EVALUATING THE SPECIAL SUPPLEMENTAL PROGRAM FOR WOMEN, INFANTS, AND CHILDREN: AN EXAMINATION OF PARTICIPATION AND PROGRAMATIC EFFECTIVENESS AMONG CHILDREN

By

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In Public Administration

Chair:

[Signatures]

Dean of the School of Public Affairs

[Signature]

Date

4/19/12

2012
American University
Washington, D.C. 20016
To my husband and champion, Brent Salmons, whose emotional
and financial support made this endeavor possible.
The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides nutritious foods, nutrition education, and referrals for health and social services to low-income pregnant, postpartum, and breastfeeding women, and their infants and children under the age of 5. Numerous studies have examined various aspects of the WIC program, particularly prenatal participation and infant birth outcomes; however, very little research specifically examines WIC’s largest participant group, children under the age of 5.

The failure to study child WIC participants is problematic for several reasons. First, it is important to determine whether the program is reaching children most in need of benefits. In addition, the primary goal of WIC is to safeguard the health of low-income children: thus, an important measure of programmatic effectiveness is whether participation in WIC actually improves the health of the child participant group. This dissertation is composed of two studies designed to shed light on these understudied areas. Both studies rely on data from the 1999-2008 National Health and Nutrition Examination Survey (NHANES).

The first study examines the influence of child, household, economic, and infant health variables on child WIC participation among 1 to 5-year-olds. Utilizing linear probability models and logistic regression, this study finds evidence that child WIC participants are more disadvantaged than eligible nonparticipants, providing further evidence of negative selection
among child WIC participants. In addition, this study finds no association between measures of infant health status at birth and the likelihood of participating as a child. The results also indicate that participation in WIC declines as a children age, a finding consistent with other WIC research.

The second study examines whether child participation in WIC is associated with improved health and well-being among children ages 2 through 4. This analysis examines the influence of WIC participation on seven outcome measures of child health and well-being: excellent/very good health, fair/poor health, overweight, at-risk overweight, normal weight, anemia, and whether the child is limited in physical activity. Using logistic regression analysis and propensity score matching, this study finds little evidence that child WIC participants perform better on measures of child health and well-being.
ACKNOWLEDGMENTS

This dissertation would not be possible without the help and support of many people. My sincere thanks go to Dr. Alison Jacknowitz, my committee chair and mentor, who has been an unending source of encouragement, expertise, and enthusiasm. From the moment I entered the doctoral program, she pushed me to challenge myself intellectually and to take my work to the next level. I am also indebted to my committee members, Dr. David Pitts and Dr. Laura Tiehen who have generously shared their time and insights with me. My thanks also go to my good friend, colleague, and fellow companion on the doctoral journey, Sasha O’Connell, who has been a constant source of emotional and academic support. Finally, I am grateful to my professors in the Department of Public Administration and Policy at American University who are too numerous to mention by name. These people represent an inspired and brilliant group of individuals from whom I have learned so much.
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CHAPTER 1
INTRODUCTION

Background

With the advent of Lyndon Johnson’s “War on Poverty” in the 1960s, the federal government increasingly devoted its attention and resources to the plight of low-income Americans. During this period, numerous studies recognized that hunger and the lack of adequate nutrition was becoming a serious problem in the United States. Events like the Poor Peoples’ March on Washington DC, the CBS documentary “Hunger in America”, and the 1969 White House Conference on Food, Nutrition, and Health brought the issue of hunger into the national spotlight (USDA, 2002). This social and political environment fostered the creation or expansion of multiple nutrition assistance programs such as the Supplemental Nutrition Assistance Program (formerly known as Food Stamps), the National School Lunch Program, the School Breakfast Program, and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

Today, the WIC program represents the third largest and most studied food and nutrition assistance program operated by the federal government (Oliveira and Frazao, 2009; Currie, 2003). Administered by the United States Department of Agriculture’s (USDA) Food and Nutrition Service (FNS), the program provides nutritious foods, nutrition education, and referrals for health and social services to low-income pregnant, postpartum, and breastfeeding women, and their infants and children under the age of 5. With over 35 years of research to support its cause, WIC has enjoyed almost unanimous praise for its effectiveness in improving the health and well-being of the nation’s infants and children. In an often cited quote, former Agriculture Secretary Dan Glickman once declared, “WIC works . . . perhaps better than any other government program in existence.”
Glickman’s words were not without a strong basis in fact. Indeed, the belief that WIC works is supported by a large body of research that has consistently found an association between prenatal WIC participation and an array of positive birth outcomes including higher mean birthweights, a lower likelihood of low birthweight or prematurity, and a reduced likelihood of neonatal mortality (e.g., Hoynes et al., 2009; Figlio et al., 2009; Bitler and Currie, 2005). However, not all WIC participation groups are studied with the same frequency or rigor.

While the research literature has devoted a great deal of attention to studying the influence of prenatal WIC participation on infant birth outcomes, relatively little research focuses on child WIC participants. This is particularly surprising when one considers that the largest WIC participant group is composed of children ages 1 through 4, accounting for approximately one-half of all program participants (Oliveira and Frazao, 2009). While child participants represent half of all program participants, administrative data indicates that eligible children are much less likely to take-up WIC benefits relative to other categorically eligible groups (USDA, 2009). The reasons behind low take-up are not well-understood.

In addition to the low take-up among eligible children, WIC administrative data provided by the FNS consistently shows a significant drop-off in participation as children age (USDA, 2010). For example, 2008 administrative data found that child WIC participation was cut in half from age 1 to age 4. More specifically, FNS data indicated that 36.5 percent of child participants were 1 year of age, but only 16.0 percent were 4 years of age at the time of their most recent certification (USDA, 2010). The limited body of academic research on child WIC receipt has also found support for the administrative data findings (Oliveira and Gundersen, 2000), but it offers limited explanations for the low take-up rate and the drop-off in participation as a child ages.
Turning to the issue of child health, a close examination of WIC research indicates that many of the health benefits attributed to WIC participation are largely derived from research examining a mother’s prenatal participation in the program and its subsequent impact on the health of newborns (e.g. incidence of prematurity, low birthweight, etc.). However, the literature is relatively silent when it comes to the benefits of child WIC participation. It is not that Secretary Glickman and others are wrong in their assessment of the WIC program, but rather, declarations like “WIC works” appear to represent an overstatement of what is known about the true effects of the WIC program among all of its participant groups. This gap in knowledge is particularly problematic because it “prevents an honest appraisal of the program and stands in the way of redesigning the program to increase its impact on those who most need its combination of food packages and counseling” (Besharov and Germanis, 1999).

To help address weaknesses in the research literature, this dissertation utilizes publicly available data from the 1999 to 2008 National Health and Nutrition Examination Survey (NHANES) to study 1) what factors influence child participation in WIC, and 2) whether child participation in WIC is associated with better performance on measures of child health and well-being. Both research questions are addressed in separate studies comprising chapters 2 and 3 of this dissertation. In terms of the broader question of child participation, the first study (chapter 2) examines the following research question for Study 1: “What child, household, economic, and health characteristics influence participation in the WIC program among children ages 1 through 4?” Turning to the more specific issue of programmatic impact, the second study (chapter 3) utilizes multivariate regression and propensity score matching techniques to examine the following research question for
Study 2: “Does childhood participation in the WIC program influence measures of health and well-being for children ages 2 through 4?” Chapter 4 presents a summary of the major research findings described in Chapters 2 and 3, and outlines the key limitations of both analytic chapters. Policy implications and recommendations for future research are also discussed.

This dissertation makes several contributions to the existing literature. First, it builds on the small body of research that examines characteristics associated with child WIC participation and the influence of child participation on a child’s health and well-being, two traditionally understudied areas of WIC research. Second, and distinct from some of the literature, Chapter 2 employs a cost-benefit framework to identify characteristics associated with child participation in the WIC program and provides some insights on possible selection issues associated with WIC take-up. Third, this dissertation utilizes a health production function to tackle the question of whether child participation in WIC is associated with better health outcomes, a particularly important issue since one objective of the program is to improve the health of children under 5 years of age. In addition, to minimize the risk of selection bias, Chapter 3 utilizes propensity score matching to estimate the influence of WIC on measures of child health and well-being—a procedure that has not been used previously to study the influence of WIC on the health of young children. Further, this dissertation specifically examines outcomes associated with overweight and obesity, an issue that is increasingly important given nationwide trends in higher rates of childhood obesity and which may be a possible unintended consequence of the WIC program. Finally, this research is conducted using a recent, nationally-representative dataset not commonly used in WIC research.
Historical Underpinnings

The WIC program is rooted in the late 1960s, a period when the medical community, policy organizations, and government officials began to acknowledge the growing problem of hunger in the country as well as its negative impact on health. For many years, medical doctors had reported increasing numbers of low-income pregnant women and their infant children complaining about inadequate food when visiting public health facilities. The turning point came in 1968 when a group of physicians met with officials from the United States Department of Health, Education, and Welfare (HEW) and the United States Department of Agriculture (USDA) in Washington, DC (Oliveira and Frazao, 2009). Out of these meetings, the physician group developed a proposal to build food commissaries linked with pre-existing neighborhood public health clinics so that physicians could prescribe food vouchers which could be redeemed at a food commissary and would provide supplemental, nutritious foods for low-income women, infants, and children (Oliveria and Frazao, 2009). By late 1968, the first two food commissaries were in place and operational in Baltimore, Maryland and Atlanta, Georgia (Oliveira and Frazao, 2009). Following the 1968 meetings, the 1969 White House Conference on Food, Nutrition and Health once again brought malnutrition and hunger center stage, recommending that special attention be given to the nutritional needs of low-income pregnant women and young children (Fox et al., 2004).

Out of this policy environment, the WIC program was formally authorized as a pilot program on September 26, 1972 by an amendment to the Child Nutrition Act of 1966\(^1\) and became a permanent program in 1975. Unlike the Supplemental Nutrition Assistance Program (SNAP), the WIC program has specific nutrient goals in providing supplemental foods.

\(^1\) P.L. 92-433
According to the FNS, the mission of the WIC program is to safeguard the health of low-income women, infants, and children who are at nutritional risk by providing foods, nutrition education and health referrals (USDA, 2012). Indeed, WIC’s authorizing legislation provides a similar mission statement, “The program shall serve as an adjunct to good health care, during critical times of growth and development, to prevent the occurrence of health problems, including drug abuse, and improve the health status of these [categorically eligible] persons”. More recently, policy experts have identified the prevention of overweight and obesity in children as an important goal of WIC and other have suggested that the program may be an important tool in achieving that goal (Ver Ploeg, 2009; Bitler and Currie, 2004; Currie, 2002).

Table 1.1 illustrates the major policy revisions WIC has undergone over the years. Some of the major changes include setting income eligibility at or below 185 percent of the federal poverty level in 1981, the expansion of WIC to include those participating in SNAP or Medicaid in 1989, standardizing definitions of nutritional risk criteria in 1999, and the 2009 overhaul of the food packages (Oliveira and Frazao, 2009). Despite its many changes, today the WIC program is a 7 billion dollar program operated through approximately 10,000 local health care clinics/sites run by 2,000 local and state health agencies and over 30 Indian tribal organizations (Richardson, 2009). Approved WIC foods are distributed by approximately 45,000 vendors (USDA, 2008).

**WIC Eligibility and Benefits**

The provision of WIC benefits is limited to pregnant women, postpartum non-breastfeeding women (not to exceed 6 months), postpartum breastfeeding women (not to exceed

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Table 1.1. Major WIC Policy Changes

<table>
<thead>
<tr>
<th>Year</th>
<th>Policy change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1972</td>
<td>Congress authorizes the Special Supplemental Food Program as a 2-year pilot (P.L. 92-433)</td>
</tr>
<tr>
<td>1973</td>
<td>Name is changed to the Special Supplemental Food Program for Women, Infants, and Children (P.L. 103-448)</td>
</tr>
<tr>
<td>1975</td>
<td>WIC authorized as a permanent program (P.L. 94-105)</td>
</tr>
<tr>
<td>1981</td>
<td>The maximum income for WIC eligibility is lowered to 185 percent of the Federal Poverty Guidelines</td>
</tr>
<tr>
<td>1989</td>
<td>Adjunctive income eligibility introduced for SNAP (Food Stamps) and Medicaid (P.L. 101-147)</td>
</tr>
<tr>
<td>1994</td>
<td>Name is changed to the Special Supplemental Nutrition Program for Women, Infants, and Children (P.L. 103-448)</td>
</tr>
<tr>
<td>1997</td>
<td>National Breastfeeding Promotion Campaign launched</td>
</tr>
<tr>
<td>1998</td>
<td>Requires income documentation and proof of residency at certification (P.L. 105-336)</td>
</tr>
<tr>
<td>1999</td>
<td>Nutritional risk criteria standardized and derived from one national list of approved criteria</td>
</tr>
<tr>
<td>2009</td>
<td>Comprehensive revisions to WIC food packages including more fruits and vegetables (7 CFR 246)</td>
</tr>
</tbody>
</table>

12 months), infants under the age of 1, and children under the age of 5. Eligibility for these groups is based on having a family income at or below 185 percent of the poverty level. In addition, automatic (adjunctive) eligibility is conveyed to persons who participate in SNAP, Medicaid, or Temporary Assistance for Needy Families (TANF). Unlike most assistance programs, WIC recipients must also be determined to be at nutritional risk by a qualified health professional such as a physician, nurse, or nutritionist (USDA, 2010). Two major types of nutritional risk are recognized for WIC eligibility: (1) medically-based risks such as anemia, underweight, overweight, or history of pregnancy complications or poor outcomes; and (2) diet-based risks such as inadequate nutrient intake (USDA, 2010).
Benefits are typically distributed as monthly checks or vouchers that allow participants to purchase a food package at authorized food stores including WIC-only stores. Importantly, the WIC food package is designed as a supplement and is not intended to meet the total nutritional needs of its participants (Fox et al., 2004). Federal regulations specify the contents of WIC food packages so they are specifically tailored to provide participants with important nutrients like protein, calcium, iron, and vitamins A and C (USDA, 2010). WIC food packages do not vary based on household income; however, they may vary by categorical group (mother, infant, child) and state of residence. In the case of children, WIC food packages provide vitamin-C rich juice, milk, iron-fortified cereal, eggs, beans or peas, and peanut butter (IOM, 2006). In addition, the FNS has now extended the child food package to include whole wheat bread, and cash vouchers for fruits and vegetables (see 7 CFR 246).³ WIC State agencies have the discretion to tailor an individual’s food package based on their health status, food restrictions or intolerances, or for reasons of administrative convenience and cost control (Oliveira and Frazao, 2009).

Another component of the WIC program is the provision of nutrition education to parents or child caregivers. The nutrition education component is intended to help participants understand the relationships between good nutrition, exercise, and health as well as emphasize, in the case of child participants, the nutritional needs of young children (Oliveira and Frazao, 2009). Federal regulations require that states offer participants two nutritional education sessions every six months; however, attendance is not required and may not be used as a condition for receipt of WIC vouchers (Oliveira and Frazao, 2009). While research in this area is lacking, an FNS-sponsored study conducted in 1990s found that a substantial percentage of women failed to attend nutrition education sessions (Fox et al., 1998). The final component of WIC services is

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³ The interim rule became effective on December 31, 2009 (see 7 CFR 246) and is now mandated in all 50 states.
referral to health and social services such as preventative medicine and other assistance programs particularly Medicaid.

**WIC Children**

The largest WIC participant group is composed of children between the ages of 1 through 4, with over 4.8 million children participating in the program in 2010 alone. Table 1.2 illustrates the most recent numbers of child WIC participants presented by state and region. Relative to others states, California has the greatest number of child participants with 829,837 participating in the program in 2010. In contrast, the State of Wyoming has the smallest number of child WIC participants at just under 6,700 children in 2010, a result that is probably driven by the fact that Wyoming is the smallest state in terms of population in the United States. In terms of regional participation, the Southeast has the greatest number of child participants, a consistent finding across each of the years examined in the table (2008-2010); while the Mountain Plains region ranks last in terms of the number of child WIC participants.

Regardless of the sheer number of child participants, however, children have the lowest coverage rate among the WIC-eligible population. This means that, as a percentage of the WIC-eligible population, children are less likely to actually receive benefits relative to pregnant, postpartum, and breastfeeding women or infants. Table 1.3 illustrates this situation by providing statistics on the number of women and children eligible for WIC, the number of monthly participants on average, as well as the associated coverage rates for all categorically eligible groups. In the period between 2001 and 2007, the coverage rate for WIC children fluctuated between 45 to 47 percent, unquestionably the lowest coverage rate compared to other

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<table>
<thead>
<tr>
<th>State/Region</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>28,245</td>
<td>31,260</td>
<td>31,364</td>
</tr>
<tr>
<td>Maine</td>
<td>13,949</td>
<td>14,740</td>
<td>15,313</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>63,589</td>
<td>68,111</td>
<td>69,223</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>8,983</td>
<td>9,641</td>
<td>9,513</td>
</tr>
<tr>
<td>New York</td>
<td>241,911</td>
<td>263,749</td>
<td>264,068</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>13,737</td>
<td>14,092</td>
<td>14,402</td>
</tr>
<tr>
<td>Vermont</td>
<td>9,901</td>
<td>10,655</td>
<td>10,400</td>
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<tr>
<td>Northeast Tribal Reservations</td>
<td>142</td>
<td>164</td>
<td>158</td>
</tr>
<tr>
<td>Northeast Region</td>
<td>380,456</td>
<td>412,412</td>
<td>414,440</td>
</tr>
<tr>
<td>Delaware</td>
<td>11,294</td>
<td>12,663</td>
<td>12,816</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>6,736</td>
<td>7,704</td>
<td>7,652</td>
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<tr>
<td>Maryland</td>
<td>64,053</td>
<td>72,811</td>
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<tr>
<td>New Jersey</td>
<td>78,362</td>
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<tr>
<td>Pennsylvania</td>
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<td>139,956</td>
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<td>Puerto Rico</td>
<td>119,132</td>
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<td>Virginia</td>
<td>69,244</td>
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<td>81,142</td>
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<td>Virgin Islands</td>
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<td>Mid-Atlantic Region</td>
<td>508,576</td>
<td>550,783</td>
<td>556,907</td>
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<td>64,293</td>
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<td>Florida</td>
<td>220,024</td>
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<td>North Carolina</td>
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<td>Tennessee</td>
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<td>Mid-Atlantic Tribal Reservations</td>
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<td>62,485</td>
<td>67,643</td>
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<tr>
<td>Midwest Region</td>
<td>607,364</td>
<td>663,160</td>
<td>680,056</td>
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*Table 1.2 (continued)*
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<th>Region</th>
<th>2008</th>
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<td>43,164</td>
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<td>Louisiana</td>
<td>62,119</td>
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<td>New Mexico</td>
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<td>722,243</td>
<td>761,853</td>
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<tr>
<td>Colorado</td>
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<td>Kansas</td>
<td>36,629</td>
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<td>10,378</td>
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<td>Washington</td>
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<td>Mountain Plains Tribal/Other Territories</td>
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<td>Western Region</td>
<td>1,073,917</td>
<td>1,158,114</td>
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<th>2005</th>
<th>2006</th>
<th>2007</th>
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<td><strong>Eligible population (millions)</strong></td>
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<td>Infants</td>
<td>2.51</td>
<td>2.21</td>
<td>2.53</td>
<td>2.61</td>
<td>2.63</td>
<td>2.74</td>
<td>2.69</td>
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<td>Children</td>
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<td>Pregnant Women</td>
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<td>1.14</td>
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<td>1.34</td>
<td>1.35</td>
<td>1.41</td>
<td>1.38</td>
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<td>Breastfeeding Women</td>
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<td>0.65</td>
<td>0.69</td>
<td>0.71</td>
<td>0.73</td>
<td>0.71</td>
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<td>Postpartum Women</td>
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<td>0.68</td>
<td>0.81</td>
<td>0.84</td>
<td>0.82</td>
<td>0.89</td>
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<td><strong>Total</strong></td>
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<td>13.75</td>
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<td>14.21</td>
<td>14.48</td>
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<td><strong>Average monthly participation (millions)</strong></td>
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<tr>
<td>Infants</td>
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<td>1.93</td>
<td>1.96</td>
<td>2.03</td>
<td>2.05</td>
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<td>Children</td>
<td>3.65</td>
<td>3.76</td>
<td>3.85</td>
<td>3.99</td>
<td>4.00</td>
<td>3.99</td>
<td>4.08</td>
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<tr>
<td>Pregnant Women</td>
<td>0.82</td>
<td>0.82</td>
<td>0.85</td>
<td>0.87</td>
<td>0.87</td>
<td>0.90</td>
<td>0.91</td>
</tr>
<tr>
<td>Breastfeeding Women</td>
<td>0.41</td>
<td>0.44</td>
<td>0.46</td>
<td>0.48</td>
<td>0.51</td>
<td>0.53</td>
<td>0.56</td>
</tr>
<tr>
<td>Postpartum Women</td>
<td>0.55</td>
<td>0.56</td>
<td>0.57</td>
<td>0.60</td>
<td>0.60</td>
<td>0.62</td>
<td>0.64</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7.36</td>
<td>7.51</td>
<td>7.68</td>
<td>7.97</td>
<td>8.03</td>
<td>8.13</td>
<td>8.38</td>
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<tr>
<td><strong>Coverage rate (percent)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Infants</td>
<td>76.67</td>
<td>87.26</td>
<td>77.58</td>
<td>77.79</td>
<td>78.21</td>
<td>76.45</td>
<td>81.29</td>
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<tr>
<td>Children</td>
<td>46.89</td>
<td>44.98</td>
<td>45.67</td>
<td>46.78</td>
<td>46.14</td>
<td>45.68</td>
<td>47.28</td>
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<tr>
<td>Pregnant Women</td>
<td>63.52</td>
<td>72.22</td>
<td>64.95</td>
<td>64.83</td>
<td>64.64</td>
<td>63.64</td>
<td>65.75</td>
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<tr>
<td>Breastfeeding Women</td>
<td>58.01</td>
<td>67.60</td>
<td>66.76</td>
<td>67.99</td>
<td>68.80</td>
<td>74.65</td>
<td>86.78</td>
</tr>
<tr>
<td>Postpartum Women</td>
<td>71.73</td>
<td>82.81</td>
<td>70.88</td>
<td>70.92</td>
<td>72.5</td>
<td>69.53</td>
<td>71.37</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>56.33</td>
<td>57.60</td>
<td>55.88</td>
<td>56.78</td>
<td>56.52</td>
<td>56.13</td>
<td>58.79</td>
</tr>
</tbody>
</table>


categorically eligible groups. In contrast, during the same period, coverage rates for infants ranged between 76.4 and 87.2 percent and coverage rates for postpartum women were between 69.5 and 82.8 percent.

While administrative data and research literature raise some tantalizing questions about low coverage rates and the tendency for children to leave WIC as they age, another important
threshold question is often neglected in the WIC literature. That question is whether the provision of WIC benefits to young children results in improved health and well-being. In other words, is WIC accomplishing its goals with respect to child participants? Surprisingly, there is a very limited amount of research addressing this issue, especially given that children make up half of all program participants and account for over half of WICs total program expenditures (Besharov and Call, 2009). The need for research in this area is essential in assessing programmatic effectiveness, but it has taken on additional urgency recently. Due to a continued period of economic weakness, the WIC program, along with other social benefit programs, is facing the possibility of budget cuts, making it more critical than ever that WIC can demonstrate its efficacy.

This dissertation is specifically designed to help build a body of knowledge about child WIC participation and minimize the limitations of existing research on the subject. Toward that end, the dissertation is comprised of two research papers that examine various aspects of child WIC participation. The first paper uses a cost-benefit framework and linear probability models and logistic regression to identify child, household, economic and infant health variables that influence the decision to participate in WIC as a child between the ages of 1 through 4. The second paper tackles the question of whether children ages 2 through 4 who participate in WIC exhibit improved health and well-being compared to eligible, nonparticipating children. For purposes of this analysis, seven dichotomous indicators of health and well-being are examined including: two self-reported measures of a child’s overall health, a measure for whether the child is limited in the amount or type of play activities he or she can engage in, a measure for anemia, and three measures that capture whether the child is overweight, at-risk overweight, or normal weight.
CHAPTER 2
UNDERSTANDING CHILD PARTICIPATION
IN THE WIC PROGRAM

Introduction

Established as a pilot program in 1972, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides nutritious foods and nutritional advice to low-income pregnant and post-partum women, infants, and children under the age of five who are classified as being nutritionally at-risk. With approximately one-fifth of children in the United States living in poverty, WIC operates on the front lines of an important battle to mitigate the negative impact of poverty on child health (DeNavas-Walt, 2009). Moreover, studies have suggested that WIC participants may be more likely to exhibit higher nutrient intakes (Oliveira and Gunderson, 2000; Currie, 2003) and experience better overall health (Carlson and Senauer, 2003). Despite these important goals and the apparent success of the program, researchers have found that child participation in the WIC program substantially lags behind the participation rates of other eligible groups which suggests that a large, potentially needy group of people are not being served.

