.071)	(0.080)	(0.066)	(0.054)	(0.070)	(0.058)
Constant	-1.475	-2.645	-1.227	-2.831	-1.306	-2.533	-0.946	-2.800
	(0.817)	(0.761)	(0.976)	(0.976)	(0.849)	(0.912)	(1.024)	(0.991)
ρ	0.166		0.294		0.578		0.643	
	(0.315)		(0.509)		(0.430)		(0.284)	
	[0.604]		[0.586]		[0.307]		[0.115]	
Observations	1332		802		1332		802	

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 coefficients and standard errors for Family Income ^{2} are multiplied by 10^3. The coefficients and standard errors for Mother's BMI ^{2} are multiplied by 10^2. Numbers in brackets are p-values from the Wald test of the hypothesis that $\rho=0$. The marginal effect of the Head Start coefficient is in italics.

Table 6: Alternative Specifications of the Impact of Head Start Participation

	Overweight		Obese	
	All	Black	All	Black
Panel A: Including Community Services and Economic Variables				
ATT	-0.037	-0.258	-0.348	-0.329
	(0.242)	(0.582)	(0.167)	(0.108)
ρ	0.117	0.499	0.776	0.733
	(0.393)	(1.023)	(0.333)	(0.194)
	[0.768]	[0.687]	[0.215]	[0.026]
Head Start	-0.104	-0.739	-1.207	-1.129
	(0.681)	(1.703)	(0.521)	(0.328)
Observations	1332	802	1332	802
Panel B: Alternate Instrument Using the Number of All Children as the Denominator				
ATT	-0.096	-0.289	-0.339	-0.361
	(0.210)	(0.305)	(0.149)	(0.097)
ρ	0.215	0.550	0.761	0.797
	(0.335)	(0.540)	(0.296)	(0.173)
	[0.532]	[0.424]	[0.156]	[0.021]
Head Start	-0.268	-0.824	-1.174	-1.216
	(0.581)	(0.896)	(0.468)	(0.284)
Observations	1332	802	1332	802
Panel C: Alternate Instrument Using Predicted Availability of Head Start				
ATT	-0.052	-0.166	-0.305	-0.348
	(0.207)	(0.335)	(0.185)	(0.109)
ρ	0.146	0.338	0.690	0.765
	(0.332)	(0.564)	(0.373)	(0.200)
	[0.671]	[0.581]	[0.234]	[0.036]
Head Start	-0.144	-0.468	-1.066	-1.172
	(0.578)	(0.955)	(0.598)	(0.324)
Observations	1300	784	1300	784

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 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, the number of health programs, the number of children's programs, and the number of services for the poor in the Head Start service region. Panel B displays the results from bivariate probit models where the exclusion restriction is the enrollment divided by all children ages 3 and 4 in the service region. Panel C displays the results from bivariate probit models where the exclusion restriction is the predicted availability of Head Start. In Panel C, the availability of Head Start is predicted from the results in Table 2, column 6 and the predicted change in enrollment based on the change in population each year. The predicted enrollment is then divided by the number of all children ages 3 and 4 in the service region. Explanatory variables not shown are the same as those displayed in Table 6. Numbers in brackets are p-values from the Wald test of the hypothesis that ρ=0.

Appendix: Caloric Intake Simulation

Following Cutler, Glaeser, and Shapiro (2003) and Schanzenbach (2005), I simulate the potential impact of a change in caloric intake on the rate of obesity using the equation:

$$K = a + (B + E)*\text{Weight} + .1K,$$

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

$$\Delta\text{Weight} = .9*\Delta K / B.$$

The values of B are based on Schofield's (1985) estimates of BMR in megajoules per 24 hours, which vary according to age and gender. For children age 3 to 10 years, B is 0.095 for boys and 0.085 for girls. For children age 10 to 18 years, B is 0.074 for boys and 0.056 for girls. These constants are then multiplied by 238.8915 to convert the units to kilocalories.

To generate the simulations in this paper, the additional weight is added to the individuals in the sample based on their gender and age in 2002. Using the new weight, body mass index is calculated and then whether the individual is overweight or obese is determined. An increase of 200 calories increases the prevalence of obesity for black children in 2002 to 35 percent. The corresponding obesity rates for increases of 300, 400, and 500 calories are 45, 51, and 60 percent, respectively.

Data Appendix

This appendix provides a detailed explanation of the creation of select 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.

Relative Availability of Head Start (all): This variable is created similarly to the relative availability of Head Start, with the exception that the denominator is the number of all children ages 3 and 4 in the community instead of the number of poor children ages 3 and 4 in the community.

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. The results from this estimation are displayed in Table 2, column 6. 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 using a fixed-effects model using data from 1988 to 2003 from the specification: $Enrollment_C = \beta_0 + \beta_1 Population_C + \beta_2 Year + \beta 3 \varphi_C + \varepsilon_C$, where C indexes the community or service region and φ is a vector of community dummy variables. The year dummy variables in this specification capture the changes in federal Head Start appropriations, in addition to any other factor that may influence national enrollment trends. Based on the estimates of the fixed-effects model and the actual changes in population, I predict the change in enrollment from 2000 for each year.

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 (BMI) is then determined as weight in kilograms / (height in meters)^2. Obese determined by the Centers for Disease Control and Prevention as having a BMI above the 95th percentile (of the age- and sex-specific distribution of BMI) and overweight or obesity is classified as a BMI above the 85th percentile. 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 1,332 children, the height and weight of 16 children were self-reported instead of being measured by the interviewer. Removing these 16 children from the sample does not impact the reported results.

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.

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).

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 civilian population age 16 and older, median family income, and median rent. These variables are gathered for each county from the 2000 Census of Population and Housing, Summary File 3. These variables are aggregated to the service region for each Head Start grantee by summing the population numbers over the counties in the service region and then creating these variables.