The largest WIC participant group is composed of children between the ages of 1 and 5 who account for approximately one-half of all program participants; however, child participants exhibit the lowest coverage rate of any categorically eligible group (Oliveira and Frazao, 2009). Table 2.1 illustrates the coverage rates among pregnant women, infants, children, postpartum women, and breastfeeding women over a 10-year period from 1998 to 2007. In 2007, only 47.3 percent of WIC-eligible children participated in the program compared to an 81.3 percent

5. Of the remaining WIC caseload, 26 percent are infants, and 25 percent are women.
coverage rate among infants and a 65.7 percent coverage rate among pregnant women (USDA, 2009). Representing the two smallest categorically eligible groups, breastfeeding women exhibited a 86.8 percent coverage rate in 2007 and postpartum women followed with a 71.3 percent coverage rate. As Table 2.1 make apparent, not only is there a substantial difference in the WIC coverage rates of children compared to other categorically eligible groups, but it also demonstrates that the difference has persisted over time.

Table 2.1. Coverage Rate by Categorically-Eligible Groups, 1998-2007

<table>
<thead>
<tr>
<th>Year</th>
<th>Infants (%)</th>
<th>Children (%)</th>
<th>Pregnant women (%)</th>
<th>Post-partum women (%)</th>
<th>Breast-feeding women (%)</th>
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<tr>
<td>1998</td>
<td>87.1</td>
<td>48.9</td>
<td>77.6</td>
<td>79.6</td>
<td>60.8</td>
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<tr>
<td>1999</td>
<td>86.2</td>
<td>48.7</td>
<td>75.4</td>
<td>78.4</td>
<td>61.5</td>
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<tr>
<td>2000</td>
<td>78.2</td>
<td>48.2</td>
<td>67.2</td>
<td>71.2</td>
<td>56.6</td>
</tr>
<tr>
<td>2001</td>
<td>76.7</td>
<td>46.9</td>
<td>63.5</td>
<td>71.8</td>
<td>58.0</td>
</tr>
<tr>
<td>2002</td>
<td>87.2</td>
<td>45.7</td>
<td>72.2</td>
<td>82.8</td>
<td>67.6</td>
</tr>
<tr>
<td>2003</td>
<td>77.6</td>
<td>45.7</td>
<td>65.0</td>
<td>70.8</td>
<td>66.7</td>
</tr>
<tr>
<td>2004</td>
<td>77.8</td>
<td>46.8</td>
<td>64.8</td>
<td>71.0</td>
<td>67.9</td>
</tr>
<tr>
<td>2005</td>
<td>78.2</td>
<td>46.1</td>
<td>64.7</td>
<td>72.5</td>
<td>68.8</td>
</tr>
<tr>
<td>2006</td>
<td>76.4</td>
<td>45.7</td>
<td>63.7</td>
<td>69.5</td>
<td>74.6</td>
</tr>
<tr>
<td>2007</td>
<td>81.3</td>
<td>47.3</td>
<td>65.7</td>
<td>71.8</td>
<td>86.8</td>
</tr>
<tr>
<td>Average</td>
<td>80.7</td>
<td>46.9</td>
<td>68.0</td>
<td>73.4</td>
<td>66.9</td>
</tr>
</tbody>
</table>


Nonparticipation among otherwise eligible individuals is not unique to the WIC program. As noted in Currie (2006), it is well-established that among social benefit programs many eligible individuals do not take-up the program benefits to which they are entitled. However, nonparticipation among children in the WIC program is particularly perplexing given the
relatively high rates of participation seen in all other participant categories. Further, while nonparticipation may not be uncommon, understanding the reasons behind it are important to the successful implementation of any program, particularly in determining whether a program is well-targeted and benefiting the population of interest.

Empirical research examining participation among children eligible for WIC is rare and the research that does exist tends to rely on relatively old data. Moreover, much of the literature examining child WIC participation relies on simple comparisons between participants and nonparticipants rather than more rigorous regression models, so the results are somewhat inconclusive and lack the nuance provided by more precise models. Despite these limitations, this body of research indicates that child WIC participants face more difficult home environments (Burstein et al., 2000) and are more likely to live in households that participate in the Supplemental Nutrition Assistance Program or SNAP\(^6\) (Oliveira and Gundersen, 2000).

Given the dearth of research conducted on child WIC participation, and the lack of more rigorous models, additional research is essential. Understanding nonparticipation among children in the WIC program is important for several reasons. To start, low participation suggests that numerous eligible and needy children may not be receiving the benefits of WIC. The WIC program cannot hope to fully accomplish its objectives if half of a targeted, eligible group is not participating. In addition, understanding the characteristics associated with child WIC participation could help policymakers better target limited program resources and improve their outreach efforts. Finally, understanding the characteristics associated with child WIC participation may be useful to future studies that examine the programmatic effectiveness of WIC participation on child health and development.

\(^6\) Formerly known as the Food Stamp Program
To better understand participation among eligible children in WIC, this study uses publicly-available data from the 1999-2008 National Health and Nutrition Examination Survey (NHANES) to examine the following research question: what factors influence WIC participation among children ages 1 to 5? Utilizing a cost-benefit framework, this research examines a broad array of child-level, household-level and economic variables thought to be associated with WIC participation. In addition, this analysis examines household measures of stability as well as measures of child health which are hypothesized to influence child participation in a number of ways.

**Background**

**The WIC Program**

Since its inception in 1972, the WIC program has become an essential component of the national strategy for providing food and nutrition assistance to low-income Americans (Oliveira and Frazao, 2009). The primary goal of WIC is to ensure that low-income women and children have access to nutritious foods during certain crucial periods of growth and development. The program is distinct from other food and nutrition assistance programs because it is narrowly tailored to a specific group of participants: nutritionally at-risk, low-income pregnant and postpartum women and their infants and children under age 5. In addition, WIC is not an entitlement program. The number of participants served is dependent upon annual appropriations established by Congress. If local WIC agencies reach their maximum budgetary caseload, a priority system based on categorical status and type of nutritional risk is used to allocate subsequent openings to eligible participants (Connor, 2010). In practice, the use of waiting lists in WIC is uncommon with few families indicating that they were denied benefits due to a lack of program funding (Jacknowitz and Tiehen, 2009; Ver Ploeg and Betson, 2003).
Eligibility for WIC is based on categorical, income, and nutritional risk criteria. To be categorically eligible, a participant must fall into one of these participant categories: a pregnant woman, post-partum woman (up to 6 months), a breastfeeding woman (up to 1 year), an infant under 12 months, or a child under the age of 5 years. In addition to the participant group requirement, WIC participants must live in households that are at or below 185 percent of the federal poverty line, or participate in another federal assistance program like SNAP, Medicaid, or Temporary Assistance for Needy Families (TANF). Finally, unlike other food and nutrition assistance programs, WIC participants must be determined to be at nutritional risk by a qualified health professional such as a physician, nurse, or nutritionist (USDA, 2010). Eligibility is conveyed for two types of nutritional risk: (1) medically-based risks such as anemia, underweight, overweight, or history of pregnancy complications or poor outcomes; and (2) diet-based risks such as inadequate nutrient intake (USDA, 2010).

The underlying theory behind the WIC program is that children, and other categorically eligible groups, suffer from nutritional deficiencies which contribute to an array of health problems. Therefore, federal regulations specify the contents of WIC food packages so they are specifically tailored to provide participants with important nutrients like protein, calcium, iron, and vitamins A and C (USDA, 2010). In the case of children, WIC food packages provide vitamin-C rich juice, milk, iron-fortified cereal, eggs, beans or peas, and peanut butter (IOM, 2006). In addition, the FNS has now extended the child food package to include whole wheat bread, and cash vouchers for fruits and vegetables (see 7 CFR 246). Participants are typically issued vouchers which may be redeemed at participating WIC food stores for those specific supplemental foods included in the approved food package. WIC food packages do not vary

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7. The interim rule became effective on December 31, 2009 (see 7 CFR 246) and is now mandated in all 50 states.
based on household income; however, they may vary by categorical group (e.g. mother, infant, and child) and state of residence. Further, while federal guidelines limit the maximum amount of food in each food package, states have some discretion over the content of food packages. For example, WIC State agencies have the discretion to tailor an individual’s food package based on their health status, food restrictions or intolerances, or for reasons of administrative convenience and cost control (Oliveira and Frazao, 2009).

In addition to supplying nutritious foods, WIC also provides nutrition education to parents or caregivers. Nutrition education is intended to help participants understand the relationships between good nutrition, exercise, and health as well as emphasize, in the case of child participants, the nutritional needs of young children (Oliveira and Frazao, 2009). States must offer participants two nutritional education sessions every six months, but participants are not required to attend them and attendance may not be used as a condition for receipt of WIC vouchers (Oliveira and Frazao, 2009). While research in this area is lacking, an FNS-sponsored study conducted in 1990s found that a substantial percentage of women failed to attend nutrition education sessions (Fox, et al., 1998). The final component of WIC services is referral to health and social services such as preventative medicine and other assistance programs particularly Medicaid.

To summarize, theoretically, children who participate in the WIC program garner several advantages over their nonparticipating counterparts. The first advantage is the supplementary food package itself. To provide the child with nutritious foods, the parents or guardians of a participating child receive a quantity-based voucher which is exchanged for nutritious foods at any participating retail outlet. The second advantage is the provision of nutrition education to

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8. As of FY 2005, there are over 44,000 authorized WIC vendors which include retail outlets, pharmacies, and WIC-only stores (USDA, 2008).
the child’s caregiver which is important in overcoming information disadvantages about the importance of nutrition and nutritional adequacy. Finally, the referrals to health and other social services provided by WIC leads to greater awareness and access to other assistance programs (USDA, 2010). Empirical research, detailed below, suggests that these theoretical advantages actually translate into some measurable, positive impacts on WIC participants.

Literature

As previously noted, children ages 1 through 4 represent the largest participant group in the WIC program, yet children also demonstrate the lowest rates of participation among the eligible population. In addition, administrative data provided by FNS consistently shows a significant drop-off in participation as children age (USDA, 2010). Both of these findings raise important programmatic questions for WIC; yet, scholarly literature examining child participation yields few insights. Two interrelated factors account for the weakness in the literature: (1) a strong focus on prenatal WIC participation among researchers, and (2) a dearth of research on child participants.

A large body of literature focuses on the factors that influence prenatal WIC participation (participation by the mother during her pregnancy) and the timing of that participation (Ku, 1989; Chatterji et al., 2002; Swann, 2007; Tiehen and Jacknowitz, 2008). This literature has yielded some interesting and important findings, For example, using data from the first wave of the 2001 Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), Tiehen and Jacknowitz (2008) find that women who are more disadvantaged are more likely to participate, and participate earlier in their pregnancies, than eligible nonparticipants. Specifically, they find that participants are more likely to be non-Hispanic Black or Hispanic, less educated, unmarried, young, participate in other assistance programs, and have incomes below the poverty line.
(Tiehen and Jacknowitz, 2008). While this literature has provided visibility into a mother’s decision to participate in WIC during her pregnancy; it does not look at child participation. In addition, given the differential WIC coverage rates of prenatal women and children, it is likely that the factors influencing prenatal WIC participation are somewhat different than the factors influencing a child’s participation in the program.

Only a handful of studies specifically examine factors influencing WIC participation in preschool age children. In general, these studies have found that participation drops off as a child ages, child participants live in households that are worse off in terms measures of financial health and more likely to have mothers who possess poor life skills. Further, these studies have shown that race/ethnicity and maternal age have an effect on child participation. However, not all research finds significant differences between participants and nonparticipants.

One of strongest studies examining child participation is Bitler and Currie’s 2004 discussion paper on behalf of the Institute for Research on Poverty. In one research question, they use the 1996 and 2001 panels of the Survey of Income and Program Participation (SIPP) to examine the determinants of WIC take-up among 4-year-old children. Using OLS regression estimates, Bitler and Currie find that a mother’s lack of education and young age are associated with participation at age 4, as are certain household characteristics such as the number of children in the home and having an infant in the home (Bitler and Currie, 2004). In addition, their research indicates a strong link between receipt of Medicaid as an infant and participation

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9. Life skills were measured using two scales: the ability to survive financially and the ability to live efficiently. The scale measuring ability to survive financially was created from five survey items: whether the mother had a bank account, had a credit card, had money at the end of the month for food, had money at the end of the month for other things, and was not bothered by bill collectors. The measure for the ability to live efficiently was created from questions about whether the mother had transportation, had alternative transportation if the primary means was unavailable, had a driver’s license, had access to a car, knew where the bus stop was, could plan shopping for sales, had a telephone, had meals at the same time every day, could keep track of appointments, and knew where to get prescriptions (Burstein et al., 2000).
in WIC at age 4. Bitler and Currie also find that children who are Non-Hispanic Black or Hispanic are more likely to participate in WIC at age 4 compared to eligible, nonparticipating children.

Turning to a somewhat less robust analysis, Burstein et al. (2000) use bivariate comparisons to evaluate differences between participants and eligible nonparticipants on a broad array of child, maternal, and household characteristics. Using a combination of data from the 1988-1994 NHANES-III, 1993-1995 SIPP, and 1994 to 1997 Comprehensive Child Development Programs (CCDP2), this study finds that child participants face a more difficult home environment in terms of parenting practices and home safety and their mother’s perform worse on tests of locus of control (the degree to which one regards their life as being under their control), financial skills, and coping mechanisms (Burstein et al., 2000). In addition, they also find that WIC child participants are more likely to be low birthweight, have health insurance, and to be born to women who smoked or drank during pregnancy; thus, the Burstein et al. study strongly suggests that child WIC participants are negatively selected into WIC.

In contrast to the findings of Burstein et al., Oliveira and Gundersen (2000) use the 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) to examine limited demographic and socioeconomic characteristics of WIC child participants compared to eligible nonparticipants and find few statistically significant differences between the two groups. Using t-tests to compare participants to eligible nonparticipants, this study finds that participation of children falls as age increases, and child participants are more likely to live in households receiving SNAP (Oliveira and Gundersen, 2000). Gundersen (2005) compares patterns of participation among eligible nonparticipants, children who initially participate but then leave the program, and children who participate during the full period of eligibility. Using the 1996 Survey of Income
and Program Participation (SIPP), Gundersen finds that children who never participate are better off across all measures of economic health than children who exit the program early and children who participate the entire time.

While the existing literature examining child participation has made some interesting findings, these studies suffer from several deficiencies. Foremost, this body of literature is still exceedingly small, so there has been no strong effort to duplicate study findings or determine whether the results hold using other large data sets. In addition, some of these studies rely solely upon bivariate comparisons to examine differences between participants and nonparticipants, limiting the ability to draw any definitive conclusions since observable differences may be attributable to other factors. Further, in the case of Bitler and Currie (2004), their research only extends to 4-year-olds, leaving out any analysis of children 1 to 3 years of age who represent the vast majority of child participants. Finally, in many instances, these findings are based upon data that is at least 15-years-old which makes it difficult to translate findings into a current assessment of participation among children.

Ultimately, this study makes several contributions to the existing literature. First, it builds on a small body of research that identifies characteristics associated with child participation in the WIC program, something that is rarely examined and is ultimately important in ascertaining whether child WIC participation is well-targeted. Second, multivariate regression techniques are utilized allowing for important controls on socioeconomic status. Third, this study is conducted using a recent, nationally-representative dataset, ensuring that the findings are current and representative. In addition, this study specifically examines whether health status at birth acts as a predictor of child participation in WIC, something that has not been done in previous studies examining child WIC participation. Further, a number of household characteristics are used as
predictors (e.g. the number of years at current residence and the number of people in the household) which have not been previously examined in a multivariate context. Finally, this research stratifies regression results by age allowing for a much more nuanced assessment of child participation.

Data

NHANES

Data for this analysis will come from the National Health and Nutrition Examination Survey (NHANES). Administered by the National Center for Health Statistics and the Centers for Disease Control and Prevention (CDC), the NHANES is designed to be nationally representative of the health and nutrition status of adults and children in the United States. After nearly 30 years of being conducted as a periodic survey, beginning in the 1999 collection year, the NHANES became a continuous annual survey with data publicly released every two years (e.g., 1999-2000). For purposes of this research, five, two-year cycles of data will be utilized which covers the period 1999-2008.

Data for the NHANES are collected from a combination of interviews with the head-of-household\textsuperscript{10}, medical evaluations, medical histories, and laboratory tests. The survey studies approximately 5,000 participants annually and it includes an oversample for persons 60 or older, Hispanics and Black persons. For the survey years 1999-2008, the NHANES response rates are between 77 and 84 percent.\textsuperscript{11} This research will utilize data collected through the NHANES household questionnaires which address questions about the family and sample persons.

\textsuperscript{10} The NHANES uses the term “household reference person”; however, in practice this person is often likened to the head-of-household. For purposes of this paper, the household reference person will be referred to as the head of household.

\textsuperscript{11} Response rates for the biennial survey releases are available at: http://www.cdc.gov/nchs/nhanes/response_rates_CPS.htm
Collectively, these individual files include information on socio-economic characteristics of the survey participant (WIC program participation, age, and gender), health condition, and body measurements (height, weight, and obesity).

Although, it is not frequently used to examine WIC participation, the NHANES is heavily utilized in the field of health and nutrition (e.g., Merikangas et al., 2010; Chaparro, 2008). For the purposes of this research, it is particularly appropriate since the NHANES includes a wide array of health outcomes. In addition, the survey includes data on a household’s poverty-to-income ratio and participation in other nutrition assistance programs like SNAP and Medicaid which allow for the creation of an analytical sample that is restricted to the WIC eligible population. Finally, since the NHANES moved to a continuous release format, the data used for this analysis will be relatively current, and therefore, cover the time period after policy changes which standardized WIC eligibility requirements and expanded Medicaid eligibility.

Coding WIC Eligibility

As discussed previously, WIC eligibility is predicated on meeting three criteria: categorical eligibility, income or adjunctive eligibility, and a determination of nutritional risk by a qualified health professional. For purposes of this research, income eligibility is determined using the NHANES variable delineating a family’s poverty-to-income ratio. If the family’s poverty-to-income ratio is at or below 185 percent of the federal poverty level (PIR<=1.85), the child is considered income-eligible for WIC. In addition, WIC eligibility is also conveyed through participation in other means-tested transfer programs. Thus, children who live in families with incomes exceeding 185 percent of the federal poverty level, but who reported

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12. Appendix A1 compares selected variables from the NHANES to WIC program data provided by the FNS.
household participation in SNAP in the last 12 months or who reported that a child’s health insurance was paid for by Medicaid, were classified as eligible for WIC program participation.\textsuperscript{13}

Despite its utility, there are limitations to using the NHANES for coding WIC eligibility. First, the NHANES does not include data to assess whether a child is at nutritional risk. In practice, however, nearly all income-eligible individuals are determined to be at nutritional risk (Ver Ploeg and Betson, 2003). Second, the NHANES does not include a variable for participation in TANF, a program that conveys adjunctive eligibility for WIC. This could result in a child erroneously classified as ineligible for WIC if their household income is above 185 percent of the federal poverty level. However, given the stricter eligibility criteria associated with TANF, this is unlikely to be a problem. In addition, in some states, the income threshold for Medicaid is higher than 185 percent of the poverty level; however, due to the lack of geographic identifiers in this version of the NHANES, it is not possible to account for this factor. Therefore, children living in states with higher eligibility thresholds who are adjunctively eligible for WIC through Medicaid participation but do not ultimately participate will be erroneously classified as ineligible for WIC. Further, the WIC variable does not include a measure for duration of WIC benefits; therefore, this research is unable to determine how long a child received the added nutritional supplementation.

Analysis Sample

The combined 1999-2008 NHANES data sets yielded a total of 51,623 survey participants. Ultimately, the analysis sample used in this research is composed of 4,650 NHANES survey children ages 1 through 4, with 3,134 determined to be eligible for WIC.

\textsuperscript{13} There were 200 children who were reported as WIC participants in the NHANES, but were ultimately coded as ineligible due to a failure to meet either income or adjunctive eligibility indicators. These children were excluded from the analysis since it is not possible to know why they are misclassified. In addition, WIC eligibility does not include participation in SCHIP.
participation. To be included in the analysis sample, several criteria must be met. First, since the
target of this research is child WIC participation, the analysis sample is limited to children who
are between the ages of 12 to 59 months at the time the survey is administered. A total of 46,302
survey respondents (90 percent) are excluded from the analysis sample for this reason. Second,
for purposes of this study, a determination of income and adjunctive eligibility is required; thus,
387 children were dropped from the sample because of missing data on poverty-to-income ratio
and/or missing information on SNAP or Medicaid participation. Third, WIC participation cannot
be missing; therefore, an additional 12 cases were dropped due to missing data about WIC
participation. Fourth, only observations with complete information on relevant variables are
included. As a result, 272 cases were excluded due to data with missing variables.\textsuperscript{14} A missing
value indicator was included for the marital status variable.

Table 2.2, Column 1 illustrates the primary characteristics of the analysis sample. The
contrast between children who are eligible for WIC and those who are ineligible is stark. In the
NHANES sample, children who are eligible for WIC are clearly less advantaged in terms of
demographic, socioeconomic, and health factors. Compared to children who are ineligible for the
program, WIC-eligible children are more likely to be Hispanic (29.3 percent of WIC-eligibles
compared to 12.4 percent of ineligibles) and Non-Hispanic, Black (20.3 percent of WIC-eligible
sample compared to 7.2 percent in the ineligible sample). WIC-eligible children are more likely
to live in a home where the head-of-household is unmarried, younger in age, foreign born, and

\textsuperscript{14} Additional sensitivity analysis is conducted to determine if the children excluded due to missing data
are different from the children included in the analysis sample. The results suggest that several important,
statistically significant differences do exist. Excluded children are more likely to come from married households
where the head of household is over age 35, and they tend to live in their homes for long periods of time which
indicates stability. However, these children also come from households that are less educated, have foreign born
head-of-households, and are large in size. Excluded children are also far more likely to be Hispanic. These findings
suggest that excluded households are most likely immigrant households that may have non-response due to language
barriers, concerns about immigration status, or lack of information.
Table 2.2. Characteristics of Children by Eligibility and Participation Status

<table>
<thead>
<tr>
<th>Child Characteristics</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participant</th>
<th>WIC nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td>White, Non-Hispanic</td>
<td>0.731*</td>
<td>0.434</td>
<td>0.358+</td>
<td>0.500</td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>0.072*</td>
<td>0.203</td>
<td>0.215</td>
<td>0.194</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.124*</td>
<td>0.293</td>
<td>0.362+</td>
<td>0.233</td>
</tr>
<tr>
<td>Other</td>
<td>0.073</td>
<td>0.070</td>
<td>0.065</td>
<td>0.073</td>
</tr>
<tr>
<td>Female</td>
<td>0.487</td>
<td>0.474</td>
<td>0.477</td>
<td>0.472</td>
</tr>
<tr>
<td>Age one</td>
<td>0.255</td>
<td>0.264</td>
<td>0.329+</td>
<td>0.208</td>
</tr>
<tr>
<td>Age two</td>
<td>0.255</td>
<td>0.255</td>
<td>0.252</td>
<td>0.258</td>
</tr>
<tr>
<td>Age three</td>
<td>0.226</td>
<td>0.245</td>
<td>0.231</td>
<td>0.258</td>
</tr>
<tr>
<td>Age four</td>
<td>0.264</td>
<td>0.235</td>
<td>0.188+</td>
<td>0.276</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household Characteristics</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participant</th>
<th>WIC nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>0.863*</td>
<td>0.525</td>
<td>0.522</td>
<td>0.528</td>
</tr>
<tr>
<td>Unmarried</td>
<td>0.067*</td>
<td>0.372</td>
<td>0.368</td>
<td>0.376</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>35.347*</td>
<td>32.758</td>
<td>32.445</td>
<td>33.034</td>
</tr>
<tr>
<td>&lt; than high school diploma</td>
<td>0.058*</td>
<td>0.378</td>
<td>0.424+</td>
<td>0.338</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.186*</td>
<td>0.297</td>
<td>0.294</td>
<td>0.299</td>
</tr>
<tr>
<td>Some college</td>
<td>0.308*</td>
<td>0.254</td>
<td>0.236</td>
<td>0.270</td>
</tr>
<tr>
<td>College degree</td>
<td>0.448*</td>
<td>0.071</td>
<td>0.045+</td>
<td>0.093</td>
</tr>
<tr>
<td>Born in US</td>
<td>0.852*</td>
<td>0.724</td>
<td>0.657+</td>
<td>0.783</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>4.155*</td>
<td>4.627</td>
<td>4.751+</td>
<td>4.517</td>
</tr>
<tr>
<td>Family lived in home &lt; 1 yr</td>
<td>0.154*</td>
<td>0.288</td>
<td>0.280</td>
<td>0.295</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.088</td>
<td>0.072</td>
<td>0.084</td>
<td>0.061</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Infant Health</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participant</th>
<th>WIC nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low birthweight</td>
<td>0.017</td>
<td>0.025</td>
<td>0.024</td>
<td>0.026</td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.105*</td>
<td>0.146</td>
<td>0.150</td>
<td>0.141</td>
</tr>
<tr>
<td>Normal birthweight</td>
<td>0.895*</td>
<td>0.854</td>
<td>0.850</td>
<td>0.858</td>
</tr>
<tr>
<td>Received newborn care in ICU</td>
<td>0.129</td>
<td>0.139</td>
<td>0.136</td>
<td>0.141</td>
</tr>
<tr>
<td>10 + doctor visits, last 12 months</td>
<td>0.112</td>
<td>0.109</td>
<td>0.120</td>
<td>0.098</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economic Health</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participant</th>
<th>WIC nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty-to-income ratio</td>
<td>3.761*</td>
<td>1.052</td>
<td>0.946+</td>
<td>1.146</td>
</tr>
<tr>
<td>Medicaid receipt by the child</td>
<td>0.000*</td>
<td>0.504</td>
<td>0.620+</td>
<td>0.402</td>
</tr>
<tr>
<td>SNAP receipt, last 12 months</td>
<td>0.000*</td>
<td>0.432</td>
<td>0.529+</td>
<td>0.346</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>0.835*</td>
<td>0.404</td>
<td>0.349+</td>
<td>0.452</td>
</tr>
</tbody>
</table>

| Sample Size             | 1,516          | 3,134        | 1,665           | 1,469             |

* indicates that the value is significantly different from all eligible participants at the 5% level using a two-tailed test.

+ indicates that the value is significantly different from nonparticipants at the 5% level using a two-tailed test.

Note: All statistics are weighted.
less educated. In fact, 37.2 percent of eligible households are headed by someone who is unmarried compared to just 6.7 percent in the ineligible sample. Likewise, 37.8 percent of WIC-eligible households are headed by someone without a high school diploma compared to just 5.8 percent in the WIC-ineligible sample. In addition, WIC-eligible households are larger in terms of number of people (4.63 people compared to 4.16) and more likely to live in their homes for a short time (28.8 percent compared to 15.4 percent of ineligibles).

In terms of health, WIC-eligible children are more likely to be low birthweight (14.6 percent) than children who are ineligible for WIC (10.5 percent). In addition, children who are eligible for WIC come from households with remarkably low poverty-to-income ratios relative to children from ineligible households (1.05 compared to 3.76 in the ineligible sample). Likewise, in the eligible sample, 40.4 percent of children come from households that reported owning or were purchasing their home compared to 83.5 percent of households in the ineligible sample.

A similar pattern is evident in the comparisons between WIC participants and eligible nonparticipants. While the differences in infant health disappear, across an array of socioeconomic variables, WIC participants appear worse off than eligible, nonparticipants. Thus, these findings support earlier research indicating that WIC participants are negatively selected into the program, meaning that they are more socioeconomically disadvantaged than eligible, nonparticipants.

Methods

Conceptual Model

One early effort to understand nonparticipation in social programs was made by the renowned economist Robert Moffitt. Moffitt identified an apparent contradiction in the tenants of consumer demand theory. Specifically, he noted that most iterations of consumer theory operated
on the premise that more of a good was better; yet, the behavior of certain low-income individuals seemed to challenge this assumption since many welfare-eligible individuals did not take-up the benefits to which they were entitled (Moffitt, 1983). Seeking a solution to this seemingly irrational decision, Moffitt modeled social program participation as a utility-maximizing decision where stigma was the main cost of participation (Moffitt, 1983). In economic terms, a utility-maximizing individual will choose to have their child participate in a social program if the perceived benefits received from the program outweigh the perceived costs associated with participation. Moffitt argued that stigma affects the utility-maximizing decision of a household by increasing the costs of program participation; thus, some households that would participate in the absence of stigma choose not to take-up benefits.

In addition, scholarly research strongly suggests that transactions costs are important determinants of take-up rates (see Currie, 2006 for a summary of this literature). Transactions costs represent the costs associated with the time and money spent on application procedures, the acquisition of appropriate documentation, and the redemption of program benefits. One study examining the influence of transactions costs on participation found that Medicaid enrollment among immigrant children increased with family size (Currie, 2000). While immigrant families with more children experience the same cost of enrollment as smaller families, they benefit more from that participation. Similarly, Currie and Grogger (2002) found that shortening recertification intervals negatively influenced participation in the SNAP program. The effect was particularly strong among groups that may experience higher transactions costs like households headed by single persons and residents of rural areas (Currie and Grogger, 2002). One study specifically examining the WIC program found that restricting the types of foods that can be
purchased negatively influenced participation, a behavior that suggests the value of the benefit is reduced relative to the costs of participation (Chatterji et al., 2002).

Further, economic literature suggests another possible explanation for low take-up may be a lack of information about the program. As noted in Currie 2006, programs like Medicaid, TANF, and SNAP are large, well-established programs, so it is likely that most low income people are aware of the programs; yet, smaller programs may be less well-known. In practice, stigma, transactions costs, and lack of information probably interact together to influence participation. For example, the size of a program’s benefit relative to stigma and transactions costs may drive the incentive to obtain information about a program (Currie, 2006).

Econometric Model

This analysis examines how certain child, household, economic, and infant health characteristics affect the decision to have a child participate in WIC. Specifically, the WIC child participation model is based on a cost-benefit framework where the net benefit of child WIC participation ($Y_i$)—the benefit minus the cost of participation—for child $i$ is a function of matrices representing child-level characteristics, household-level characteristics, economic characteristics, infant health status, survey year, and the error term ($\varepsilon$):  

$$Y_i = \alpha + \text{Child}_i \beta_1 + \text{Household}_i \beta_2 + \text{Economic}_i \beta_3 + \text{Health}_i \beta_4 + \text{Year}_i \beta_5 + \varepsilon_i$$

$Y_i = 1$ if $Y_i > 0$ and 0 otherwise

This study utilizes Linear Probability Models (LPM) to estimate equations explaining child WIC participation. The model includes variables that capture the benefits of child participation and the stigma or transactions costs associated with participation in the WIC program. To ensure the model is not sensitive to analytic method, logit regression models are also estimated and are reported alongside the LPM results. In addition to running LPMs to examine overall WIC participation, this research also estimates separate equations by child age.
to study how the determinants vary for children at different ages. Year fixed effects are included for all models to account for unobservable factors that may vary by year.

The NHANES contains numerous child-level and household-level measures that are reported by the survey participant, and in the case of children, these measures are reported by a proxy person. In many instances, the proxy will be the mother, but it is not possible to know what the exact relationship is between the proxy and the survey child. The NHANES also contains numerous indicators of economic circumstance and child health at birth. The child, household, economic, and health variables are used in this analysis to control for factors found in the existing literature to be associated with WIC program participation and to explore other potential factors that may be associated with WIC child participation. In addition, consistent with the cost-benefit framework, many of the explanatory variables included in this analysis attempt to capture the benefits of participation and the stigma or transactions costs associated with participation and information about the program.\textsuperscript{15}

\textbf{Child WIC Participation}

The dependent variable is a binary indicator that captures child WIC participation. In theory, participation in WIC indicates that the benefits of participation outweigh the costs. In this study, WIC participants are identified as children ages 1 through 4 who are receiving WIC benefits at the time of the survey (“Is \{Sample Person\} now receiving benefits from the WIC program?”). Nonparticipants are children who were reported as not receiving WIC benefits at the

\textsuperscript{15} Since the public release version of the NHANES does not include geographic identifiers, it is not possible to link to state policy variables which might also influence a cost assessment. The failure to analyze state-level policy variables, although limiting, is unlikely to change the outcome of this study. While state policy variables may be important in explaining between-state variation in WIC participation, this analysis focuses on a more national-level assessment of WIC participation. In addition, other research using state policy variables has found some limited effect on WIC participation; however, omitting the policy variables had little effect on other regression results (Tiehen and Jacknowitz, 2008).
time of the survey, but who were otherwise eligible. In this sample, a total of 1,665 children were reported as current WIC participants and 1,469 children were determined to be eligible but nonparticipating, resulting in a total participation rate of 53 percent.¹⁶

**Child Characteristics**

A child’s race/ethnicity is captured by using indicators for Non-Hispanic White, Hispanic (includes Mexican Americans and Other Hispanic), Non-Hispanic Black, and Other which includes races like Asian, Native American, etc. (Non-Hispanic White is the omitted category). An indicator variable is used to capture a child’s gender. Four dummy indicators are used to capture a child’s age in years and are derived from a survey question that ascertains the child’s age in months at the time of the survey (age 1 is the omitted category).

**Household Characteristics**

Household characteristics used in this research are made up of two components. They include demographic information about the household reference person (subsequently referred to as the head-of-household for purposes of this study) as well as information about duration at current residence and family structure.¹⁷ To capture the head-of-household’s marital status, indicators are created for married, unmarried, and whether marital status was missing (unmarried is the omitted category). The indicator for unmarried includes people who are divorced, divorced.

¹⁶. The Food and Nutrition Service (FNS) reported a WIC child participation rate of 47.3 percent in 2007, the most recent estimate currently available (USDA, 2009). The participation rate in this analysis may be overstated due to higher Medicaid thresholds in some states which allow adjunctive eligibility through WIC even though incomes may exceed 185 percent of the poverty level. One study suggests that expanding Medicaid eligibility to individuals with higher incomes has had a negligible effect on WIC participation, serving to expand eligibility, but not participation, leading them to conclude that increases in WIC participation among children have not been driven by higher-income families made eligible through Medicaid expansions (Bitler and Currie, 2004).

¹⁷. According to the NHANES 2005-2006 codebook the household reference person is defined as the first household member 18 years of age or older listed on the Screener household member roster who owns or rents the residence where members of the household reside.
widowed, separated, never married, or living with a partner. A continuous variable was included to capture the age of the head-of-household while an indicator variable was used to capture whether the head-of-household was born in the U.S. Education is captured with four dichotomous indicators: less than high school diploma, high school diploma, some college, and college degree (college degree is the omitted category).

Indicators are included that account for household size. Theoretically, a large household may experience fewer transactions costs and exhibit a greater need for program benefits compared to those in smaller households. A continuous variable is used to measure household size and is derived from the demographic questionnaire that asks how many people are in the household.\textsuperscript{18} In addition, indicators are included to capture a household’s duration at their current residence. In theory, families that are transient, who move often and spend limited time at any one address, are less stable and may experience higher costs of participation since they must register these changes with their local WIC offices to continue to receive benefits.\textsuperscript{19} Two indicators are created to gauge transience: less than 1 year and ten or more years at the household’s current residence.

\textbf{Infant Health}

Measures of infant and/or child health status are included which may influence the perception of the benefits and cost of child WIC participation. The exact direction of the

\textsuperscript{18} The NHANES does not allow for a determination of the number of children versus the number of adults in a given household.

\textsuperscript{19} An alternative explanation is that people who live in their homes for long periods of time are simply unable to move because they lack the resources to do so. This explanation is not considered likely. First, a comparison of the groups (live in their homes less than 1 year and live in their homes 10 or more years) finds large and statistically significant differences. Those living in their homes for more than 10 years are much better off socioeconomically, particularly in terms in PIR, so it is unlikely that they lack the means to move. Second, extensive literature on poverty and housing instability finds a relationship between frequent moves and poverty and homelessness (see Clark, 2010).
association in unclear since a sick child may increase transactions costs or magnify the benefit of WIC. A child’s health at birth is captured with three dummy indicators for whether they were very low birthweight (VLBW), low birthweight (LBW) or normal birthweight. Information about birth weight is obtained from the Early Childhood Questionnaire administered during the household interview by the child’s proxy; thus, data on birthweight is self-reported. Children who weighed less than 1,500 grams at birth are classified as VLBW, children who weighed less than 2,500 grams are classified as LBW, and children who weighed 2,500 grams or higher are classified as normal birthweight (normal birthweight is omitted category).

To further measure a child’s early health status, an indicator variable is included for whether the child received intensive newborn care post-birth (“Did {Sample Person} receive any newborn care in an intensive care unit, premature nursery, or any other type of special care facility?”). In addition, an indicator variable is used to identify children who have been to a doctor or other health care professional 10 or more times in the last year. This indicator is constructed using responses to a question in the health utilization questionnaire (“During the past 12 months, how many times {has Sample Person} seen a doctor or other health care professional about {his/her} health at a doctor's office, a clinic, hospital emergency room, at home or some other place? Do not include times {/s/he was} hospitalized overnight”).

Economic Factors

Literature examining WIC participation has consistently found that household economic factors are important predictors of participation in the WIC program. To capture family income adjusted for household size, a continuous variable for the poverty-to-income ratio is included in

---

20. The measures of health used to predict WIC participation in this analysis are not exhaustive. It is likely that there are other factors not captured here that influence child WIC participation.
the analysis. In addition, an indicator is created to capture whether the child lives in a home that is owned or being purchased. Home ownership acts as a proxy for economic well-being and is expected to decrease the probability of participation since the perceived benefits of WIC may be lower for this group and the accompanying costs may be perceived as higher.

Prior program participation, hypothesized to lower transactions cost and stigma, is captured by including dichotomous indicators for Medicaid and SNAP participation. The NHANES health insurance utilization questionnaire asks whether the survey child is currently covered by Medicaid (“{Is Sample Person} covered by Medicaid?”). Unlike Medicaid receipt, which is measured at the child level, SNAP participation is captured at the household level and is based on a survey question which asks whether anyone in the household is authorized to receive SNAP benefits in the last 12 months (“[In the last 12 months], were {you/you or any members of your household} authorized to receive Food Stamps [which includes a food stamp card or voucher, or cash grants from the state for food]?”).

Because of the complexity of the NHANES sample design, using analytic approaches based on data from a simple random sample are inappropriate for this analysis (CDC, 2011). A failure to account for the complex design could lead to biased estimates and exaggerated significance levels; therefore, sample weights are constructed based upon variables provided by the NHANES and the National Center for Health Statistics (NCHS) which reflect the unequal probabilities of selection and non-response. In addition, to produce unbiased estimates of variance, standard errors are calculated using the Taylor Series Linearization method per CDC analytic guidelines (CDC, 2011).

21. Beginning with the 2007-2008 data collection, the NHANES no longer collects individual-level information on SNAP receipt; thus, household-level participation is utilized for this research.

22. The stratum variable (SDMVSTRA) and the primary sampling unit (PSU) variable (SDMVPSU) are
Results

Summary statistics for WIC child participants and eligible, nonparticipants are provided in Table 2.2. Taken as a whole, the descriptive statistics suggest that children who participate in WIC appear to be more disadvantaged across many socioeconomic measures than eligible children who do not participate in the program. Relative to eligible nonparticipants, children who participate in WIC are younger, more likely to be Hispanic, and less likely to be non-Hispanic White. Compared to eligible nonparticipants, child WIC participants are less likely to have a head-of-household who is U.S. born or highly educated, and child participants tend to live in households that are very large in terms of household size. Compared to their eligible, nonparticipating counterparts, child WIC participants are significantly more likely to live in households with very low poverty-to-income ratios, more likely to receive Medicaid, more likely to be in a household that has received SNAP benefits in the last 12 months, and less likely to live in a home that is owned or being purchased. In terms of child health, unlike the differences seen between WIC eligible and ineligible samples, there are no statistically significant differences between WIC participants and nonparticipants.

Table 2.3 provides regression results modeling WIC participation among children ages 1 to 5.\textsuperscript{23} For purposes of this paper, only the results of the LPM are discussed below. Results from the logit regression model are reported alongside the LPM and are included as a robustness check; however, the results of the LPM and logit models do not substantively vary in terms of the direction of the coefficient or the level of significance.\textsuperscript{24} Differences were observed in terms

---

\textsuperscript{23} Results were also run without applying the NHANES sample weights. In general, the results were consistent with what is reported in Table 2.3; however, in many cases, the magnitude of significance changed. In a few cases, some variables became insignificant while others became significant.

\textsuperscript{24} Some scholars have expressed concerns over the error term not being normally distributed in a LPM
Table 2.3. Linear Probabilities and Logistic Odds of Child WIC Participation

<table>
<thead>
<tr>
<th></th>
<th>LPM</th>
<th>Odd ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.</td>
<td>SE</td>
</tr>
<tr>
<td><strong>Child characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>0.057</td>
<td>0.035</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.118**</td>
<td>0.033</td>
</tr>
<tr>
<td>Other</td>
<td>0.043</td>
<td>0.050</td>
</tr>
<tr>
<td>Female</td>
<td>0.005</td>
<td>0.022</td>
</tr>
<tr>
<td>Age two</td>
<td>-0.116**</td>
<td>0.026</td>
</tr>
<tr>
<td>Age three</td>
<td>-0.130**</td>
<td>0.028</td>
</tr>
<tr>
<td>Age four</td>
<td>-0.183**</td>
<td>0.030</td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.072*</td>
<td>0.028</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>-0.002+</td>
<td>0.001</td>
</tr>
<tr>
<td>&lt; than high school diploma</td>
<td>0.069+</td>
<td>0.038</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.084*</td>
<td>0.040</td>
</tr>
<tr>
<td>Some college</td>
<td>0.083*</td>
<td>0.039</td>
</tr>
<tr>
<td>Born in US</td>
<td>-0.111**</td>
<td>0.028</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>0.016+</td>
<td>0.009</td>
</tr>
<tr>
<td>Family lived in home less than 1 yr</td>
<td>-0.045+</td>
<td>0.026</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.147**</td>
<td>0.047</td>
</tr>
<tr>
<td><strong>Economic health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty-to-income ratio</td>
<td>-0.054**</td>
<td>0.020</td>
</tr>
<tr>
<td>Medicaid receipt by child</td>
<td>0.175**</td>
<td>0.028</td>
</tr>
<tr>
<td>SNAP receipt, last 12 months</td>
<td>0.116**</td>
<td>0.033</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>-0.059*</td>
<td>0.029</td>
</tr>
<tr>
<td><strong>Infant health</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low birthweight</td>
<td>-0.010</td>
<td>0.069</td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.009</td>
<td>0.034</td>
</tr>
<tr>
<td>Received newborn care in ICU</td>
<td>-0.009</td>
<td>0.034</td>
</tr>
<tr>
<td>10 + doctor visits, last 12 months</td>
<td>0.010</td>
<td>0.030</td>
</tr>
</tbody>
</table>

*Note: Estimates are weighted. Missing value indicator variables are included for the variables household reference person marital status and income. Sample size includes 3,134 children eligible for WIC.

+ significant at the 10% * significant at 5%, ** significant at 1%

of the magnitude of the coefficients. The LPM estimates the influence of child, household, health, and economic factors on child WIC participation. Consistent with the descriptive due to the binary nature of the dependent variable. In addition, LPMs can yield unusual results such as probabilities greater than 1. Due to these concerns, logit models are usually preferred over LPMs.
statistics from Table 2.2, the LPM results indicate that children who participate in WIC are socioeconomically disadvantaged relative to eligible, low-income children who do not participate in WIC.

In terms of race/ethnicity, being Hispanic has a strong and significant effect on child participation. Compared to eligible nonparticipants, Hispanic children are 11.8 percentage points more likely to participate than non-Hispanic White children. Since this study finds an overall participation rate of 53 percent, this translates into a 22.3 percent difference in overall participation. Interestingly, in the LPM specification, there is no statistically significant difference between participants and nonparticipants in terms of being Non-Hispanic, Black; however, the results in the logit model indicate some mild positive significance.

While they vary widely in terms of direction and magnitude, all of the household-level variables in this model specification are significantly associated with child WIC participation. Heads-of-household who are older, US-born, and demonstrate transience (e.g. lived in their home for less than 1 year) are negatively associated with child WIC participation. As the head-of-household ages, each additional year of life is associated with a 0.2 percentage point reduction in participation. Compared to eligible non-participants, children who live in households where the head-of-household is US born are 11.1 percentage points less likely to participate in WIC. Likewise, children who live in households that have resided in their homes less than a year are 4.5 percentage points less likely to participate in the program. While the level of significance is somewhat weak, this finding is interesting because it provides some support to the idea that transient households experience higher transaction costs in terms of establishing residency, forwarding mail, and/or changing their address with the local WIC program.
In contrast, the results in Table 2.3 indicate that a lack of education, the number of people in a household, and living in a home 10 or more years are positively associated with child WIC participation. Each additional person in a household is associated with a 1.6 percentage point increase in child WIC participation, a result that suggests that transaction costs decrease with more people in the household.\textsuperscript{25} Of note, children who live in households where the head-of-household is married are 7.2 percentage points more likely to participate in the WIC program, a finding that is somewhat surprising since married households tend to be more socioeconomically advantaged.

Turning to the economic variables, the results suggest that measures of economic health are significantly associated with child participation in WIC. Families with low poverty-to-income ratios, Medicaid recipients, and SNAP recipients are significantly more likely to participate in WIC compared to eligible children who do not participate. The effect is particularly strong among Medicaid recipients who are 17.5 percentage points more likely to participate in WIC compared to children who are eligible for WIC, but do not participate. Children who live in households where the family owns or is buying the home are less likely to participate in WIC compared to their eligible, nonparticipating counterparts.

One important finding of this research is the relationship between a child’s early health status and child participation in WIC. The regression results indicate that measures of infant and child health are not significantly associated with child WIC participation. This is true across all measures of infant/child health examined in this study. Children who were born with low or very low birthweights were no more or less likely to participate in WIC than children who were born

\textsuperscript{25} The public version of the NHANES does not provide information on the age or relationship of the people in the household. It likely the probability of WIC participation increases because other children in the household are participating in WIC, a finding that is consistent with research by others (Bitler and Currie, 2004). However, given the NHANES limitations, it is not possible to draw any definitive conclusion.
with normal birthweights. Likewise, children who received intensive newborn care or who had 10 or more visits with a doctor or other health professional over the last year were no more or less likely to participate in WIC than eligible, nonparticipating children.26

One powerful difference that is observed in Table 2.3 is the significant drop-off in the likelihood of WIC participation as a child ages. Consistent with other research examining child WIC participation, the results indicate that children who are ages 2 and 3 are far significantly less likely to participate than 1 year olds (11.6 and 13.0 percentage points, respectively). Children who are age 4 are over 18 percentage points less likely to participate in WIC compared to children who are age 1, representing a 65 percent decrease from the baseline WIC participation rate.

Tables 2.4 through 2.7 examine the characteristics of NHANES children ages 1 through 4. Table 2.4 provides the means and proportions for ineligible children, eligible children, WIC participants, and WIC nonparticipants who are 1 year of age at the time of the survey. A comparison of means between WIC-ineligible children and WIC-eligible children highlight the fact that there are major differences between these groups at age 1.

This pattern of differences between WIC eligible and ineligible children holds for all ages, but it is particularly true of 1 year-olds where WIC-eligible children are significantly more likely to be low or very low birthweight and less likely to be normal birthweight.

Table 2.4 also demonstrates the results of a statistical comparison of means between WIC participants and eligible nonparticipants at age 1. Since this comparison is between children who come from low-income households, the fact that there are fewer statistically significant

26. Due to concerns about possible collinearity between the variables for very low birthweight and receipt of intensive newborn care, regressions were also estimated excluding intensive newborn care from the analysis. The health variables remained insignificant.
### Table 2.4. Characteristics of NHANES Children at Age 1: Means and Proportions

<table>
<thead>
<tr>
<th></th>
<th>Age 1</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participant</th>
<th>WIC nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>0.760*</td>
<td>0.429</td>
<td>0.359+</td>
<td>0.526</td>
<td></td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>0.067*</td>
<td>0.198</td>
<td>0.213</td>
<td>0.177</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.116*</td>
<td>0.305</td>
<td>0.366+</td>
<td>0.219</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>0.058</td>
<td>0.069</td>
<td>0.062</td>
<td>0.078</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.453</td>
<td>0.467</td>
<td>0.464</td>
<td>0.472</td>
<td></td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.861*</td>
<td>0.517</td>
<td>0.522</td>
<td>0.511</td>
<td></td>
</tr>
<tr>
<td>Unmarried</td>
<td>0.075*</td>
<td>0.359</td>
<td>0.345</td>
<td>0.379</td>
<td></td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>33.857*</td>
<td>32.447</td>
<td>32.534</td>
<td>32.324</td>
<td></td>
</tr>
<tr>
<td>&lt; than high school diploma</td>
<td>0.034*</td>
<td>0.369</td>
<td>0.427+</td>
<td>0.288</td>
<td></td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.195*</td>
<td>0.314</td>
<td>0.322</td>
<td>0.304</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>0.308</td>
<td>0.256</td>
<td>0.215+</td>
<td>0.313</td>
<td></td>
</tr>
<tr>
<td>College degree</td>
<td>0.463*</td>
<td>0.061</td>
<td>0.036+</td>
<td>0.095</td>
<td></td>
</tr>
<tr>
<td>Born in US</td>
<td>0.876*</td>
<td>0.726</td>
<td>0.668+</td>
<td>0.807</td>
<td></td>
</tr>
<tr>
<td>Number of people in household</td>
<td>3.983*</td>
<td>4.504</td>
<td>4.626+</td>
<td>4.335</td>
<td></td>
</tr>
<tr>
<td>Family lived in home &gt; 1 yr</td>
<td>0.158*</td>
<td>0.320</td>
<td>0.287+</td>
<td>0.368</td>
<td></td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.056</td>
<td>0.076</td>
<td>0.097+</td>
<td>0.047</td>
<td></td>
</tr>
<tr>
<td><strong>Economic Health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty-to-income ratio</td>
<td>3.787*</td>
<td>1.045</td>
<td>0.952+</td>
<td>1.175</td>
<td></td>
</tr>
<tr>
<td>Medicaid receipt by child</td>
<td>—</td>
<td>0.535</td>
<td>0.627+</td>
<td>0.408</td>
<td></td>
</tr>
<tr>
<td>SNAP stamp receipt, last 12 months</td>
<td>—</td>
<td>0.445</td>
<td>0.497+</td>
<td>0.372</td>
<td></td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>0.840*</td>
<td>0.366</td>
<td>0.336</td>
<td>0.407</td>
<td></td>
</tr>
<tr>
<td><strong>Infant Health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low birthweight</td>
<td>0.013*</td>
<td>0.034</td>
<td>0.037</td>
<td>0.030</td>
<td></td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.095*</td>
<td>0.141</td>
<td>0.169+</td>
<td>0.103</td>
<td></td>
</tr>
<tr>
<td>Normal birthweight</td>
<td>0.905*</td>
<td>0.859</td>
<td>0.831+</td>
<td>0.897</td>
<td></td>
</tr>
<tr>
<td>Received newborn care in ICU</td>
<td>0.130</td>
<td>0.147</td>
<td>0.155</td>
<td>0.136</td>
<td></td>
</tr>
<tr>
<td>10 + doctor visits, last 12 months</td>
<td>0.223</td>
<td>0.185</td>
<td>0.210+</td>
<td>0.151</td>
<td></td>
</tr>
<tr>
<td><strong>Sample Size</strong></td>
<td>453</td>
<td>981</td>
<td>626</td>
<td>355</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Estimates are weighted. Missing value indicator variables are included for the variable household reference person marital status.

* indicates that the value is significantly different from all eligible participants at the 5% level using a two-tailed test.

+ indicates that the value is significantly different from nonparticipants at the 5% level using a two-tailed test.

— By definition, children who participate in SNAP or Medicaid are eligible for WIC.
differences in unsurprising, but a number of major differences persist. WIC children are more likely to be Hispanic and less likely to be White. Compared to other eligible nonparticipating 1-year-olds, WIC participants live in less educated households that are headed by someone who is foreign-born and large in terms of the number of people in the household. One-year-old WIC participants experience significant economic disadvantage relative to children from eligible nonparticipating households as they have lower PIRs and more participation in other assistance programs. Of note, WIC child participants who are age 1 are more likely to have born low birthweight and less likely to have been normal birthweight, suggesting that the perceived benefit of WIC participation is higher among households with low birthweight children.27

Table 2.5 examines the differences between WIC ineligible children and eligible children as well as WIC participants and nonparticipants at the age of 2. The pattern of differences between WIC-ineligible and WIC-eligible children remains the same; however, the differences in birthweight identified in Table 2.4 disappear. In addition, many of the differences observed in 1-year-olds persist between WIC participants and eligible nonparticipants at age 2; however, the two groups become indistinct in terms of exposure to higher education (some college and college degree) and duration at current residence (lived there less than 1 year or more than 10 years). Here again, significant differences in terms of economic status are observed with 2-year-old WIC children living in households where the residence is rented, where PIR is low, and where participation in other assistance programs is higher, relative to the households of eligible, nonparticipating 2-year-olds.

27. The NHANES does not collect information on prenatal receipt of WIC, so it is not possible to know whether these children also participated in WIC during the prenatal period.
### Table 2.5. Characteristics of NHANES Children at Age 2: Means and Proportions

<table>
<thead>
<tr>
<th></th>
<th>Age 2</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WIC</td>
<td>WIC</td>
<td>WIC</td>
<td>WIC</td>
</tr>
<tr>
<td></td>
<td>ineligible</td>
<td>eligible</td>
<td>participant</td>
<td>nonparticipant</td>
</tr>
<tr>
<td><strong>Child characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>0.762*</td>
<td>0.450</td>
<td>0.342+</td>
<td>0.543</td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>0.061*</td>
<td>0.190</td>
<td>0.218</td>
<td>0.167</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.118*</td>
<td>0.299</td>
<td>0.384+</td>
<td>0.227</td>
</tr>
<tr>
<td>Other</td>
<td>0.058</td>
<td>0.060</td>
<td>0.056</td>
<td>0.064</td>
</tr>
<tr>
<td>Female</td>
<td>0.519</td>
<td>0.490</td>
<td>0.471</td>
<td>0.507</td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.858*</td>
<td>0.538</td>
<td>0.539</td>
<td>0.537</td>
</tr>
<tr>
<td>Unmarried</td>
<td>0.060*</td>
<td>0.361</td>
<td>0.355</td>
<td>0.366</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>34.619*</td>
<td>32.211</td>
<td>32.530</td>
<td>31.938</td>
</tr>
<tr>
<td>&lt; than high school diploma</td>
<td>0.083*</td>
<td>0.381</td>
<td>0.470+</td>
<td>0.303</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.159*</td>
<td>0.318</td>
<td>0.270+</td>
<td>0.359</td>
</tr>
<tr>
<td>Some college</td>
<td>0.314*</td>
<td>0.233</td>
<td>0.210</td>
<td>0.252</td>
</tr>
<tr>
<td>College degree</td>
<td>0.444*</td>
<td>0.069</td>
<td>0.050</td>
<td>0.085</td>
</tr>
<tr>
<td>Born in US</td>
<td>0.874*</td>
<td>0.710</td>
<td>0.613+</td>
<td>0.792</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>4.069*</td>
<td>4.606</td>
<td>4.881+</td>
<td>4.370</td>
</tr>
<tr>
<td>Family lived in home less than 1 yr</td>
<td>0.162*</td>
<td>0.311</td>
<td>0.290</td>
<td>0.330</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.068</td>
<td>0.074</td>
<td>0.076</td>
<td>0.072</td>
</tr>
<tr>
<td><strong>Economic health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty-to-income ratio</td>
<td>3.760*</td>
<td>1.047</td>
<td>0.913+</td>
<td>1.162</td>
</tr>
<tr>
<td>Medicaid receipt by child</td>
<td>—</td>
<td>0.512</td>
<td>0.642+</td>
<td>0.400</td>
</tr>
<tr>
<td>SNAP receipt, last 12 months</td>
<td>—</td>
<td>0.431</td>
<td>0.565+</td>
<td>0.316</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>0.816*</td>
<td>0.392</td>
<td>0.340+</td>
<td>0.436</td>
</tr>
<tr>
<td><strong>Infant health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low birthweight</td>
<td>0.010</td>
<td>0.010</td>
<td>0.016</td>
<td>0.005</td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.103</td>
<td>0.145</td>
<td>0.153</td>
<td>0.138</td>
</tr>
<tr>
<td>Normal birthweight</td>
<td>0.897</td>
<td>0.855</td>
<td>0.847</td>
<td>0.862</td>
</tr>
<tr>
<td>Received newborn care in ICU</td>
<td>0.143</td>
<td>0.112</td>
<td>0.139+</td>
<td>0.089</td>
</tr>
<tr>
<td>10 + doctor visits, last 12 months</td>
<td>0.093</td>
<td>0.110</td>
<td>0.101</td>
<td>0.119</td>
</tr>
<tr>
<td><strong>Sample Size</strong></td>
<td>447</td>
<td>932</td>
<td>493</td>
<td>439</td>
</tr>
</tbody>
</table>

*Note: Estimates are weighted. Missing value indicator variables are included for the variable household reference person marital status.

* indicates that the value is significantly different from all eligible participants at the 5% level using a two-tailed test.

+ indicates that the value is significantly different from nonparticipants at the 5% level using a two-tailed test.

— By definition, children who participate in SNAP or Medicaid are eligible for WIC
Tables 2.6 and 2.7 examine the differences between WIC ineligible children and eligible children as well as WIC participants and nonparticipants at the ages of 3 and 4, respectively. While the differences between WIC-eligible children and ineligible children observed at ages 1 and 2 persist; the number of statistically significant differences between WIC participants and eligible nonparticipants at ages 3 and 4 decrease. At ages 3 and 4, there are no statistically significant differences between participants and nonparticipants at any level of education. In addition, there are no significant differences in terms of the number of people in the household. Interestingly, unlike other age groups, 4-year-old WIC participants are less likely to have been born low birthweight, more likely to be normal birthweight, and less likely to have received newborn care in the ICU after birth. However, caution must be exercised in interpreting this finding since the sample size among 4-year-old becomes very small.

Table 2.8 estimates the age-stratified linear probabilities of child WIC participation. Like the regression in Table 2.3, the dependent variable is an indicator for WIC participation and the independent variables represent matrices of child, household, economic, and health characteristics that may be associated with WIC participation. At age 1, Hispanics are 12.7 percentage points more likely to participate in WIC compared to White children. Variables that are positively associated with WIC participation at age 1 include married and less educated heads-of-household, living in a household that has resided in the same place for 10 or more years, and living in a household that has received Medicaid or SNAP. Variables that negatively influence WIC participation at age 1 include being US-born, living in a household for less than 1 year, and experiencing increases in PIR.

Like children at age 1, many of the same variables influence child participation in WIC at age 2. However, the influence of lack of education on participation disappears along with
<table>
<thead>
<tr>
<th>Child characteristics</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participant</th>
<th>WIC nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td>White, Non-Hispanic</td>
<td>0.686*</td>
<td>0.440</td>
<td>0.360+</td>
<td>0.503</td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>0.081*</td>
<td>0.221</td>
<td>0.225</td>
<td>0.217</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.143*</td>
<td>0.263</td>
<td>0.325+</td>
<td>0.214</td>
</tr>
<tr>
<td>Other</td>
<td>0.090</td>
<td>0.076</td>
<td>0.090</td>
<td>0.066</td>
</tr>
<tr>
<td>Female</td>
<td>0.453</td>
<td>0.453</td>
<td>0.472</td>
<td>0.438</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Household characteristics</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>0.870*</td>
<td>0.523</td>
<td>0.514</td>
<td>0.530</td>
</tr>
<tr>
<td>Unmarried</td>
<td>0.063*</td>
<td>0.387</td>
<td>0.392</td>
<td>0.382</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>36.374*</td>
<td>33.557</td>
<td>32.590</td>
<td>34.321</td>
</tr>
<tr>
<td>&lt; than high school diploma</td>
<td>0.051*</td>
<td>0.380</td>
<td>0.375</td>
<td>0.384</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.167*</td>
<td>0.293</td>
<td>0.314</td>
<td>0.276</td>
</tr>
<tr>
<td>Some college</td>
<td>0.291</td>
<td>0.253</td>
<td>0.262</td>
<td>0.246</td>
</tr>
<tr>
<td>College degree</td>
<td>0.491*</td>
<td>0.075</td>
<td>0.050</td>
<td>0.094</td>
</tr>
<tr>
<td>Born in US</td>
<td>0.835*</td>
<td>0.752</td>
<td>0.700+</td>
<td>0.792</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>4.232*</td>
<td>4.723</td>
<td>4.720</td>
<td>4.726</td>
</tr>
<tr>
<td>Family lived in home less than 1 yr</td>
<td>0.150*</td>
<td>0.226</td>
<td>0.222</td>
<td>0.229</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.096</td>
<td>0.073</td>
<td>0.089</td>
<td>0.061</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Economic health</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty-to-income ratio</td>
<td>3.797*</td>
<td>1.046</td>
<td>0.970+</td>
<td>1.106</td>
</tr>
<tr>
<td>Medicaid receipt by child</td>
<td>—</td>
<td>0.514</td>
<td>0.621+</td>
<td>0.429</td>
</tr>
<tr>
<td>SNAP receipt, last 12 months</td>
<td>—</td>
<td>0.461</td>
<td>0.549+</td>
<td>0.391</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>0.843*</td>
<td>0.443</td>
<td>0.371+</td>
<td>0.499</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Infant health</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Very low birthweight</td>
<td>0.007</td>
<td>0.028</td>
<td>0.023</td>
<td>0.032</td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.088</td>
<td>0.137</td>
<td>0.157</td>
<td>0.121</td>
</tr>
<tr>
<td>Normal birthweight</td>
<td>0.912</td>
<td>0.863</td>
<td>0.843</td>
<td>0.879</td>
</tr>
<tr>
<td>Received newborn care in ICU</td>
<td>0.093</td>
<td>0.132</td>
<td>0.129</td>
<td>0.134</td>
</tr>
<tr>
<td>10 + doctor visits, last 12 months</td>
<td>0.063</td>
<td>0.075</td>
<td>0.068</td>
<td>0.080</td>
</tr>
</tbody>
</table>

**Note:** Estimates are weighted. Missing value indicator variables are included for the variable household reference person marital status.

* indicates that the value is significantly different from all eligible participants at the 5% level using a two-tailed test.

+ indicates that the value is significantly different from nonparticipants at the 5% level using a two-tailed test.

— By definition, children who participate in SNAP or Medicaid are eligible for WIC
Table 2.7. Characteristics of NHANES Children at Age 4: Means and Proportions

<table>
<thead>
<tr>
<th>Age 4</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participant</th>
<th>WIC nonparticipant</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>0.713*</td>
<td>0.415</td>
<td>0.375</td>
<td>0.439</td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>0.079*</td>
<td>0.205</td>
<td>0.201</td>
<td>0.208</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.121*</td>
<td>0.305</td>
<td>0.371+</td>
<td>0.266</td>
</tr>
<tr>
<td>Other</td>
<td>0.086</td>
<td>0.075</td>
<td>0.053</td>
<td>0.087</td>
</tr>
<tr>
<td>Female</td>
<td>0.516</td>
<td>0.488</td>
<td>0.516</td>
<td>0.471</td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.863*</td>
<td>0.522</td>
<td>0.509</td>
<td>0.531</td>
</tr>
<tr>
<td>Unmarried</td>
<td>0.069*</td>
<td>0.384</td>
<td>0.396</td>
<td>0.376</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>36.601*</td>
<td>32.869</td>
<td>31.999</td>
<td>33.393</td>
</tr>
<tr>
<td>&lt; than high school diploma</td>
<td>0.065*</td>
<td>0.385</td>
<td>0.419</td>
<td>0.365</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.218</td>
<td>0.258</td>
<td>0.255</td>
<td>0.260</td>
</tr>
<tr>
<td>Some college</td>
<td>0.315</td>
<td>0.276</td>
<td>0.277</td>
<td>0.276</td>
</tr>
<tr>
<td>College degree</td>
<td>0.402*</td>
<td>0.080</td>
<td>0.050</td>
<td>0.099</td>
</tr>
<tr>
<td>Born in US</td>
<td>0.822*</td>
<td>0.709</td>
<td>0.646+</td>
<td>0.747</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>4.333*</td>
<td>4.686</td>
<td>4.835</td>
<td>4.596</td>
</tr>
<tr>
<td>Family lived in home less than 1 yr</td>
<td>0.148*</td>
<td>0.290</td>
<td>0.326</td>
<td>0.269</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.133*</td>
<td>0.064</td>
<td>0.068</td>
<td>0.061</td>
</tr>
<tr>
<td><strong>Economic health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty-to-income ratio</td>
<td>3.710*</td>
<td>1.072</td>
<td>0.952+</td>
<td>1.145</td>
</tr>
<tr>
<td>Medicaid receipt by child</td>
<td></td>
<td>0.450</td>
<td>0.576+</td>
<td>0.374</td>
</tr>
<tr>
<td>SNAP receipt, last 12 months</td>
<td></td>
<td>0.390</td>
<td>0.514+</td>
<td>0.315</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>0.839*</td>
<td>0.418</td>
<td>0.354+</td>
<td>0.457</td>
</tr>
<tr>
<td><strong>Infant health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low birthweight</td>
<td>0.036</td>
<td>0.028</td>
<td>0.012</td>
<td>0.038</td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.131</td>
<td>0.162</td>
<td>0.105+</td>
<td>0.196</td>
</tr>
<tr>
<td>Normal birthweight</td>
<td>0.869</td>
<td>0.838</td>
<td>0.895+</td>
<td>0.804</td>
</tr>
<tr>
<td>Received newborn care in ICU</td>
<td></td>
<td>0.146</td>
<td>0.166</td>
<td>0.106+</td>
</tr>
<tr>
<td>10 + doctor visits, last 12 months</td>
<td>0.064</td>
<td>0.055</td>
<td>0.052</td>
<td>0.058</td>
</tr>
</tbody>
</table>

**Sample Size** 332  605  244  361

*Note: Estimates are weighted. Missing value indicator variables are included for the variable household reference person marital status.*

* indicates that the value is significantly different from all eligible participants at the 5% level using a two-tailed test.

+ indicates that the value is significantly different from nonparticipants at the 5% level using a two-tailed test.

— By definition, children who participate in SNAP or Medicaid are eligible for WIC.
Table 2.8. Linear Probabilities of WIC Participation by Age of Child

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>0.092</td>
<td>0.080</td>
<td>0.076</td>
<td>-0.068</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.127*</td>
<td>0.113*</td>
<td>0.166**</td>
<td>0.034</td>
</tr>
<tr>
<td>Other</td>
<td>0.071</td>
<td>0.005</td>
<td>0.111</td>
<td>-0.017</td>
</tr>
<tr>
<td>Female</td>
<td>-0.037</td>
<td>-0.029</td>
<td>0.027</td>
<td>0.054</td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>0.116*</td>
<td>0.052</td>
<td>0.091</td>
<td>-0.009</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>-0.001</td>
<td>0.001</td>
<td>-0.005*</td>
<td>-0.004</td>
</tr>
<tr>
<td>&lt; than high school diploma</td>
<td>0.179*</td>
<td>0.091</td>
<td>0.061</td>
<td>-0.018</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.155</td>
<td>0.016</td>
<td>0.166*</td>
<td>0.022</td>
</tr>
<tr>
<td>Some college</td>
<td>0.065</td>
<td>0.087</td>
<td>0.148</td>
<td>0.042</td>
</tr>
<tr>
<td>Born in US</td>
<td>-0.092*</td>
<td>-0.127**</td>
<td>-0.098</td>
<td>-0.112</td>
</tr>
<tr>
<td>Number of people in household</td>
<td>-0.006</td>
<td>0.039**</td>
<td>-0.001</td>
<td>0.025</td>
</tr>
<tr>
<td>Family lived in home less than 1 yr</td>
<td>-0.106**</td>
<td>-0.051</td>
<td>-0.058</td>
<td><strong>0.050</strong></td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.212*</td>
<td>-0.009</td>
<td>0.217*</td>
<td>0.155</td>
</tr>
<tr>
<td><strong>Economic health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poverty-to-income ratio</td>
<td>-0.065*</td>
<td>-0.057</td>
<td>-0.031</td>
<td>-0.048</td>
</tr>
<tr>
<td>Medicaid receipt by child</td>
<td>0.180**</td>
<td>0.179**</td>
<td>0.169**</td>
<td>0.165**</td>
</tr>
<tr>
<td>SNAP receipt, last 12 months</td>
<td>0.076</td>
<td>0.155**</td>
<td>0.088</td>
<td>0.122*</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>-0.063</td>
<td>-0.043</td>
<td>-0.064</td>
<td>-0.058</td>
</tr>
<tr>
<td><strong>Infant health</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very low birthweight</td>
<td>-0.035</td>
<td>0.263</td>
<td>-0.067</td>
<td>0.000</td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.063</td>
<td>-0.007</td>
<td>0.053</td>
<td>-0.097</td>
</tr>
<tr>
<td>Received newborn care in ICU</td>
<td>0.013</td>
<td>0.087</td>
<td>-0.039</td>
<td>-0.119*</td>
</tr>
<tr>
<td>10 + doctor visits, last 12 months</td>
<td>0.086</td>
<td>-0.046</td>
<td>-0.057</td>
<td>-0.017</td>
</tr>
</tbody>
</table>

**Sample Size**: 981 932 616 605

*Note: Estimates are weighted. Missing value indicator variables are included for the variable household reference person marital status. Wald tests were run to determine whether there were statistically significant differences in the coefficients between children at age 1 and age 4. Significant differences appear in bold.

*significant at 5%, ** significant at 1%

duration at current residence; while the number of people in the household becomes positively and significantly associated with participation. At age 3, a number of statistically significant differences are observed between WIC participants and nonparticipants; however, the variables that influence participation at age 3 are somewhat different from the types of variables.
influencing participation at age 2. At age 4, very few significant differences are observed between WIC participants and non-participants. Children age 4 who participate in Medicaid are 16.5 percentage points more likely to participate than their eligible, nonparticipating counterparts. This is also true for SNAP participation where WIC participation is associated with a 12.2 percentage point increase in the likelihood of participating. Interestingly, receipt of newborn care in the ICU is a significant predictor of WIC participation among 4-year-olds.28

Taken together, these findings suggest that child participants at ages 3 and 4 may be in households that are better off than children at ages 1 and 2 which may explain, in part, the drop-off in participation. Given the high significance of Medicaid, and SNAP at age 4, it is possible that adjunctive eligibility is driving participation in older children. Since those children are already participating in other social programs, the costs of staying in the WIC program may be negligible.

**Discussion and Conclusions**

Research shows that rates of child participation in the WIC program substantially lag behind the participation rates of other groups that are categorically eligible. Since child participation in WIC has been associated with improvements in child nutritional intake and better health, understanding factors associated with nonparticipation among children eligible for WIC is essential. This research builds upon a relatively small body of literature that has focused on child participation in WIC by examining potential predictors of participation in terms of a cost-benefit framework. Generally, this study finds that nonparticipation is more common in

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28. Wald tests were conducted to examine whether the coefficients between child age 1 and age 4 were statistically different. In nearly all cases, the coefficients were not statistically different. The significant results are illustrated in bold print in Table 8.
households headed by someone who is US born, households that are more transient, and among older children. Ultimately, the regression results yield several major findings.

In general, WIC participation appears to be associated with children and families who are more disadvantaged in terms of socioeconomic status; thus, they are negatively selected into the program. The analysis suggests that certain factors such as constrained finances (measured by PIR and lack of home ownership), previous and current program participation, and household size are significant predictors of child participation in the WIC program. To these groups, those who are worse off relative to eligible nonparticipants, the benefits of participation exceed the cost of WIC program participation. This finding is not inconsistent with other research examining child WIC participation, but it has important consequences. Ultimately, the presence of negative selection into the program may cause program evaluators to underestimate the influence of child WIC, since children may be predisposed to bad outcomes even in the absence of the program.

Second, the primary regression results in Table 2.3 find no association between measures of infant and/or child health and child participation in WIC. However, the age-stratified regression results presented in Table 2.8 do find some effect on child participation at age 4. Compared to nonparticipants, at age 4 children who received newborn care in the ICU after birth are nearly 12 percentage points less likely to participate; however, this result is not found at any other age and may be an artifact of the relatively small sample. In general, these results suggest that parents or guardians may not include health status at birth in their assessment of the costs and benefits of WIC participation. Since four of the five measures of health are derived from health status at birth, it is possible that as children age, parents exclude health status from their
evaluation of the costs and benefits of WIC participation, in part because they perceive that the initial problems with their child’s health have resolved themselves.

Representing a third major finding, this research indicates that there is a considerable age effect taking place with child WIC participation. Compared to children who are participating at age 1, children at ages 2, 3, and 4 are significantly less likely to participate (11.6, 13.0, and 18.3 percentage points less likely, respectively). This finding is consistent with other research examining WIC child participation (Oliveira and Gunderson, 2000) and does indicate that the probability of participation decreases as a child’s age increases. The specific reasons behind the drop off in participation as a child ages are not clear and cannot be definitivelyascertained given the limits of NHANES data, but the age stratification results explored in Table 2.4 are suggestive.

At ages 1 and 2, there are significant differences between participants and nonparticipants in terms of race, marital status, education, and duration at current residence, but by age 3 and particularly age 4, the number of significant differences between child WIC participants and nonparticipants diminishes to the point where very few differences are evident between WIC participants and their eligible, nonparticipating counterparts.

There are several possible explanations for the age drop-off. First, a child’s parent or guardian may perceive that the WIC food package provided to children under age 5 is insufficient in total value to warrant the cost of program participation, so while participation may start as an infant when WIC benefits are most generous, we may see drop-off as program benefits become less generous.\(^\text{29}\) In addition, at the local level, providers may place an emphasis

\(^{29}\) Lending support to this possibility, additional sensitivity analyses revealed that the age effect disappeared when the sample was limited to only those whose eligibility was conveyed adjunctively through participation in either the SNAP or Medicaid. In theory, those who receive WIC eligibility through their participation in other assistance programs will experience lower costs of participation, and therefore, be more likely
on targeting infants and very young children, thereby focusing their resources on recruitment rather than retention. Alternatively, it may be that WIC children are entering preschool or daycare programs that provide additional food supplementation or other resources, negating their need for WIC, especially in light of its relatively modest monetary benefit.

A fourth major finding is the persistent and strongly significant, negative effect of US-born households on child WIC participation. Children who reside in households where the head-of-household is born in the United States are far less likely to participate in the WIC program, representing a 20.9 percent difference in the overall WIC coverage rate. This difference persists in the 1-year-old and 2-year-old samples in the age-stratified results presented in Table 2.8. These findings suggest that foreign-born households may be worse off than US born households and may place greater value on the benefits attached to WIC; however, even controlling for economic factors like income, the strength of significance and the size of the coefficient remain the same. This finding is somewhat surprising given the many potential barriers to participation that foreign-born households might face like language barriers and programmatic awareness.

In addition to the four major findings articulated above, this analysis finds that household transience and stability are important predictors of child participation. Children who come from stable families that have resided in their homes for 10 years or more are significantly more likely to participate in the program; although the age-stratified results fail to find a pattern. Similarly, children who come from more transient families, families that have resided in their homes for less than 1 year, are less likely to participate in the program. One possible explanation for this result is the high transactions costs for people who move frequently in terms of acquiring the

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Caution should be used in interpreting this result due to the relatively small sample size (n=180) when the sample was restricted to only those children whose eligibility was conveyed adjunctively.
requisite documents to establish income and residency information and receive vouchers.

Similarly, transactions costs may be lower for families with stable addresses and a less transient household.

While the findings of this research are suggestive, they should be interpreted with a great deal of caution. In particular, the age-stratification results suffer from small sample sizes, so the results presented here should be reexamined using other large, nationally representative data sets to see if the findings of this research can be replicated. One major limitation of this paper is that it is not possible to make causal claims. Individuals choose to participate in WIC and it is not possible to examine all of the factors, observable and unobservable, that contribute to the decision to participate. While the NHANES offers a wide variety of health indicators, it provides only limited information on maternal and household characteristics that may be useful in further understanding the participation decision. Another limitation is that the NHANES, by nature of its design, cannot reveal the entire range and duration of participation for a child which would allow for a more nuanced assessment of the participation decision. Finally, consistent with other research examining WIC participation, this research assumes that the child receiving WIC benefits is actually consuming that food, rather than being redistributed to other family members.

Despite these limitations, this analysis may have important implications for researchers, policymakers, and program managers. As stakeholders continue to evaluate the programmatic effectiveness of WIC, it becomes critical to understand the differences between children who participate in WIC and eligible nonparticipants. A failure to account for these differences may lead to biased estimates of the effectiveness of WIC participation among children. In this study, the results suggest that child participants are negatively selected into WIC, but that effect seems to diminish as a child ages. In terms of policy implications, one clear predictor of a child’s
participation as they age is participation in other social programs, particularly Medicaid. Thus, Medicaid participation, and to a lesser extent SNAP participation, can potentially act as vehicles for increasing participation among older, eligible children; thus, further outreach efforts to Medicaid offices may be effective in increasing child participation. This research also suggests that program managers, who are seeking to increase child participation in WIC, should consider directing resources and outreach efforts toward transient households. Finally, the finding that child WIC participants are less likely to come from US born households suggests that program officials may have been successful in outreach efforts to mitigate the costs of participation for foreign-born households in terms of language and cultural barriers.
CHAPTER 3
EXAMINING THE INFLUENCE OF WIC ON
CHILD HEALTH AND WELL-BEING

Introduction

Poverty is a serious concern in the United States, due in part, to the strong association between being low-income and having poor health. Of particular concern, the number of families with children living in poverty has steadily increased from 12.7 percent in the year 2000 to 17.1 percent in 2009 (DeNavas-Walt et al., 2010). These circumstances may have profound implications for public health since living in a low-income household is strongly linked to increases in negative health outcomes including disease, mental illness, and premature mortality (Woolf et al., 2006). Over the years, the federal government has deployed a number of nutrition assistance programs aimed at ensuring the health of vulnerable Americans, particularly children. The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) represents one government effort to mitigate the negative effects of poverty on child health and well-being.

The WIC program was conceived in the face of increasing evidence that nutritional deficiencies threatened the health of low-income pregnant women and children, resulting in increased costs to society (White House Conference Report, 1969). Thus, the nutritional assistance provided by WIC was designed to act as an adjunct to good health care during critical periods of growth and development to prevent health problems and to improve the overall health of low-income women and children.30 Growing steadily from 88,000 participants and an initial $10.4 million Congressional appropriation in 1974, today WIC is a $6.7 billion per year program.

serving approximately 10 million women, infants, and children (United States Department of Agriculture (USDA), 2011). Despite its popularity, there are significant gaps in WIC research, most notably, a failure to provide persuasive empirical evidence that WIC participation improves the health and well-being of its largest participant group: children under the age of 5. Children under the age of 5 years represent the largest WIC participant group, accounting for approximately one-half of all program participants (Oliveira and Frazao, 2009). Children also account for over half of WICs total program expenditures (Besharov and Call, 2009). However, the body of research examining child participation, and particularly, the effectiveness of WIC participation among children is remarkably sparse. The lack of rigorous study is problematic since one goal of WIC is to safeguard the health of low-income children: thus, an important measure of programmatic effectiveness is whether participation in WIC actually improves the health of the child participant group. Moreover, the need for research in this area has taken on additional urgency recently. Given the current economic climate, the WIC program is facing the possibility of unprecedented cuts to its budget, making it more critical than ever that WIC can demonstrate its efficacy. Further, knowing what facets of the program work well may help decision-makers strategically deploy scarce economic resources in this time of fiscal austerity.

This study adds to a small, but growing, body of literature examining whether child participation in the WIC program is associated with improved health and well-being among young children. Using the 1999-2008 National Health and Nutrition Examination Survey (NHANES), this analysis examines whether child WIC participation influences measures of

31. Of the remaining WIC caseload, 26 percent are infants, and 25 percent are women.

32. H.R. 2112, the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act of 2012, slated $6.0 billion for the WIC program, a potential 10 percent reduction below the FY11 funding level. Ultimately, a House and Senate conference committee agreed to appropriate $6.6 billion in WIC funding, representing a 5 percent reduction from FY2011 levels. The appropriations bill was signed into law on November 18, 2011 (P.L. 112-55).
overall health and well-being in children ages 2 through 4. The NHANES is a recent, nationally-representative dataset which includes detailed information for examining factors that influence child health and well-being including demographic, socio-economic, and medical data. Taken as a whole, this study finds little evidence that WIC improves the health and well-being of child participants; however, additional research is required to fully understand whether and to what extent WIC affects child health and well-being.

Background

The WIC Program

Since its inception in 1972, the WIC program has become an essential component of the national strategy for providing food and nutrition assistance to low-income Americans (Oliveira and Frazao, 2009). The WIC program is designed to ensure that low-income women and children have access to nutritious foods during crucial periods of growth and development. The program is distinct from other food and nutrition assistance programs because it is narrowly tailored to a specific group of participants: nutritionally at-risk, low-income pregnant and postpartum women and their infants and children under age 5. In addition, WIC is not an entitlement program. The number of participants served is dependent upon annual appropriations established by Congress. If local WIC agencies reach their maximum budgetary caseload, a priority system based on categorical status and type of nutritional risk is used to allocate subsequent openings to eligible participants (Connor, 2010).

Eligibility for WIC is based on categorical, income, and nutritional risk criteria. To be categorically eligible, a participant must fall into one of these participant categories: a pregnant woman, post-partum woman (up to 6 months), a breastfeeding woman (up to 1 year), an infant under 12 months, or a child under the age of 5 years. In addition to the participant group
requirement, WIC participants must live in households that are at or below 185 percent of the federal poverty line, or participate in another federal assistance program like the Supplemental Nutrition Assistance Program (SNAP), Medicaid, or Temporary Assistance for Needy Families (TANF). Finally, unlike other food and nutrition assistance programs, WIC participants must be determined to be at nutritional risk by a qualified health professional such as a physician, nurse, or nutritionist (USDA, 2010). Eligibility is conveyed for two types of nutritional risk: (1) medically-based risks such as anemia, underweight, overweight, or history of pregnancy complications or poor outcomes; and (2) diet-based risks such as inadequate nutrient intake (USDA, 2010).

The underlying theory behind the benefits provided by the WIC program is that children, and other categorically eligible groups, suffer from nutritional deficiencies which contribute to an array of health problems that endanger the development of infants and children like prematurity, mortality, low birthweight, delayed development, and anemia (Rossi, 1998). Therefore, WIC food packages are specifically tailored to provide participants with important nutrients like protein, calcium, iron, and vitamins A and C. WIC food packages do not vary based on household income; however, they may vary by categorical group (mother, infant, child) and state of residence. In the case of children, WIC food packages provide vitamin-C rich juice, milk, iron-fortified cereal, eggs, beans or peas, and peanut butter (IOM, 2006). In addition, the FNS has now extended the child food package to include whole wheat bread, and cash vouchers for fruits and vegetables (see 7 CFR 246). Participants are typically issued vouchers which may be redeemed at authorized WIC food stores for those specific supplemental foods included in the

33. Formerly known as the Food Stamp Program.

34. The interim rule became effective on December 31, 2009 (see 7 CFR 246) and is now mandated in all 50 states.
approved food package. Further, while federal guidelines limit the maximum amount of food in each food package, states have some discretion over the content of food packages. For example, WIC State agencies have the discretion to tailor an individual’s food package based on their health status, food restrictions or intolerances, or for reasons of administrative convenience and cost control (Oliveira and Frazao, 2009).

In addition to supplying nutritious foods, WIC also provides nutrition education to parents or caregivers. Nutrition education is intended to help participants understand the relationships between good nutrition, exercise, and health as well as emphasize, in the case of child participants, the nutritional needs of young children (Oliveira and Frazao, 2009). States must offer parents or caregivers two nutritional education sessions every six months, but participants are not required to attend them and attendance may not be used as a condition for receipt of WIC vouchers (Oliveira and Frazao, 2009). The full benefit of nutrition education classes is unclear; however, an FNS-sponsored study conducted in 1990s found that a substantial percentage of women failed to attend nutrition education sessions (Fox, et al., 1998). The final component of WIC services is referral to health and social services such as preventative medicine and other assistance programs particularly Medicaid.

In summary, children who participate in the WIC program garner several advantages over their nonparticipating counterparts. The first advantage is the supplementary food package itself. To provide the child with nutritious foods, the parents or guardians of a participating child receive a quantity-based voucher which is exchanged for nutritious foods at any participating retail outlet.35 The second advantage is the provision of nutrition education to the child’s caregiver which is important in overcoming information disadvantages about the importance of

35. As of FY 2005, there are over 44,000 authorized WIC vendors which include retail outlets, pharmacies, and WIC-only stores (USDA, 2008).
nutrition and nutritional adequacy. Finally, the referrals to health and other social services provided by WIC leads to greater awareness and access to other assistance programs.

**Literature**

Public health literature suggests that nutritional deficiencies lead to certain health conditions including prematurity, infant mortality, low birthweight, delayed development, and anemia (Rossi, 1998; Rush et al., 1988). It is these health outcomes that the WIC program is specifically designed to mitigate. When Congress launched WIC almost forty years ago, hunger was the key nutrition-related problem facing low-income Americans. Today, obesity is surpassing hunger as the nation’s most serious nutrition-related health problem, and as such, a major goal of WIC is the prevention of overweight and obesity in children (Bitler and Currie, 2004). In light of these objectives, an important programmatic question for WIC is whether enhanced nutritional supplementation is actually yielding better health outcomes for program participants, particularly children. Research on the health outcomes of child WIC participants is not widespread as much of the existing literature on WIC tends to focus on pregnancy and infant health outcomes (Biter and Currie, 2004; Carlson and Senauer, 2005).

To date, the vast majority of research evaluating WIC has focused heavily on maternal prenatal participation and subsequent infant birth outcomes. In general, this large body of research has found that women who participated in WIC during their pregnancies had better infant birth outcomes than low-income women who did not (Besharov and Germanis, 2001; Currie, 2003; and Oliveira and Frazao, 2009). For example, in an evaluation of Medicaid mothers in 19 states, researchers found that WIC participants were less likely to have babies who were low or very low birthweight, premature or very premature, or were in the lowest quartile or decile of birthweight for their gestational age (Bitler and Currie, 2005). Taking advantage of
income-eligibility cutoffs to examine Florida women who were marginally eligible or ineligible for WIC, Figlio et al. (2009) find that prenatal WIC participation significantly decreases the likelihood of giving birth to a low birthweight baby. Similarly, Hoynes et al. (2009) use the initial launch of the WIC program to estimate the impact on infant birth outcomes. Ultimately, they find that the implementation of WIC leads to improvements in average birthweight and a reduction in births that are classified as low birthweight (Hoynes et al., 2009). More recently, Foster et al. (2010) use the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID) to examine the impact of WIC on the health of newborns. Results from their fixed-effects models indicated some statistically significant effects on reductions in preterm birth and birth weight; however, results from additional models found no effects (Foster et al., 2010).

In stark contrast, very little research has examined the impact of WIC participation on young children. One early study conducted by Rose, Habicht, and Devaney (1998) found that WIC participation was associated with greater intakes of 10 different nutrients including iron and zinc. Using 1989-1991 data from the Continuing Survey of Food Intake by Individuals (CSFII), this study examined dietary data for children ages 1 to 4 with incomes below 130 percent of the federal poverty level and found not only were WIC participants reporting higher nutrient intakes compared to their nonparticipating counterparts, but those effects were stronger than the effects seen in the SNAP Program. Similarly, Oliveira and Gundersen (2000) utilized data from 1994-1996 CSFII and found that children receiving WIC had a higher intakes of iron, Vitamin C, and Vitamin A, three nutrients targeted specifically by the WIC program. One limitation of the Rose, Habicht, and Devaney analysis was their failure to control for selection into the program. However, when Oliveira and Gundersen controlled for selection using a small subset of 180 children who lived in households in which someone other than the child was already
participating, they found that WIC participants still exhibited higher intakes of iron relative to nonparticipants (Oliveira and Gundersen, 2000).

Moving beyond the outcome of nutrient intake, Carlson and Senauer (2003) examined how child WIC participation influenced one measure of child health and well-being. Using data from the 1994 to 1998 NHANES, their analysis used ordered probit regression models to estimate the influence of child participation on a physician-reported measure of overall health. Interestingly, Carlson and Senauer found that children living in households that participated in WIC were more likely to be in excellent health (2003). One major limitation of this analysis is that it measures WIC participation at the household-level, so the child is not necessarily the recipient of the WIC benefits. Moreover, the study fails to properly control for the possibility of selection bias which could lead to over or under estimates of the effect of WIC.

More recently, Bitler and Currie (2004) utilized the 1996 and 2001 panels of the Survey of Income and Program Participation (SIPP) to examine how child WIC participation influences anthropometric, health, and health care utilization measures in children 4 to 6 years of age. Using the Medicaid income cutoff at the time of birth as an instrument, this study found that WIC participation at age 4 strongly decreased the probability of a child being classified as overweight\(^{36}\), but did not significantly influence the probability of being underweight. While this study found WIC effects with regard to body weight, the results of the instrumental variables approach found no discernible effect on measures of health limitations or health status (Bitler and Currie, 2004). Interestingly, unlike many WIC studies, the comparison group in this research is composed of households less than 3.5 times the federal poverty level which may result in comparisons to children who are more socioeconomically advantaged.

\(^{36}\) Body mass index (BMI) greater than the 85th percentile for gender and age
Interestingly, a developing body of literature has emerged that focuses on whether child WIC participation has spillover effects on non-targeted populations, particularly older children. One recent effort to examine WIC’s spillover effects used data from the 1988-1994 NHANES to determine whether age-ineligible children (age 5+), who live in WIC-participating families have better dietary intake than children in nonparticipating families (Ver Ploeg, 2009). The results indicate that age-ineligible children in WIC-participating families performed better on Healthy Eating Index scores than older children in nonparticipating families, finding that suggests substitution was occurring between targeted and non-targeted beneficiaries in the same family (Ver Ploeg, 2009). More recently, Woodward and Ribar (2011) utilized data from the 2002-2003 Child Development Supplement of the Panel Study of Income Dynamics (PSID) to explore the relationship between households’ participation in various food assistance programs, including WIC, and 10-17 year-old children’s intake of food items. The results indicate that WIC participation by other household members is associated with increased consumption of milk and cereal by the non-targeted children (Woodward and Ribar, 2011).

The instant study contributes to literature on WIC in several important ways. First, it adds to a very small body of research that examined whether child WIC participations results in measurable improvements in a child’s health and well-being. As the largest participant group, an important measure of programmatic effectiveness is whether the nutritional supplementation provided by WIC to young, eligible children results in better health. Second, this study includes important controls for selection bias by utilizing propensity score matching to estimate the impact of WIC on measures of child health and well-being. To my knowledge, this is the first paper use propensity score matching to examine the influence of WIC on the health of young children. Third, this research is conducted using a recent, nationally-representative dataset,
ensuring that the findings are timely. Finally, this research specifically examines medically-verified measures of BMI as health outcomes. Studying BMI is particularly important since reducing the levels of obesity in children is increasingly identified as an important goal of WIC (Bitler and Currie, 2004).

Data

NHANES

Data for this analysis are derived from the National Health and Nutrition Examination Survey (NHANES). Administered by the National Center for Health Statistics and the Centers for Disease Control and Prevention (CDC), the NHANES is designed to be nationally representative of the health and nutrition status of adults and children in the United States. After nearly 30 years of being conducted as a periodic survey, beginning in the 1999 collection year, the NHANES became a continuous annual survey with data publicly released every two years (e.g., 1999-2000). For purposes of this research, five, two-year cycles of data will be utilized which covers the period 1999-2008. The survey studies approximately 5,000 participants annually and includes an oversample for person 60 or older, Hispanics, and African-Americans.

Data for the NHANES are collected from a combination of interviews with the head-of-household, medical evaluations, medical histories, and laboratory tests. This research will utilize data collected through the NHANES household questionnaire and physical examination. The average response rates for the interview and examination portions of the survey vary slightly; however, for the survey years 1999-2008, the response rates are between 77 and 84

\[37\] The NHANES uses the term “household reference person”; however, in practice this person is often likened to the head-of-household. For purposes of this paper, the household reference person will be referred to as the head of household. In this sample, females account for 48 percent of heads-of-household and 52 percent are male.
Collectively, these individual files include information on demographic and socio-economic characteristics of the survey participant (WIC program participation, age, and gender), health condition, and physician-collected body measurements (e.g. height and weight).

Although it has not been frequently used to examine WIC participation, the NHANES is heavily utilized in the field of health and nutrition. For the purposes of this research, it is particularly appropriate since the NHANES includes a wide array of medically verified, non self-reported health outcomes. In addition, the survey includes data on a household’s poverty-to-income ratio and participation in other nutrition assistance programs like SNAP and Medicaid, which allows for the creation of an analytical sample that is restricted to the WIC eligible population. Also, the NHANES data used in this study is recent, and therefore, covers the time period after the policy changes standardizing WIC eligibility requirements and expanding Medicaid eligibility. Finally, in addition to child health and well-being, the survey also includes socioeconomic and demographic data on the survey child and the household which is necessary for examining factors influencing WIC participation.

Coding WIC Eligibility

As discussed previously, WIC eligibility is predicated on meeting three criteria: categorical eligibility, income or adjunctive eligibility, and a determination of nutritional risk by a qualified health professional. For purposes of this study, the categorically eligible group of interest is WIC children; thus, the NHANES variable that captures a respondent’s age in months is used to ensure that only children between the ages of 2 through 4 are included in the analysis (24-59 months). Income eligibility is determined using the NHANES variable delineating a

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38. Response rates for the biennial survey releases are available at: http://www.cdc.gov/nchs/nhanes/response_rates_CPS.htm
family’s poverty-to-income ratio. If the family’s poverty-to-income ratio is at or below 185 percent of the federal poverty level (PIR<1.85), the child is considered income-eligible for WIC. In addition, WIC eligibility is also conveyed adjunctively through participation in other means-tested transfer programs. Thus, children who live in families with incomes exceeding 185 percent of the federal poverty level, but who reported household participation in SNAP in the last 12 months or who reported that a child’s health insurance was paid for by Medicaid, were classified as eligible for WIC program participation.\(^{39}\)

Despite its utility, there are limitations to using the NHANES for coding WIC eligibility. First, the NHANES does not include data to assess whether a child is at nutritional risk. In practice, however, nearly all income-eligible individuals are determined to be at nutritional risk (Ver Ploeg and Betson, 2003). Second, the NHANES does not include a variable for participation in TANF, a program that conveys adjunctive eligibility for WIC. This could result in a child erroneously classified as ineligible for WIC if their household income is above 185 percent of the federal poverty level. However, given the stricter eligibility criteria associated with TANF, this is unlikely to be a problem. In addition, in some states, the income threshold for Medicaid is higher than 185 percent of the income-to-poverty ratio; however, due to the lack of geographic identifiers in the public-use version of the NHANES, it is not possible to account for this factor. Therefore, children living in states with higher eligibility thresholds who are adjunctively eligible for WIC through Medicaid participation but do not ultimately participate will be erroneously classified as ineligible for WIC. It is unlikely that failing to adjust for higher Medicaid eligibility thresholds will strongly influence the results of this study due to the

\(^{39}\) Ultimately, this sample included 61 children who were reported as WIC participants in the NHANES, but were ultimately coded as ineligible due to a failure to meet either income or adjunctive eligibility indicators. These children were excluded from the analysis since it is not possible to know why they are misclassified.
relatively small number of children it would affect.\textsuperscript{40} As of January 2008, only twelve states and the District of Columbia had Medicaid eligibility thresholds for children that exceeded the WIC threshold (Besharov and Call, 2009).\textsuperscript{41}

Analysis Sample

The combined 1999-2008 NHANES data sets yielded a total of 51,623 survey participants. Ultimately, the analysis sample used in this study is composed of 3,081 NHANES survey children ages 2 through 4. To be included in the analysis sample, five criteria must be met, with the number excluded provided in parentheses. First, the survey respondent must be a child between the age of 2 and 4 (45,477). Children under age 2 are excluded from this analysis because there is no consensus on the appropriate measures for body mass in very young children. Second, the child must have participated in both the interview portion of the survey and the medical exam to ensure the presence of child characteristics and measures of health and well-being (2,509). Third, information on income or adjunctive eligibility cannot be missing (350). In addition, a number of covariates had incomplete data resulting in an additional 194 respondents dropped from the analysis.\textsuperscript{42} Of these cases, 91 were dropped due to missing information about the head-of-household’s education. Finally, participation in the WIC program must be known (12). In this sample, the rate of child WIC participation among eligible participants is 48.9

\textsuperscript{40} In addition, sensitivity analyses were conducted which used an eligibility threshold of 250 percent of the federal poverty level. The results did not vary.

\textsuperscript{41} These twelve states include: Arkansas, Hawaii, Louisiana, Maryland, Minnesota, New Mexico, North Carolina, Ohio, Rhode Island, Vermont, Washington, Wisconsin, and the District of Columbia.

\textsuperscript{42} Additional analysis was conducted to compare the characteristics of children dropped due to missing data to children with non-missing data. A small number of statistically significant differences were identified. Children who were dropped from the analysis due to missing data were more likely to Black or Hispanic, Age two and age four, and more likely to live in households that had lived at the same residence for 10 or more years.
percent which is consistent with the 47.3 percent child participation rate reported by the Food and Nutrition Service (FNS) in 2007, the most recent estimate currently available (USDA, 2009).

**Methods**

**Conceptual Model**

The underlying theory behind this study is based on Gary Becker’s household production model (1965, 1976). Becker’s seminal theory on household behavior asserts that households combine market goods and time in household production functions to produce commodities that maximize their utility functions. In addition to many other applications, Becker’s theory has been extended to include the production of health (Grossman, 1972). In economic terms, health is a product of the household production function in which the household seeks to obtain a particular level of health. The desired level of health (utility-maximization) is produced with inputs of market goods which include time, medical care, and nutrition. Becker’s theory is particularly useful in this case because the WIC program is specifically designed to change the production of health in a household by altering the type of food consumed (Currie, 2003).

The Becker household model has served as the basis for numerous studies examining the health and nutrition status of children in both developed and developing countries (see Rosenzweig and Schultz, 1983; Behrman and Deolalikar, 1988; and Strauss and Thomas, 1998). Other research employing the household production model has found that maternal awareness of the importance of health and nutrition strongly influences the quality of a child’s diet (Variyam et al., 1999). Becker’s theory has also served as the basis for at least one study that specifically examines the WIC program. In their 2003 study, Carlson and Senauer employ a health production function to examine whether child WIC participation contributed to an improvement in child health, focusing on one measure of overall health (Carlson and Senauer, 2003).
Logistic Regression Model

Following an approach similar to Carlson and Senauer (2003), this study estimates this influence of child WIC participation on measures of child health and well-being using a health production function. The model is specified in the following manner:

\[ H = \alpha + \beta_1 W + \beta_2 X + \varepsilon \]

Where \( H \) is one of seven outcome measures of child health and well-being, \( \alpha \) is the constant, \( W \) is a binary indicator of WIC participation equal to 1 if the eligible, child participates in WIC and 0 if the child is an eligible nonparticipant, \( X \) represents a matrix of control variables for child, household, economic, and prenatal/at-birth characteristics that may influence measures of child health and well-being, and \( \varepsilon \) is the error term. In theory, WIC participation should improve the health and well-being of child participants by educating parents and caregivers on the importance of nutrition, providing referral services to other health professionals, and most importantly, facilitating the consumption of a healthy diet through the provision of nutritious food.

One standard methodological approach to examining the influence of child WIC participation on child health and well-being is multivariate regression—such an approach is employed in this study. Since the dependent variables of interest are binary, logistic regression analysis is used to compare the health and well-being of WIC child participants to their eligible, nonparticipating counterparts.

Measures of Child Health and Well-Being

In this analysis, the dependent variables represent seven dichotomous measures of child health and well-being. The first two measures of child health are self-reported by a parent or guardian. Indicators are included for whether the child is in excellent/very good health (compared to children in the good, fair, or poor health categories) and for fair/poor health
(compared to children in the excellent, very good or good health categories).\textsuperscript{43} In addition, indicators are included to assess whether a child is overweight, at-risk overweight, or normal weight based upon guidance provided by the CDC.\textsuperscript{44} Overweight is a binary variable with a value of 1 if the survey child is classified as overweight and a value of 0 if the child is not. The survey child is classified as overweight if his or her body mass index (BMI) (kg/m\textsuperscript{2}) is at or above the 95th percentile on the CDCs BMI-for-age percentile chart, given the child’s gender.

The next BMI measure is at-risk overweight, which is a binary variable with a value of 1 if the survey child is classified as at-risk overweight and a value of 0 if the child is not. The survey child is classified as at-risk overweight if his or her body mass index (BMI) (kg/m\textsuperscript{2}) is less than the 95th percentile and at or above the 85\textsuperscript{th} percentile, given the child’s gender and age. Finally, a binary indicator is included to capture whether the child is normal weight. A survey child is classified as normal weight if his or her body mass index (BMI) (kg/m\textsuperscript{2}) is greater than or equal to the 5\textsuperscript{th} percentile or less than the 85\textsuperscript{th} percentile, given the child’s gender and age. Heights and weights used to calculate BMI are not self-reported, but rather, are obtained by trained personnel during the Mobile Exam Center (MEC) component of the NHANES assessment which substantially increases the accuracy of the BMI measures.

Another commonly used indicator to capture child health is anemia. For purposes of this study, anemia is defined as having abnormally low hemoglobin given a child’s age and gender.\textsuperscript{45}

\textsuperscript{43} These categories are derived from a self-reported, five-point scale where one represents excellent health and five represents poor health. In this sample, very few children were rated in poor health; thus, the category is combined with fair health for analytic purposes. In addition, consistent with similar research, the categories for excellent and very good health were combined for analytic purposes since the distinction between the two categories is unclear. The results of the regression analyses without combining categories of general health are presented in Appendix B2.

\textsuperscript{44} An indicator for underweight was also considered, but ultimately not included in the analysis. Only 95 children in the primary analysis sample were identified as underweight. Additional sensitivity analyses indicated that WIC participation had no significant influence on the likelihood of being underweight.

\textsuperscript{45} Iron-deficient anemia was also examined as a possible outcome; however, due to the very low
Per CDC recommendations, children ages 2 to 4 are considered anemic if their hemoglobin level measured less than 11.1 g/dL (CDC, 1998). The measure for hemoglobin is routinely captured as a part of the complete blood count (CBC) work-up during the laboratory component of the NHANES. A final measure of health and well-being is an indicator for whether the survey child is limited in the amount or type of play activities he or she can engage in due to a physical, mental or emotional problem.  

Child WIC Participation

The key independent variable is a binary indicator that captures child WIC participation. Unlike some analyses of the WIC program which assess household-level WIC participation, this study specifically examines the receipt of benefits by the child. The WIC participation variable is created based on responses to questions about whether the child received WIC benefits in the previous 12 month period and whether the child is currently receiving WIC benefits. Children who responded affirmatively to both questions are classified as participants. Those who did not receive WIC benefits in the previous 12 months and who are not currently receiving benefits are classified as nonparticipants. Unfortunately, the NHANES does not capture participation information during the entire period of child eligibility; therefore, it is possible that this study

46. This question is derived from the NHANES Physical Functioning Questionnaire. The exact wording is as follows, “The next set of questions is about limitations caused by any long-term physical, mental or emotional problem or illness. Please do not include temporary conditions, such as a cold. Is {SP} limited in the kind or amount of play activities (he/she) can do because of a physical, mental or emotional problem?”

47. For example, if someone in the household receives WIC benefits, but the survey child does not, the child is classified as an eligible, nonparticipant.

48. The question about receiving WIC in the prior 12 months is worded as follows: “Has {Sample Person} received benefits from the WIC program in the last 12 months?” The question about current WIC receipt is as follows: “Is {Sample Person} now receiving benefits from the WIC program?”
erroneously classifies children as nonparticipants who received WIC outside the 12 month period prior to the survey being administered.

Covariates

The NHANES contains numerous child-level and household-level measures that are reported by the survey participant, and in the case of children, these measures are reported by a proxy person. In many instances, the proxy will be the mother, but it is not possible to know the exact relationship between the proxy and the survey child. The NHANES also contains numerous indicators of economic well-being and maternal/prenatal health behaviors. The child, household, economic, and prenatal/at-birth health variables are used in this analysis to control for factors found in the existing literature to be associated with WIC program participation and health outcomes. In addition to the control variables, the NHANES contains numerous measures of child health and well-being which are used as dependent variables.

This study includes a number of child, household, and economic variables that previous research suggests may be important in both the decision to participate in WIC as well as child health and well-being (Gundersen and Oliveira, 2000; Carlson and Senauer, 2003; Bitler and Currie, 2004). In terms of child-level control variables, a child’s race/ethnicity is captured by using indicators for Non-Hispanic White, Hispanic, Non-Hispanic Black, and Other, which includes races like Asian, Native American, etc. (Non-Hispanic White is the reference category). In addition to race/ethnicity, three dummy indicators are used to capture a child’s age in years. These variables are derived from a NHANES survey question that ascertains the child’s age in months at the time of the survey (age 4 is the reference category).

49. Since the public release version of the NHANES does not include state identifiers, it is not possible to control for state-level policy characteristics. However, the literature examining the influence of WIC program participation on child health provides little theoretical basis for including such variables.
Household-level characteristics include demographic information about the household reference person (referred to as the head-of-household for purposes of this study) as well as information about duration at current residence and family structure. An indicator is included for whether the head-of-household is married and a continuous variable captures the age of the head-of-household. Education is captured with four dichotomous indicators: less than high school diploma, high school diploma, some college, and college degree (college degree is the omitted category). Because being US born may influence the decision to take-up WIC as well as health and well-being, a binary indicator variable is included to capture whether the survey child resides with a head-of-household who is US born. To capture the size of the household, a continuous variable is included to capture the number of people in the household.\(^{50}\) In addition, indicators are included to capture a household’s duration at their current residence: less than 1 year and ten or more years at the household’s current residence. Further, three variables are included which attempt to control for maternal prenatal behaviors and at-birth health status that might influence the participation decision and health and well-being. Indicators are included for whether the mother smoked during her pregnancy, whether the survey child weighed less than 2,500 grams at birth, and whether the child is breastfed.

To capture the economic well-being of a household, a continuous variable for poverty-to-income ratio is included. In addition, because home ownership may act as a proxy for economic well-being, an indicator is created to capture whether the child lives in a home that is owned or being purchased. Participation in other assistance programs, which may influence participation and health and well-being, is captured by including dichotomous indicators for Medicaid and SNAP participation. Medicaid participation is determined by the response to the NHANES 50. The NHANES does not allow for a determination of the number of children versus the number of adults in a given household.
health insurance utilization questionnaire which asks whether the survey child is currently covered by Medicaid ("{Is Sample Person} covered by Medicaid?"). Unlike Medicaid receipt, which is measured at the child level, SNAP participation is captured at the household level and is based on a survey question which asks whether anyone in the household is authorized to receive SNAP benefits in the last 12 months ("[In the last 12 months], were {you/you or any members of your household} authorized to receive Food Stamps [which includes a food stamp card or voucher, or cash grants from the state for food]? ").\(^{51}\)

Selection Bias

While extremely useful, one problem with relying on regression techniques to estimate the effects of WIC participation on child health and well-being is that it may not adequately control for selection bias. Selection bias is the concern that participants differ from nonparticipants in ways that are unmeasured and also influence the outcome of interest, a pervasive issue in WIC research (Joyce et al., 2005). Ideally, the most credible approach for measuring the effectiveness of child WIC participation on child health and well-being is a randomized experiment where children are randomly assigned to receive the treatment, WIC benefits, or assigned to a control group where they do not receive benefits. If assignment is truly random, the treatment and control groups would not differ on the unobserved characteristics that have the potential to affect the outcome of interest. Due to practical considerations, however, most studies of the WIC program necessarily rely on statistical comparisons between program participants and eligible, nonparticipants, which makes the identification of treatment effects a challenge (see Besharov and Germanis, 2001; Currie, 2003).

\(^{51}\) Note: The Food Stamp Program in now referred to as SNAP. Beginning with the 2007-2008 data collection, the NHANES no longer collects individual-level information on SNAP receipt; thus, household-level participation is utilized for this research.
The presence of selection bias may cause researchers to overstate or understate improvements in the health and well-being of children. The presence of selection bias can lead to an underestimate of WIC’s effect on child health and well-being if there is negative selection into WIC. For example, if WIC successfully targets children who are the poorest of the poor, then participants may be more likely to have negative health outcomes even in the absence of WIC benefits. Alternatively, if children who participate in WIC come from families that are more motivated, more knowledgeable, or more concerned about health, then there may be positive selection. Positive selection into WIC would likely lead to an overestimate of the effect of WIC on health outcomes.

Numerous studies find evidence of selection bias in the WIC program; however, given the limited research examining children, most of these studies examine the selection issue in terms of prenatal WIC. For example, in their study of delayed participation among prenatal WIC participants, Tiehen and Jacknowitz find evidence of negative selection into WIC on observable characteristics like assistance program participation, low household income and assets, and the absence of private health insurance (Tiehen and Jacknowitz, 2008). Similarly, Bitler and Currie find evidence of strong negative selection among Medicaid mothers who participate in WIC in terms of education, age, marital status, paternal involvement with the birth, smoking, obesity, use of public assistance last year, and previous negative birth outcomes (Bitler and Currie, 2005). Looking specifically at WIC children, Burstein et al. find that child participants lack mothers with good financial skills and effective coping mechanisms (Burstein et al., 2000). In addition, they also find that WIC child participants are more likely to be low birthweight and born to women who smoked or drank during pregnancy, which strongly suggests that child WIC participants are negatively selected into WIC.
Unfortunately, randomization is not feasible in a voluntary program like WIC; thus, researchers must employ a variety of methodological techniques to address the problems that arise when using observational data like the NHANES. Multivariate regression that controls for as many observable characteristics as possible can be an effective method of addressing some of the concerns over selection. This is the approach followed in the logistic regression analysis in the present study. However, researchers rarely have access to the data that would be necessary to rule out selection problems completely, so this method may still generate biased coefficients. As noted by Gibson-Davis and Foster (2006), regression is not without its problems which include an assumption that the effect of the program is constant. In reality, it is unlikely that the effect of WIC is the same for all participants.

Propensity Score Matching

Contemporary advances in non-experimental design methodology have provided an additional option for evaluating nonrandomized programs, minimizing some of the problems encountered in using multivariate regression approaches (Gibson-Davis and Foster, 2006). One alternative approach is propensity score matching. Propensity score matching is an analytic method developed by Rosenbaum and Rubin (1983, 1984) to reduce the possibility of selection bias in observational data. In simple terms, this approach matches treated and untreated subjects on the propensity score, defined as the conditional probability of assignment to a treatment group given a vector of observed variables (Rosenbaum and Rubin, 1983). In theory, propensity score matching minimizes the risk of selection bias by approximating a randomized experiment, providing a more rigorous estimate of the true effect of child WIC participation on child health and well-being (Rosenbaum & Rubin, 1983).52 Used heavily in research examining labor

52. Since PSM theoretically approximates a randomized experiment, this method is thought to also reduce
markets (Heckman and et al., 1997; Dehejia and Wahba, 1999), the method has also been widely utilized in the field of social welfare research to examine education policy (Hansen, 2004; Hong and Raudenbush, 2005; and Wilde and Hollister, 2007), employment and earnings policy (Yoshikawa et al., 2003), and nutrition assistance policy in terms of the SNAP program (Gibson-Davis and Foster, 2006). In addition, propensity score matching has been used in research examining early and late prenatal WIC take-up (Lazariu-Bauer et al., 2004) as well as the influence of WIC on infant health (Foster et al., 2010).

To obtain the propensity scores, this approach first estimates a logistic regression model that predicts the treatment, in this case child WIC participation, and accounts for covariates related to both WIC participation and child health and well-being. The predicted probability is known as the propensity score. Cases are then matched on their propensity scores to estimate the effect of WIC participation on a given measure of child health and well-being. In the present study, the propensity score is used to match children ages two through four who did and did not receive WIC in the previous 12 months. One advantage of PSM over regression is that the coefficients report the average treatment effect on the treated (ATT). The ATT is the mean difference in health outcomes between WIC participants and nonparticipants, representing the effect of WIC participation on measures of child health and well-being among children who did and did not participate in WIC, but who have similar propensities for participating based on observable characteristics. Unlike regression, it does not assume that the benefits of WIC are the same for all recipients.

bias arising from endogeneity. Numerous studies have employed PSM to reduce endogeneity bias (Frisco, et al., 2007; Mocan and Tekin, 2006).

53. This analysis uses psmatch2, a user-developed program by Leuven and Sianesi (2003), which can be installed in Stata to implement propensity score matching. The program employs a number of common matching algorithms including nearest neighbor, caliper, kernel, and local linear matching.
It is standard practice to employ multiple matching algorithms when utilizing propensity score matching techniques for analytic purposes. Evaluating the robustness of the estimates across algorithms increases the reliability of the results by illustrating that outcomes do not depend on a particular specification (Heinrich et al., 2010). Numerous matching algorithms are available that estimate the ATT and three such algorithms are applied in this study.

One of the most common and easily understood matching algorithms is nearest neighbor matching (Dehaja and Wahba, 2002). This algorithm matches each treated child to a control child with the smallest distance in terms of propensity score from the treated child. Nearest neighbors can be selected in two ways: with replacement and without replacement (Heinrich et al., 2010). Matching with replacement allows each treated case to be matched to the nearest control case even if the control case has been previously selected. Nearest neighbor matching with replacement has the advantage of matching the most similar cases thereby reducing bias. The trade-off, however, is this approach excludes more cases from the sample which increases variance in the estimates (Smith and Todd, 2005). Alternatively, nearest neighbor matching can be conducted without replacement, meaning that each treatment case is matched to only one case in the control group. The disadvantage to matching without replacement is that it tends to increase bias in the estimates because it may require treatment cases to be matched to control cases that are ultimately quite different in propensity score. Because of this concern, this study reports results using nearest neighbor with replacement in its primary results section (see Appendix B1 for results using nearest neighbor without replacement).

Another matching algorithm that estimates the ATT is kernel matching. This approach is distinct from nearest neighbor matching in that it identifies matches using multiple control cases. Kernel matching uses the weighted average of all cases in the control group to match to
individual cases in the treatment group. In addition, control cases that are closer in propensity score to the treatment case are given more weight than those cases that are further away (Smith and Todd, 2005). Like the bias/efficiency tradeoff seen with nearest neighbor, kernel matching has the advantage of using all of the control cases thereby reducing the variance of the matching. However, it also increases bias since some of the matches are of poor quality (Smith and Todd 2005). In kernel matching, the key parameter is the bandwidth. As noted by DiNardo (2002), smaller bandwidths reduce the possibility of bias, and in general, one should err on the side of selecting a bandwidth that is too small rather than too large. Thus, this study reports kernel matching results using the default bandwidth of .06 (see Appendix B1 for kernel matching results using different bandwidths).

Despite its utility, propensity score matching is subject to a number of limitations. Two primary limitations outlined by Gibson-Davis and Foster (2006) are reliance on the ignorability/unconfoundedness assumption and the common support limitation. Ignorability (Rosenbaum and Rubin, 1983), also known as unconfoundedness (Imbens, 2004), refers to the assumption that by controlling for differences in a set of measurable and observable covariates, all biases are removed in comparisons of the treated and untreated in terms of outcomes. If unobserved characteristics influence both the use of WIC and child health and well-being, the ignorability assumption is violated, meaning that the treatment and control groups may differ in unobservable ways, leading researchers to erroneously conclude that any differences are the result of the treatment rather than the unobserved characteristics (Gibson-Davis and Foster, 2006). There is no formal test to assess whether the ignorability assumption is true. Instead, it is a theoretical assumption that may be invoked based upon programmatic knowledge and the informational richness of the data (Caliendo and Kopeinig, 2008).
In addition to the ignorability/unconfoundedness assumption, propensity score matching can be estimated only for the area of overlap between the propensity scores, also known as the common support region (Imbens, 2004; Smith and Todd, 2005). Propensity score matching cannot estimate the average treatment effect for cases outside the common support region, where no comparable person can be found in the control group. As explained by Gibson-Davis and Foster (2006), such persons would have propensity scores equal to either one or zero because all people with the same slate of observable characteristics chose or did not choose treatment. For purposes of this study, all analysis is conducted on cases within the common support region.\(^{54}\)

A final limitation of propensity score matching is related to the NHANES survey data itself. The NHANES is a complex multi-stage probability sample which, properly weighted, is intended to be nationally representative. Some issues arise, however, when utilizing the NHANES for propensity score matching. For example, NHANES recommends using Taylor-series linearized standard error for analysis; however, when using propensity score matching, bootstrapped standard errors are generally preferred.\(^{55}\) In addition, the second stage of propensity score matching resamples the data by eliminating cases outside the common support region. It is unclear, then, whether the NHANES statistics remain nationally representative after the matching is complete. However, given the very small number of cases eliminated, it is unlikely to affect representativeness.

**Results**

Table 3.1 provides summary statistics for all NHANES children ages 2 through 4. A quick glance at Table 3.1 yields a strong picture of negative selection into the program. This is

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54. Eight cases were outside the region of common support.

55. Both methods of calculating standard errors were examined. The results were not sensitive to standard error specification.
true for comparisons between eligible and ineligibles as well as comparisons between WIC participants and eligible, nonparticipants. Table 3.1 results particularly indicate stark differences between the WIC eligible sample and the ineligible sample. On a broad array of measures, children who are ineligible for WIC are more advantaged than children who are eligible for the program. Children who are ineligible for WIC are predominately Non-Hispanic White, live in smaller, stable households headed by more educated people. In terms of prenatal and at-birth health indicators, ineligible children are better off. WIC-ineligible children are less likely to be low birthweight at their birth (9.5 percent compared to 13.5 percent), less likely to be born to a mother who smoked during her pregnancy (11 percent compared to 20.6 percent), and much more likely to be breastfed (77.6 percent compared to 59.1 percent). In addition, children who are WIC-ineligible are economically better off. Compared to eligible children, they evince much higher poverty-to-income ratios (3.665 compared to 1.028), are far more likely to own their own home (80.6 percent compared to 40.7 percent), and, inherent in their status as WIC ineligible, they do not participate in other assistance programs. Finally, in terms of child well-being, Table 3.1 indicates that WIC-ineligible children are healthier. These children are significantly more likely to be reported in excellent/very good health—89.3 percent compared to 72.7 percent in the eligible sample. WIC-ineligible children are less likely to be reported in fair/poor health (1.2 percent compared to 5.9 percent). These children are less likely to be overweight (7.2 percent compared to 10.1 percent), more likely to be normal weight, and they are less likely to report limitations in the amount or type of play due to a physical or emotional problem (1.4 percent compared to 2.8 percent).

In contrast, the results in Table 3.1 demonstrate somewhat fewer statistically significant differences between eligible children who participated in WIC and other eligible children who
Table 3.1. Characteristics of Children by Eligibility and Participation Status: Proportions and Means

<table>
<thead>
<tr>
<th>Child characteristics</th>
<th>WIC ineligible</th>
<th>WIC eligible</th>
<th>WIC participants</th>
<th>Eligible non-participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hispanic, White</td>
<td>0.724*</td>
<td>0.429</td>
<td>0.331+</td>
<td>0.504</td>
</tr>
<tr>
<td>Non-Hispanic, Black</td>
<td>0.074*</td>
<td>0.213</td>
<td>0.227</td>
<td>0.202</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.131*</td>
<td>0.298</td>
<td>0.377+</td>
<td>0.237</td>
</tr>
<tr>
<td>Other race</td>
<td>0.071</td>
<td>0.061</td>
<td>0.066</td>
<td>0.057</td>
</tr>
<tr>
<td>Age 2</td>
<td>0.314</td>
<td>0.336</td>
<td>0.369+</td>
<td>0.311</td>
</tr>
<tr>
<td>Age 3</td>
<td>0.300</td>
<td>0.336</td>
<td>0.328</td>
<td>0.342</td>
</tr>
<tr>
<td>Age 4</td>
<td>0.386</td>
<td>0.328</td>
<td>0.303+</td>
<td>0.347</td>
</tr>
<tr>
<td>Household characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married head-of-household</td>
<td>0.876*</td>
<td>0.522</td>
<td>0.506</td>
<td>0.535</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>35.84*</td>
<td>33.234</td>
<td>32.716</td>
<td>33.632</td>
</tr>
<tr>
<td>Less than HS diploma</td>
<td>0.067*</td>
<td>0.390</td>
<td>0.430+</td>
<td>0.359</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.205*</td>
<td>0.280</td>
<td>0.272</td>
<td>0.287</td>
</tr>
<tr>
<td>Some college</td>
<td>0.310*</td>
<td>0.256</td>
<td>0.255</td>
<td>0.256</td>
</tr>
<tr>
<td>College degree</td>
<td>0.418*</td>
<td>0.075</td>
<td>0.044+</td>
<td>0.098</td>
</tr>
<tr>
<td>Born in the US</td>
<td>0.841*</td>
<td>0.721</td>
<td>0.644+</td>
<td>0.779</td>
</tr>
<tr>
<td>Household size</td>
<td>4.201*</td>
<td>4.746</td>
<td>4.904+</td>
<td>4.625</td>
</tr>
<tr>
<td>Family lived in home &lt; 1 yr</td>
<td>0.161*</td>
<td>0.262</td>
<td>0.269</td>
<td>0.256</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.101</td>
<td>0.078</td>
<td>0.082</td>
<td>0.075</td>
</tr>
<tr>
<td>Prenatal/at-birth characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.095*</td>
<td>0.135</td>
<td>0.141</td>
<td>0.130</td>
</tr>
<tr>
<td>Mother smoke prenatally</td>
<td>0.110*</td>
<td>0.206</td>
<td>0.194</td>
<td>0.215</td>
</tr>
<tr>
<td>Breastfed</td>
<td>0.776*</td>
<td>0.591</td>
<td>0.575</td>
<td>0.603</td>
</tr>
<tr>
<td>Economic well-being</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family poverty-to-income ratio</td>
<td>3.665*</td>
<td>1.028</td>
<td>0.915+</td>
<td>1.115</td>
</tr>
<tr>
<td>SNAP receipt past 12 months</td>
<td>0.000*</td>
<td>0.437</td>
<td>0.548+</td>
<td>0.351</td>
</tr>
<tr>
<td>Medicaid receipt by the child</td>
<td>0.000*</td>
<td>0.495</td>
<td>0.627+</td>
<td>0.394</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>0.806*</td>
<td>0.407</td>
<td>0.355+</td>
<td>0.447</td>
</tr>
<tr>
<td>Health and well-being</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child in excellent or very good health</td>
<td>0.893*</td>
<td>0.727</td>
<td>0.688</td>
<td>0.757</td>
</tr>
<tr>
<td>Child in fair or poor health</td>
<td>0.012*</td>
<td>0.059</td>
<td>0.073</td>
<td>0.047</td>
</tr>
<tr>
<td>Child is overweight</td>
<td>0.072*</td>
<td>0.101</td>
<td>0.082</td>
<td>0.115</td>
</tr>
<tr>
<td>Child is at-risk overweight</td>
<td>0.078</td>
<td>0.099</td>
<td>0.125+</td>
<td>0.079</td>
</tr>
<tr>
<td>Child normal weight</td>
<td>0.809*</td>
<td>0.752</td>
<td>0.749</td>
<td>0.754</td>
</tr>
<tr>
<td>Child has anemia</td>
<td>0.026</td>
<td>0.030</td>
<td>0.036</td>
<td>0.025</td>
</tr>
<tr>
<td>Child limited in amount/type of play</td>
<td>0.014*</td>
<td>0.028</td>
<td>0.034</td>
<td>0.023</td>
</tr>
</tbody>
</table>

Sample Size 998 2,083 1,018 1,065

Note: All statistics are weighted.

* indicates that the value is significantly different from eligibles at the 5 percent level using a two-tailed test.
+ indicates that the value is significantly different from eligible nonparticipants at the 5 percent level.
did not participate in the program. Looking at comparisons of means and proportions between child WIC participants and eligible, nonparticipating children, these findings indicate that differences persist in terms of race, level of education, US born, household size, and all measures of economic well-being. Importantly, these differences strongly suggest that WIC participants are worse off than other low-income, eligible children who did not participate in the program.

Only 33.1 percent of child WIC participants are Non-Hispanic, White compared to 50.4 percent among eligible nonparticipants. Child WIC participants are also younger than eligible nonparticipants. For example, 36.9 percent of WIC participants are 2 years of age while only 31.1 percent of eligible nonparticipants are. Child WIC participants live in households that are less educated. In fact, 43.0 percent of child WIC participants live in households where the head-of-household does not have a high school diploma compared to 35.9 percent among eligible, nonparticipants. Similarly, 4.4 percent of WIC children live in households where the head-of-household has a college degree compared to nearly 10 percent among eligible, nonparticipating children. Child WIC participants are less likely to live with US born heads-of-household and more likely to live in large households. Child WIC participants are also more likely to live in households that have lower poverty-to-income ratios, participate in SNAP and Medicaid, and they are less likely to own their home.

Overall, many of the differences seen between ineligible children and eligible children persist in the comparisons between WIC participants and eligible nonparticipants. However, two sets of characteristics defy this trend: prenatal/at-birth health variables and measures of child well-being. Unlike the differences that exist between ineligible children and eligible children, there are no statistically significant differences between WIC participants and eligible, nonparticipants in terms of being low birthweight, having a mother who smoked prenatally, or
being breastfed. In addition, child WIC participants demonstrated no statistically significant differences between their eligible, nonparticipating counterparts on any of the measures of child health and well-being with the exception of one outcome. WIC participants were more likely to be at-risk overweight than eligible, nonparticipants (12.5 percent compared to 7.9 percent).

Table 3.2 displays the results of the logit regression analysis estimating the influence of child WIC participation on measures of child well-being.\textsuperscript{56} Representing separate regressions, Columns 1 through 7 characterize each of the seven dependent variables capturing child health and well-being. In each case, the key independent variable is a measure of child WIC participation and additional covariates are included to control for certain child-level, household-level, economic, and prenatal/at-birth characteristics. Coefficients are reported as odds ratios. Odd ratios above one mean that the measure of health and well-being is more likely; while odds ratios below one indicate that the measure of health and well-being is less likely. For example, in column 1, children who are Non-Hispanic, Black are significantly less likely than Non-Hispanic, Whites to report being in excellent/very good health, conditional on age, education, and certain household, economic and prenatal/at-birth characteristics. In general, the key finding in Table 3.2 is that child WIC participants are not statistically different from eligible, nonparticipants on measures of child well-being.\textsuperscript{57} This finding holds across all measures of child-well-being including measures of overall health, body mass, anemia, and limitations in physical activity due to physical, mental or emotional problems.

\textsuperscript{56} Models were also run without applying NHANES sample weights. Results did not substantively change (e.g. no statistically significant differences).

\textsuperscript{57} Given the number of independent variables, there is some concern that possible collinearity may be obscuring the influence of the key independent variable, WIC participation, on the dependent variables capturing health and well-being. However, when regressions were limited to the bivariate relationship between WIC participation and health outcomes only, the results remained unchanged. No statistically significant relationships were observed.
Table 3.2. Estimating the Influence of WIC Participation on Child Health and Well-Being: Odds Ratios

<table>
<thead>
<tr>
<th>Child characteristics</th>
<th>Excellent/ good health (I)</th>
<th>Fair/poor health (II)</th>
<th>Overweight (III)</th>
<th>At-risk overweight (IV)</th>
<th>Normal weight (V)</th>
<th>Anemia (VI)</th>
<th>Limited play activities (VII)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIC Participant</td>
<td>0.999</td>
<td>1.199</td>
<td>0.742</td>
<td>1.282</td>
<td>0.960</td>
<td>1.097</td>
<td>1.414</td>
</tr>
<tr>
<td>Non-Hispanic, Black</td>
<td>0.562**</td>
<td>1.102</td>
<td>1.285</td>
<td>1.129</td>
<td>0.870</td>
<td>6.567*</td>
<td>1.033</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.444**</td>
<td>1.183</td>
<td>1.890*</td>
<td>1.369</td>
<td>0.750</td>
<td>3.178</td>
<td>1.446</td>
</tr>
<tr>
<td>Other race</td>
<td>0.337**</td>
<td>2.664</td>
<td>0.733</td>
<td>0.925</td>
<td>1.161</td>
<td>3.117</td>
<td>2.794*</td>
</tr>
<tr>
<td>Age 2</td>
<td>1.282*</td>
<td>0.664</td>
<td>0.332**</td>
<td>0.969</td>
<td>1.613**</td>
<td>2.996**</td>
<td>0.703</td>
</tr>
<tr>
<td>Age 3</td>
<td>1.218+</td>
<td>1.315</td>
<td>0.522**</td>
<td>1.160</td>
<td>1.069</td>
<td>0.745</td>
<td>0.603+</td>
</tr>
<tr>
<td>Household characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married head-of-household</td>
<td>1.159</td>
<td>0.752</td>
<td>1.020</td>
<td>1.343</td>
<td>0.881</td>
<td>0.459+</td>
<td>0.594</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>0.995</td>
<td>0.981</td>
<td>1.013</td>
<td>1.003</td>
<td>0.985*</td>
<td>0.984</td>
<td>1.030*</td>
</tr>
<tr>
<td>High school diploma</td>
<td>1.023</td>
<td>0.445*</td>
<td>0.768</td>
<td>1.378</td>
<td>1.059</td>
<td>1.086</td>
<td>1.744+</td>
</tr>
<tr>
<td>Some college</td>
<td>1.082</td>
<td>0.862</td>
<td>0.832</td>
<td>0.759</td>
<td>1.414*</td>
<td>0.819</td>
<td>1.530</td>
</tr>
<tr>
<td>College degree</td>
<td>1.085</td>
<td>0.434</td>
<td>0.753</td>
<td>0.832</td>
<td>1.319</td>
<td>1.625</td>
<td>2.044</td>
</tr>
<tr>
<td>Born in the US</td>
<td>1.707**</td>
<td>0.609</td>
<td>0.630</td>
<td>1.211</td>
<td>1.247</td>
<td>0.413+</td>
<td>2.318+</td>
</tr>
<tr>
<td>Household size</td>
<td>0.950</td>
<td>0.922</td>
<td>0.844*</td>
<td>1.000</td>
<td>1.095+</td>
<td>1.072</td>
<td>0.960</td>
</tr>
<tr>
<td>Family lived in home &lt; 1 yr</td>
<td>0.903</td>
<td>0.907</td>
<td>0.828</td>
<td>0.933</td>
<td>1.079</td>
<td>0.850</td>
<td>1.895+</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>1.250</td>
<td>1.360</td>
<td>3.048**</td>
<td>0.768</td>
<td>0.650</td>
<td>0.099*</td>
<td>0.709</td>
</tr>
<tr>
<td>Prenatal/at-birth characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.794</td>
<td>2.098*</td>
<td>0.700</td>
<td>0.556+</td>
<td>1.149</td>
<td>1.038</td>
<td>2.100+</td>
</tr>
<tr>
<td>Mother smoke prenatally</td>
<td>0.866</td>
<td>1.404</td>
<td>1.371</td>
<td>1.123</td>
<td>1.045</td>
<td>0.966</td>
<td>1.133</td>
</tr>
<tr>
<td>Breastfed</td>
<td>1.256+</td>
<td>1.133</td>
<td>0.832</td>
<td>0.991</td>
<td>1.238</td>
<td>0.494*</td>
<td>0.933</td>
</tr>
<tr>
<td>Economic well-being</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family poverty-to-income ratio</td>
<td>1.220+</td>
<td>0.640+</td>
<td>0.839</td>
<td>1.156</td>
<td>0.965</td>
<td>0.948</td>
<td>1.162</td>
</tr>
<tr>
<td>SNAP receipt past 12 months</td>
<td>0.886</td>
<td>0.717</td>
<td>1.232</td>
<td>1.077</td>
<td>0.823</td>
<td>0.933</td>
<td>1.447</td>
</tr>
<tr>
<td>Medicaid receipt by the child</td>
<td>0.963</td>
<td>1.481</td>
<td>0.693+</td>
<td>1.245</td>
<td>1.170</td>
<td>1.109</td>
<td>1.098</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>1.078</td>
<td>0.517+</td>
<td>0.691</td>
<td>0.685</td>
<td>1.312</td>
<td>1.670</td>
<td>0.793</td>
</tr>
</tbody>
</table>

Note: Estimates are weighted. Taylor linearized standard errors were used to compute the t-statistic. Reference categories include child is non-Hispanic White, child is age 4, and household reference person has a college degree.

** Significant at 1 percent; * Significant at 5 percent; + Significant at 10 percent
Overall, the results from Table 3.2 find no positive effects from child WIC participation on measures of overall health, play activity, or anemia. Importantly, however, child WIC participation was not associated with an increased likelihood of being overweight or at-risk overweight. This is noteworthy because some researchers have raised concerns about whether program participation might be correlated with increased instances of obesity in children (Ver Ploeg, 2009).

While the results presented here are certainly suggestive, they are far from conclusive. Multivariate regression techniques are useful in controlling for potentially confounding variables, there is still concern over the effect of any unmeasured variables that are correlated with both WIC participation and child well-being. In addition, regression is dependent on properly specifying functional form. A great deal of WIC research relies on regression approaches that assume the effect of WIC is the same for all participants, which may not be the case. Importantly, those participants who are most in need may benefit from WIC differently than those who are less in need. In contrast, propensity score matching yields estimates on the average treatment effect on the treated (ATT) which, unlike regression, accounts for the differential effects of WIC on recipients.

The first step in propensity score matching is to identify the variables associated with child WIC participation—specifying the child participation regression model. The results of this effort are provided in Table 3.3. The propensity score is estimated using measures of child race/ethnicity, child age, and head-of household’s marital status, age, education level and whether they were US born. Measures are also included for household size, duration at current residence, and economic well-being (PIR, SNAP receipt, Medicaid receipt, and home ownership). In addition, certain prenatal/at-birth characteristics are included which may
Table 3.3. First Stage Propensity Score Matching: A Child WIC Participation Model

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Coefficient</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic, Black</td>
<td>0.229</td>
<td>0.200</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.576**</td>
<td>0.187</td>
</tr>
<tr>
<td>Other race</td>
<td>0.189</td>
<td>0.301</td>
</tr>
<tr>
<td>Age 2</td>
<td>0.340*</td>
<td>0.151</td>
</tr>
<tr>
<td>Age 3</td>
<td>0.262+</td>
<td>0.152</td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married head-of-household</td>
<td>0.182</td>
<td>0.138</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>-0.014+</td>
<td>0.008</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.122</td>
<td>0.157</td>
</tr>
<tr>
<td>Some college</td>
<td>0.294</td>
<td>0.183</td>
</tr>
<tr>
<td>College degree</td>
<td>-0.169</td>
<td>0.252</td>
</tr>
<tr>
<td>Born in the US</td>
<td>-0.543**</td>
<td>0.160</td>
</tr>
<tr>
<td>Household size</td>
<td>0.105*</td>
<td>0.049</td>
</tr>
<tr>
<td>Family lived in home &lt; 1 yr</td>
<td>-0.050</td>
<td>0.142</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.479</td>
<td>0.299</td>
</tr>
<tr>
<td><strong>Prenatal/at-birth characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low birthweight</td>
<td>-0.150</td>
<td>0.176</td>
</tr>
<tr>
<td>Mother smoke prenatally</td>
<td>0.019</td>
<td>0.153</td>
</tr>
<tr>
<td>Breastfed</td>
<td>-0.090</td>
<td>0.141</td>
</tr>
<tr>
<td><strong>Economic well-being</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family poverty-to-income ratio</td>
<td>-0.207+</td>
<td>0.108</td>
</tr>
<tr>
<td>SNAP receipt, last 12 months</td>
<td>0.564**</td>
<td>0.172</td>
</tr>
<tr>
<td>Medicaid receipt by the child</td>
<td>0.716**</td>
<td>0.163</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>-0.197</td>
<td>0.158</td>
</tr>
</tbody>
</table>

Observations 2,083

Note: Coefficients based on logistic regression. Estimates are weighted. Taylor Linearized standard errors are reported.

** Significant at 1 percent; * Significant at 5 percent; + Significant at 10 percent

influence the decision to take-up WIC. These measures were specifically chosen based on previous studies and theory, and the results in Table 3.3 are consistent with previous research on the determinants of child WIC participation.
The first stage results in Table 3.3 indicate that children who participate in WIC are more likely to be Hispanic (Non-Hispanic, White is the reference group), younger in age (age 4 if the reference group), and more like to live in households headed by younger people. Child participants are less likely to live in households headed by someone who is US born and are somewhat more likely to live in larger households. In addition, Table 3.3 illustrates that child WIC participation is strongly related to economic circumstance. Child WIC participants live in households that are more likely to participate in SNAP or Medicaid and households that exhibit lower poverty-income ratio.

The next stage of propensity score matching is to calculate the average difference in measures of child well-being between each treated unit and its neighbor using selected matching algorithms. Table 3.4 presents the results of propensity score matching on the seven binary outcome measures for child health and well-being using the matching algorithms for nearest neighbor with replacement as well as kernel matching (bandwidth=.06). The difference column reports the average treatment effect on the treated (ATT) or the health outcome the child participant would theoretically have, but for receiving WIC. When evaluating the results of propensity score matching, researchers look for consistent results across the various matching algorithms employed.

In general, the results presented in Table 3.4 find no statistically significant differences between the treated units and control units on six of the seven measures of child health and well-being. In terms of overall health, at-risk overweight, normal weight, limits on play activities, and anemia, children who participate in WIC are no better or worse off compared to other eligible children with the same propensity to participate in the program. However, one significant difference emerges in the nearest-neighbor matching algorithm. Child WIC participants are 5.3
Table 3.4. Average Treatment Effect on the Treated (ATT): Estimates of the Influence of WIC Participation on Child Health and Well-Being

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Control</th>
<th>Difference</th>
<th>SE</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearest Neighbor with Replacement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child is in excellent/very good health</td>
<td>0.666</td>
<td>0.697</td>
<td>-0.031</td>
<td>0.036</td>
<td>-0.861</td>
</tr>
<tr>
<td>Child is in fair/poor health</td>
<td>0.073</td>
<td>0.068</td>
<td>0.005</td>
<td>0.018</td>
<td>0.278</td>
</tr>
<tr>
<td>Child is overweight</td>
<td>0.091</td>
<td>0.144</td>
<td>-0.053</td>
<td>0.020</td>
<td>-2.650**</td>
</tr>
<tr>
<td>Child is at-risk overweight</td>
<td>0.113</td>
<td>0.104</td>
<td>0.01</td>
<td>0.023</td>
<td>0.435</td>
</tr>
<tr>
<td>Child is normal weight</td>
<td>0.748</td>
<td>0.719</td>
<td>0.029</td>
<td>0.031</td>
<td>0.935</td>
</tr>
<tr>
<td>Child is limited in play activities</td>
<td>0.043</td>
<td>0.031</td>
<td>0.012</td>
<td>0.015</td>
<td>0.800</td>
</tr>
<tr>
<td>Child has anemia</td>
<td>0.043</td>
<td>0.049</td>
<td>-0.006</td>
<td>0.012</td>
<td>-0.500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kernel Matching (Bandwidth = .06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child is in excellent/very good health</td>
<td>0.666</td>
<td>0.700</td>
<td>-0.034</td>
<td>0.020</td>
<td>-1.700</td>
</tr>
<tr>
<td>Child is in fair/poor health</td>
<td>0.073</td>
<td>0.064</td>
<td>0.009</td>
<td>0.012</td>
<td>0.750</td>
</tr>
<tr>
<td>Child is overweight</td>
<td>0.091</td>
<td>0.114</td>
<td>-0.022</td>
<td>0.017</td>
<td>-1.294</td>
</tr>
<tr>
<td>Child is at-risk overweight</td>
<td>0.113</td>
<td>0.099</td>
<td>0.014</td>
<td>0.017</td>
<td>0.824</td>
</tr>
<tr>
<td>Child is normal weight</td>
<td>0.748</td>
<td>0.742</td>
<td>0.006</td>
<td>0.024</td>
<td>0.250</td>
</tr>
<tr>
<td>Child is limited in play activities</td>
<td>0.043</td>
<td>0.035</td>
<td>0.008</td>
<td>0.011</td>
<td>0.727</td>
</tr>
<tr>
<td>Child has anemia</td>
<td>0.043</td>
<td>0.039</td>
<td>0.004</td>
<td>0.011</td>
<td>0.367</td>
</tr>
</tbody>
</table>

Note: Standard errors are bootstrapped (50 reps). Covariates include black, Hispanic, other (white), age two, age three (age four), marital status and age of head-of-household, high school diploma, some college, college degree (less than high school diploma), born in the US, household size, lived at current residence less than 1 year, lived at current residence more than 10 years, family poverty-to-income ratio, SNAP participation, Medicaid participation, own home, low birthweight, mother smoked during pregnancy, and child is breastfed.

** Significant at 1 percent; * Significant at 5 percent
percentage points less likely to be overweight (BMI greater than the 95th percentile for gender and age) compared to their control group; however, this result was not duplicated in the kernel matching algorithm. With the exception of the outcome for overweight, the results in Table 3.4, together with the logistic regression results from Table 3.2, strongly suggest that child WIC participation is not associated with better outcomes on the seven measures of health and well-being examined in this study.

Appendix B1 presents sensitivity analyses which employ additional matching algorithms. In general, the results in Appendix B1 are consistent with the findings in the primary results reported in Table 3.4; however, using the nearest neighbor without replacement approach and the kernel density of .80, the results suggest that child WIC participants are significantly less likely to be reported in excellent or very good health. Such a finding is unsurprising given negative selection into WIC; however, this finding does suggest some sensitivity to the matching algorithm specified.

The final component to propensity score matching is to check how well the matching succeeded in balancing the characteristics of the treated and untreated groups. This is accomplished using t-tests of the equality of means before and after matching. Table 3.5 illustrates the difference in means for all variables before and after matching. Columns I and II provide means and proportions for child participants and eligible, nonparticipants prior to matching. A number of statistically significant differences are evident between the two groups. This covariate imbalance suggests that there is evidence of selection bias. Columns III and IV provide means and proportions for child participants and eligible, nonparticipants after matching on propensity scores. The results indicate that after matching, there are substantially fewer
statistically significant differences, suggesting that matching successfully reduced the bias
associated with observable characteristics.

Table 3.5. Differences in Covariate Means and Proportions Before and After Propensity Score
Matching

<table>
<thead>
<tr>
<th></th>
<th>Before matching</th>
<th>After matching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WIC participants</td>
<td>Eligible nonparticipants</td>
</tr>
<tr>
<td></td>
<td>(I)</td>
<td>(II)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic, Black</td>
<td>0.285</td>
<td>0.306</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.478*</td>
<td>0.345</td>
</tr>
<tr>
<td>Other race</td>
<td>0.056</td>
<td>0.049</td>
</tr>
<tr>
<td>Age 2</td>
<td>0.467*</td>
<td>0.379</td>
</tr>
<tr>
<td>Age 3</td>
<td>0.28</td>
<td>0.293</td>
</tr>
<tr>
<td>Household characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married head-of-household</td>
<td>0.471</td>
<td>0.485</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>32.884</td>
<td>33.313</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.243</td>
<td>0.264</td>
</tr>
<tr>
<td>Some college</td>
<td>0.218</td>
<td>0.242</td>
</tr>
<tr>
<td>College degree</td>
<td>0.037*</td>
<td>0.072</td>
</tr>
<tr>
<td>Born in the US</td>
<td>0.582*</td>
<td>0.734</td>
</tr>
<tr>
<td>Household size</td>
<td>4.910*</td>
<td>4.717</td>
</tr>
<tr>
<td>Family lived in home &lt; 1 yr</td>
<td>0.284</td>
<td>0.304</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>0.067</td>
<td>0.067</td>
</tr>
<tr>
<td>Prenatal/at-birth characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.142</td>
<td>0.136</td>
</tr>
<tr>
<td>Mother smoke prenatally</td>
<td>0.157</td>
<td>0.185</td>
</tr>
<tr>
<td>Breastfed</td>
<td>0.573</td>
<td>0.568</td>
</tr>
<tr>
<td>Economic well-being</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family poverty-to-income ratio</td>
<td>0.870*</td>
<td>1.074</td>
</tr>
<tr>
<td>SNAP receipt past 12 months</td>
<td>0.552*</td>
<td>0.404</td>
</tr>
<tr>
<td>Medicaid receipt by the child</td>
<td>0.616*</td>
<td>0.443</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>0.317*</td>
<td>0.378</td>
</tr>
<tr>
<td>Sample Size</td>
<td>1,018</td>
<td>1,065</td>
</tr>
</tbody>
</table>

Note: The sample size is smaller in column three due to dropping observations that violate the common support assumption.

* indicates that the value is significantly different from eligible nonparticipants at the 5 percent level using a two-tailed test.
Discussion and Conclusions

The intent of this study is to determine whether participation in the WIC program positively influences the health and well-being of its largest participant group, children. Examining that question is a challenging undertaking, in part due to the challenges of evaluating a concept as complex as health and well-being and also due to the bias that is inherent in working with observational data. This study represents one effort to dig into what is a very complex and multi-faceted issue. Despite these difficulties, one clear and fairly consistent trend has emerged. In general, the results of this analysis fail to provide a definitive picture of success for the portion of the WIC program that pertains to children.

In terms of positive findings, the results in this study indicate that the neediest are receiving benefits. WIC children appear to be negatively selected into the program across a range of variables—that is, they come from families that are significantly disadvantaged relative to other low-income families. In addition, the multiple analytic approaches utilized in this study do not find that child WIC participants are any worse off in terms of health and well-being compared to other low-income children. Given the tendency toward negative selection into the program, this is not an outcome that would suggest failure on the part of the program. In fact, it could indicate that WIC has reduced disparities in the health and well-being of child WIC participants such that we see no observable difference between WIC participants and eligible nonparticipants. Further, the results suggest that child WIC participation is not associated with an increased likelihood of being overweight or at-risk overweight.

At the same time, the results of this study cannot be interpreted as a measure of success for the program. Overall, the analysis found little support for the notion that child WIC participation improves child health and well-being. The logistic regression results found no statistically significant differences in health and well-being between child WIC participants and
eligible, nonparticipants. Similarly, the propensity score matching technique, which approximates what the health of the child participant would have been but for their participation in WIC, found almost no statistically significant differences in terms of health or well-being outcomes. While, the nearest neighbor algorithm did indicate that child WIC participants were significantly less likely to be overweight, this result did not carry through in any other matching algorithms, thereby diminishing the impact of the finding.

While the lack of statistically significant findings are suggestive, a cautious interpretation is reasonable since propensity score matching balances only observed variables. Like multivariate regression analysis, propensity score matching does not correct for unobservable variables that may influence the decision to participate in WIC, so the possibility of introducing biased results remains. In addition, this study only examines seven measures of child health and well-being. Certainly, there are other measures that should be considered when determining the effectiveness of WIC on child health. Finally, the NHANES does not allow this study to accurately capture a child’s entire period of exposure to WIC, including a mother’s prenatal participation, which might be important in influencing a child’s long-term health and well-being as well as influence subsequent participation decisions.  

Despite the limitations of this study, it is possible there are alternative reasons why this analysis finds little influence of child WIC participation on measures of child health and well-being. It is possible policy-makers and program enthusiasts simply expect too much from the program. For example, is it reasonable to expect that a supplemental food package offering a value of $41 per month, on average, is sufficient to create and sustain marked changes in the

58. Beginning in the 2007-2008 NHANES data cycle, a question was added to capture a mother’s prenatal participation in the WIC program, as well as the duration of that participation.

59. Average monthly food benefit is reported by the FNS website as of September 1, 2011. See
health and well-being of child participants? While not commonly discussed in the research literature, this issue has been raised by Besharov and Germanis (2001). Together, they question whether WICs relatively limited food package offerings and counseling benefits could have the strong effects asserted by program advocates, especially when the food supplement is both small in dollar value and may replace food purchases the family would have otherwise made (Besharov and Germanis, 2001).

In addition, the emerging body of literature that examines the spillover effects of child participation in WIC on age-ineligible children in the same household offers another alternative possibility. This literature suggests that the WIC food package for children may be shared to an extent that age-ineligible children in the same household actually demonstrate significant increases in the consumption of food products offered in WIC food packages (Ver Ploeg, 2009; Woodward and Ribar, 2011). While such findings suggest positive spillover benefits to older children, it may also explain the failure to find statistically significant differences in this study, since the health benefits of child participation are being mitigated by distribution of food package benefits to age ineligible children in the household.

Going forward, additional research that examines the influence of child WIC participation on child health and well-being is required. More research effort should be directed at understanding the measurable health benefits provided by the WIC food package to participating children and whether increasing or otherwise altering the food benefit would yield the desired outcomes. In that vein, more research is needed to further explore the WIC spillover effect discussed above. Expanding on this study, future research should be conducted using other nationally-representative datasets to determine whether the results from this study can be

duplicated. Further, outcome measures should be expanded to include developmental and/or dietary outcomes to provide a broader picture of health and well-being. While it offers a number of benefits, the NHANES is particularly limited in its ability to understand the full scope of WIC participation among children, which is essential in making firm decisions about its programmatic effectiveness. In summary, the research literature on child participation is still in its infancy and a good deal of work remains.
CHAPTER 4

CONCLUSION

Background

The WIC program is frequently referred to as the most studied food and nutrition assistance program (Oliveira and Frazao, 2009; Currie, 2003). A myriad of academic research and administrative reports have examined various aspects of the WIC program, particularly prenatal participation and infant birth outcomes; however, not all aspects of the program have been examined with equal rigor. A close examination of WIC literature yields relatively little research examining the largest participant group, young children ages 1 through 4. In fact, children under the age of 5 years account for approximately one-half of all program participants (Oliveira and Frazao, 2009) and over half of WICs total program expenditures (Besharov and Call, 2009). However, research on child WIC participation has been extremely limited, a marked disparity when compared to the voluminous body of research examining other areas of WIC including prenatal participation and its influence on infant birth outcomes.

Looking at the broader topic of child WIC participation, two specific research areas have been identified as requiring particular attention: the determinants of child WIC participation and the health effect of WIC participation on children. Both research areas represent understudied components of WIC and both are critical to ultimately evaluating programmatic effectiveness; thus, the lack of rigorous study in these areas is problematic. Turning to the determinants of child WIC participation, understanding the factors influencing participation (and nonparticipation) allows program managers to better determine whether the program is well-targeted and reaching its population of interest. This is particularly important in the case of WIC because child WIC participants exhibit extremely low rates of participation compared to other categorically eligible groups. These low participation rates are particularly concerning because eligible, needy children
may not be receiving the benefits to which they are entitled, and thus, WIC may be failing in achieving its goals.

In terms of the health effects of WIC on children, one major goal of WIC is to safeguard the health of low-income children; therefore, an important measure of programmatic effectiveness is whether participation in the program actually improves the health of the child participant group. Beyond that, knowing which facets of a program are working can assist program staff in strategically deploying limited resources during periods of budget reduction. However, the body of research examining the effect of WIC participation on child health is remarkably sparse.

This dissertation was designed to shed light on these understudied areas by 1) identifying the factors that influence child participation in WIC, and 2) examining whether child participation in WIC is associated with better performance on selected measures of child health and well-being. Relying upon data from the 1999-2008 National Health and Nutrition Examination Survey (NHANES), each research question was separately addressed in Chapters 2 and 3, respectively. Importantly, neither research study was designed to be the final word in answering these research questions, as both studies face significant methodological challenges as well as practical concerns. Rather, the findings are intended to act as a basis in building a body of knowledge about child participation in the WIC program upon which future research can grow.

Findings

This dissertation has yielded some important insights into child WIC participation. The primary findings from the Chapter 2 and Chapter 3 analyses are summarized below:

- NHANES data indicates that child participants are negatively selected into WIC
• No association between measures of infant health status at birth and the likelihood of participating as a child
• Participation in WIC falls as age increases
• Children who reside in households where the head-of-household is born in the United States are far less likely to participate in the WIC program
• Child WIC participants do not perform better on the measures of child health and well-being examined in this study
• Child WIC participation is not associated with being overweight or at-risk overweight

Turning to the findings from Chapter 2, administrative data has repeatedly shown that rates of child participation in the WIC program fall short of the participation rates seen in pregnant and postpartum women and infants. Empirical research examining participation among children eligible for WIC has yielded few insights on why participation may be so low among otherwise eligible children. In addition, research has found a steady decline in WIC participation as children age, but the reasons for this decline are unclear. Seeking to overcome these problems, the Chapter 2 analysis identified child-level, household-level, infant/child health and economic factors associated with WIC participation in children ages 1 through 4. The dependent variable was a binary indicator that captured child WIC participation, with a child considered a WIC participant if they received WIC benefits in the previous 12 month period and currently received WIC benefits. Linear probability models (LPM) and logistic regression provided the basis of the methodological approach.

One finding that was immediately apparent in the Chapter 2 analysis was the tendency toward negative selection into the WIC program. A simple comparison of clearly indicated that child participants came from families that were worse in terms of socio-economic status, a
finding that persisted in the multivariate analysis as well. In other words, child WIC participants were more disadvantaged than the rest of the population, indicating that WIC is reaching the neediest children. Interestingly, this picture of negative selection is also seen in literature examining the determinants of prenatal WIC take-up, which has consistently found prenatal participants are negatively selected on a broad range of socio-demographic characteristics including education, income, use of public assistance, race, and foreign-born (Bitler and Currie, 2005; Fox et al., 2004).

Another major finding of this research concerns the relationship between a child’s early health status and child participation in WIC. Results from LPM and logistic regression analysis suggest that measures of infant and early child health are not significantly associated with child WIC participation. In other words, the presence of a health condition did not appear to make a child more likely to participate in the program. This was true for each of the measures of infant/child health examined in Chapter 2. Children who were born with low or very low birthweights were no more or less likely to participate in WIC than children who were born with normal birthweights. Similarly, children who received intensive newborn care or who had 10 or more visits with a doctor or other health professional over the last year were no more or less likely to participate in WIC than eligible, nonparticipating children. One exception was found in the age-stratified regression results which found, at age 4, children who received newborn care in the ICU after birth were less likely to participate; however, this result was not found at any other age and could be an artifact of the relatively small sample size. In general, these results suggest that parents or guardians do not appear to include a child’s health status in their evaluation of the costs and benefits of WIC participation.
The appearance of a considerable age effect represents another major finding. The Chapter 2 analysis revealed that child participation dropped off with age, a finding that was consistent with other research examining child WIC participation (Oliveira and Gunderson, 2000). There are many potential explanations for this drop-off. A child’s parent or guardian might perceive that the WIC food package provided to children is not worth the cost of program participation. Alternatively, parents might decide to have their infant participate because the formula component of the WIC package is of greater value, but drop-out of the program as the formula benefit ends and the total value of the food package declines. A child’s parent or guardian might also believe the health benefits of WIC participation are associated only with participation at earlier ages. Another possibility is that local providers might place an emphasis on targeting infants and very young children, thereby focusing their resources on recruitment rather than retention.

The specific reasons behind the drop-off in participation as a child ages could not be definitively ascertained given the limits of NHANES data. However, to provide further insight, additional analyses were conducted to examine child participation, stratified by age. Overall, the age stratification results demonstrated that the factors driving participation varied by the age category. At ages 1 to 3, a number of statistically significant differences were evident between child WIC participants and eligible nonparticipants. Although it varied at each age, participation was driven by factors such as race, marital status, education, and duration at current residence, but by age 4, the differences between child WIC participants and nonparticipants diminished to the point where very few significant differences were evident between WIC participants and their eligible, nonparticipating counterparts. The single consistent trend in the age stratified results related to receipt of benefits from other assistance programs. At all ages, participation was
significantly associated with participation in Medicaid, and to a lesser extent, receipt of SNAP benefits. In addition, the results indicated that children who participated at age 1 appeared to be more disadvantaged than eligible, nonparticipating 1-year-olds in terms of income and education; however, as ages 2 to 4, the gap in socioeconomic disadvantage between participants and nonparticipants disappears quickly.

A third major finding was the persistent negative effect of US-born households on child WIC participation. Children who resided in households where the head-of-household was born in the United States were much less likely to participate in the WIC program, although in terms of sheer numbers, US-born households account for the vast majority of eligible households. Given the many potential barriers to participation that foreign-born households might face like language barriers and programmatic awareness, this finding is perplexing. It is possible that foreign-born households are simply needier than US-born households and may place greater value on the benefits attached to WIC; however, even controlling for economic factors like income, the strength of significance and the size of the coefficient remain the same.

This analysis also found interesting results related to measures of household transience and stability. Children who came from geographically stable families that resided in their homes for 10 years or more were more likely to participate in the program. Similarly, children who came from more transient families, families that had resided in their homes for less than 1 year, were somewhat less likely to participate in the program. One possible explanation for this result is the higher transactions costs for people who move frequently in terms of acquiring the requisite documents to establish income and residency information and receive vouchers.

Chapter 3 focused on determining whether children who participated in WIC performed better on measures of health and well-being compared to other nonparticipating, low-income
children. Like Chapter 2, this analysis relied on NHANES data to examine child WIC participation; however, due to limits on the body mass index (BMI) outcome measures, only children ages 2 through 4 were included in the analysis. Seven binary measures of child health and well-being represented the dependent variables: excellent/very good health, fair/poor health, child limited in physical activities, overweight, at-risk overweight, normal weight, and anemia. Numerous socio-demographic variables were included as control variables. In terms of research methods, to examine whether WIC participation was associated with better health and well-being, this study relied on two approaches: logistic regression and propensity score matching (PSM).

Like Chapter 2, the results from the Chapter 3 analysis support the finding that WIC children are negatively selected into the program, which means participating children came from families that were socioeconomically disadvantaged relative to other eligible low-income families. This result indicates that WIC benefits may be well-targeted since they appear to be reaching children who are worse off. Importantly, the logistic regression results in Chapter 3 did not find that child WIC participants were any worse off in terms of health and well-being compared to other low-income children. Given the tendency toward negative selection into the program, the failure to find significant differences is not, in itself, indicative of programmatic failure. In fact, one interpretation of the results could be that WIC has reduced disparities in the health and well-being of child WIC participants to an extent that observable differences between WIC participants and eligible nonparticipants are no longer evident. Unfortunately, the propensity score matching (PSM) results do not support this particular interpretation.

The coefficients in the PSM algorithms report the Average Treatment Effect on the Treated (ATT). Technically, the ATT is the average difference in health outcomes child WIC
participants and nonparticipants, representing the effect of WIC participation on measures of child health and well-being among children who did and did not participate in WIC, but who have similar propensities for participating based on observable characteristics. Functionally, the ATT provides a counterfactual—what the health of the child participant would have been but for their participation in WIC. Looking at ATT, the results of the analysis found no consistent, statistically significant differences in terms of health or well-being outcomes across matching algorithms. In summary, given the lack of significant differences between the treatment and control groups in the primary propensity score matching algorithms as well as the logistic regressions, the results in Chapter 3 found no discernible WIC effect on measures of child health and well-being.

Limitations

The analyses in Chapters 2 and 3 suffer from some significant data limitations. In both analyses, it is not possible to make causal claims. Because individuals choose to participate in WIC, it is not possible to examine all of the factors, particularly unobservable factors, which contribute to the decision to participate. In addition, the NHANES, by nature of its design, cannot reveal the entire range and duration of participation which may be important in examining child health and well-being and would allow for a more nuanced assessment of the participation decision. Further, like other research examining WIC participation, these analyses assume that the child receiving WIC benefits is actually consuming that food, rather than being redistributed to other family members.

Turning to the limitations exclusive to the Chapter 2 analysis, the age-stratification results suffer from small sample sizes, primarily the 4-year-old group. Going forward, the results should be reexamined using other large, nationally representative data sets to determine whether
the findings can be duplicated. Additionally, while the NHANES offers a wide variety of health indicators, it provides only limited information on maternal and household characteristics (e.g. prenatal care, maternal health, and employment status) that may be useful in further understanding the participation decision. Further, the public release version of the NHANES does not provide geographic identifiers, preventing any analysis of state-level policy variables nor does it provide family identifiers that would provide information about other children in the household.

In terms of Chapter 3 limitations, the PSM technique does not correct for unobservable variables that may influence the decision to participate in WIC, so the possibility of introducing biased results remains. In addition, the Chapter 3 analysis only examined seven measures of child health and well-being. Certainly, there are other measures that should be considered when making any final determination about the effectiveness of WIC on child health. A final limitation of the Chapter 3 analysis specifically concerns prior participation in the WIC program. Unfortunately, at the time of this analysis, the NHANES did not collect information about a mother’s prenatal WIC participation; however such participation could have an important influence a child’s subsequent health and would be an important consideration.

Policy Implications

Despite the limitations outlined above, both studies have important implications for researchers, policymakers, and program managers. As policy stakeholders continue to evaluate the programmatic effectiveness of WIC, it is essential to understand the differences between children who participate in WIC and eligible children who are not participating in the program. Any failure to account for these differences may lead to misleading estimates of the effectiveness of WIC participation among children.
Both analyses find child participants are negatively selected into WIC, suggesting that overall the program may be well-targeted, garnering participation among the poorest children. In terms of policy implications, one clear predictor of a child’s participation as they age is participation in other social programs, particularly Medicaid. Thus, Medicaid participation, and to a lesser extent SNAP participation, can potentially act as vehicles for increasing participation among older, eligible children; therefore, further outreach efforts to Medicaid offices may be effective in increasing child participation. This research also suggests that program managers, who are seeking to increase child participation in WIC, should consider directing resources and outreach efforts toward transient households. It is possible that transience interferes with the paperwork needs required for establishing income and residency information and it may interfere with the ability to obtain the benefits. In addition, the finding that child WIC participants are significantly less likely to come from US born households suggests that program officials may have been successful in outreach efforts to mitigate the costs of participation for foreign-born households in terms of language and cultural barriers.

Turning to the policy implications of the results in Chapter 3, the failure to find significant differences between child participants and their nonparticipating counterparts on measures of health and well-being is provocative. Obviously, the findings calls into question just how well WIC is performing for young children, and it may be tempting for program critics to use these results to bolster claims that WIC does not work. However, given the limitations of the study, it would be extremely inappropriate to view these results as defining evidence that WIC does not improve the health and well-being of young children. Instead, the results of this study, as well as Chapter 2, should be considered the opening salvo is a broader research effort to dig out the effect of WIC on child health and well-being.
Future Research

Additional research is essential to accurately gauge whether WIC is reaching its programmatic goals for its largest participant group—children. Broadly speaking, future research should use other large, nationally representative datasets to 1) duplicate the findings presented here, and 2) examine alternative measures of child health and well-being like developmental and/or dietary outcomes. Ideally, future research would account for prenatal WIC participation as well as lifetime WIC participation to more accurately capture exposure to the treatment. The NHANES itself may facilitate this effort. Beginning with the 2007-2008 release cycle, the NHANES started collecting information about a mother’s receipt of WIC benefits during her pregnancy. Another new question introduced to the survey capture the duration of that prenatal participation, offering the opportunity for researchers to conduct a more nuanced assessment.

In addition to adding controls for prenatal participation, two alternative hypotheses warrant further exploration. First, research should focus on the issue raised by Besharov and Germanis (2001) about whether WIC can reasonably be expected to make marked changes in child health given the relatively low value of the food package. Together, Besharov and Germanis questioned whether WICs relatively limited food package offerings and counseling benefits could have the strong effects asserted by program advocates, especially when the food supplement is both small in dollar value and may replace food purchases the family would have otherwise made (Besharov and Germanis, 2001). At issue, what is the threshold-level nutrient consumption required to actually observe health impacts in children.

Second, additional research is needed to examine the possible spillover effects of child participation WIC on age-ineligible children and adults living in the same household. While still in its infancy, this literature suggests that the WIC food package for children may be shared to an extent that age-ineligible children in the same household demonstrate significant increases in the
consumption of food products offered in WIC food packages (Ver Ploeg, 2009; Woodward and Ribar, 2011). While these findings do suggest positive spillover benefits to older children, they may also explain the failure to find statistically significant differences in health outcomes, since the health benefits of child participation are potentially mitigated by the distribution of food package benefits to age ineligible children in the household. Beyond spillover benefits to other children in the household, this research should also examine whether spillovers are evident in adults.
APPENDIX A
A COMPARATIVE ANALYSIS OF DATA SETS

Table A1. Comparison of NHANES and WIC Program Data on Selected Child Characteristics

<table>
<thead>
<tr>
<th></th>
<th>NHANES</th>
<th>WIC PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIC participation rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% participating</td>
<td>53.1</td>
<td>49.5</td>
</tr>
<tr>
<td>Age of child participant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age 1</td>
<td>32.9</td>
<td>36.5</td>
</tr>
<tr>
<td>Age 2</td>
<td>25.2</td>
<td>25.5</td>
</tr>
<tr>
<td>Age 3</td>
<td>23.1</td>
<td>22.0</td>
</tr>
<tr>
<td>Age 4</td>
<td>18.8</td>
<td>16.0</td>
</tr>
<tr>
<td>Race/ethnicity of child</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, Non-Hispanic</td>
<td>35.8</td>
<td>30.1</td>
</tr>
<tr>
<td>Black, Non-Hispanic</td>
<td>21.5</td>
<td>19.0</td>
</tr>
<tr>
<td>Hispanic</td>
<td>36.2</td>
<td>44.8</td>
</tr>
<tr>
<td>Other</td>
<td>6.5</td>
<td>5.2</td>
</tr>
<tr>
<td>≤ 100% poverty level</td>
<td>64.4</td>
<td>60.9</td>
</tr>
<tr>
<td>Mean household size</td>
<td>4.7</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Source: WIC program data are taken from WIC Participant and Program Characteristics 2008, USDA Alexandria, VA: January 2010.
## APPENDIX B

### SENSITIVITY ANALYSES

Table B1. Sensitivity Analysis

<table>
<thead>
<tr>
<th></th>
<th>Treated</th>
<th>Control</th>
<th>Difference</th>
<th>SE</th>
<th>t-stat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kernel Matching BW=.01</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child is in excellent/very good health</td>
<td>0.667</td>
<td>0.695</td>
<td>-0.029</td>
<td>0.026</td>
<td>-1.115</td>
</tr>
<tr>
<td>Child is in fair/poor health</td>
<td>0.073</td>
<td>0.067</td>
<td>0.006</td>
<td>0.016</td>
<td>0.375</td>
</tr>
<tr>
<td>Child is overweight</td>
<td>0.091</td>
<td>0.113</td>
<td>-0.022</td>
<td>0.013</td>
<td>-1.692</td>
</tr>
<tr>
<td>Child is at-risk overweight</td>
<td>0.113</td>
<td>0.097</td>
<td>0.016</td>
<td>0.018</td>
<td>0.889</td>
</tr>
<tr>
<td>Child is normal weight</td>
<td>0.748</td>
<td>0.745</td>
<td>0.002</td>
<td>0.025</td>
<td>0.080</td>
</tr>
<tr>
<td>Child is limited in play activities</td>
<td>0.043</td>
<td>0.036</td>
<td>0.007</td>
<td>0.011</td>
<td>0.636</td>
</tr>
<tr>
<td>Child has anemia</td>
<td>0.043</td>
<td>0.036</td>
<td>0.006</td>
<td>0.012</td>
<td>0.500</td>
</tr>
<tr>
<td><strong>Kernel Matching BW=.80</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child is in excellent/very good health</td>
<td>0.666</td>
<td>0.729</td>
<td>-0.062</td>
<td>0.020</td>
<td>-3.100*</td>
</tr>
<tr>
<td>Child is in fair/poor health</td>
<td>0.073</td>
<td>0.051</td>
<td>0.023</td>
<td>0.013</td>
<td>1.769</td>
</tr>
<tr>
<td>Child is overweight</td>
<td>0.091</td>
<td>0.107</td>
<td>-0.016</td>
<td>0.011</td>
<td>-1.455</td>
</tr>
<tr>
<td>Child is at-risk overweight</td>
<td>0.113</td>
<td>0.101</td>
<td>0.012</td>
<td>0.014</td>
<td>0.857</td>
</tr>
<tr>
<td>Child is normal weight</td>
<td>0.748</td>
<td>0.743</td>
<td>0.005</td>
<td>0.020</td>
<td>0.250</td>
</tr>
<tr>
<td>Child is limited in play activities</td>
<td>0.043</td>
<td>0.032</td>
<td>0.011</td>
<td>0.009</td>
<td>1.222</td>
</tr>
<tr>
<td>Child has anemia</td>
<td>0.043</td>
<td>0.034</td>
<td>0.009</td>
<td>0.009</td>
<td>1.000</td>
</tr>
<tr>
<td><strong>Nearest Neighbor without Replacement</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child is in excellent/very good health</td>
<td>0.666</td>
<td>0.726</td>
<td>-0.059</td>
<td>0.022</td>
<td>-2.682*</td>
</tr>
<tr>
<td>Child is in fair/poor health</td>
<td>0.073</td>
<td>0.051</td>
<td>0.022</td>
<td>0.011</td>
<td>2.000*</td>
</tr>
<tr>
<td>Child is overweight</td>
<td>0.091</td>
<td>0.106</td>
<td>-0.015</td>
<td>0.012</td>
<td>-1.250</td>
</tr>
<tr>
<td>Child is at-risk overweight</td>
<td>0.113</td>
<td>0.100</td>
<td>0.014</td>
<td>0.015</td>
<td>0.933</td>
</tr>
<tr>
<td>Child is normal weight</td>
<td>0.748</td>
<td>0.744</td>
<td>0.003</td>
<td>0.018</td>
<td>0.167</td>
</tr>
<tr>
<td>Child is limited in play activities</td>
<td>0.043</td>
<td>0.032</td>
<td>0.011</td>
<td>0.010</td>
<td>1.100</td>
</tr>
<tr>
<td>Child has anemia</td>
<td>0.043</td>
<td>0.035</td>
<td>0.008</td>
<td>0.011</td>
<td>0.727</td>
</tr>
</tbody>
</table>

**Note:** Propensity matching methods use bootstrapped standard errors (50 replications). Covariates include black, Hispanic, other (white), age two, age three (age four), head-of-household marital status and age, high school diploma, some college, college degree (less than high school diploma), born in the US, household size, lived at current residence less than 1 year, lived at current residence more than 10 years, family poverty-to-income ratio, SNAP participation, Medicaid participation, own home, low birthweight, mother smoked during pregnancy, and child is breastfed.
Table B2. Estimating the Impact of WIC Participation on Individual Self-Reported Measures of Child Health: Odds Ratios

<table>
<thead>
<tr>
<th></th>
<th>Excellent health (I)</th>
<th>Very good health (II)</th>
<th>Good health (III)</th>
<th>Fair health (IV)</th>
<th>Poor health (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WIC Participant</td>
<td>0.817*</td>
<td>1.324*</td>
<td>0.928</td>
<td>1.308</td>
<td>0.261</td>
</tr>
<tr>
<td>Non-Hispanic, Black</td>
<td>0.699*</td>
<td>0.961</td>
<td>1.978**</td>
<td>1.056</td>
<td>2.228</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.480**</td>
<td>1.212</td>
<td>2.475**</td>
<td>1.144</td>
<td>1.429</td>
</tr>
<tr>
<td>Other race</td>
<td>0.452*</td>
<td>0.909</td>
<td>2.538**</td>
<td>2.766*</td>
<td>—</td>
</tr>
<tr>
<td>Age 2</td>
<td>1.207</td>
<td>1.011</td>
<td>0.852</td>
<td>0.704</td>
<td>0.292</td>
</tr>
<tr>
<td>Age 3</td>
<td>1.167</td>
<td>0.998</td>
<td>0.710*</td>
<td>1.403</td>
<td>0.635</td>
</tr>
<tr>
<td><strong>Household characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married head-of-household</td>
<td>1.082</td>
<td>1.048</td>
<td>0.936</td>
<td>0.702</td>
<td>2.094</td>
</tr>
<tr>
<td>Age of head-of-household</td>
<td>1.010+</td>
<td>0.977**</td>
<td>1.011</td>
<td>0.979</td>
<td>0.99</td>
</tr>
<tr>
<td>High school diploma</td>
<td>0.95</td>
<td>1.123</td>
<td>1.244</td>
<td>0.399*</td>
<td>1.341</td>
</tr>
<tr>
<td>Some college</td>
<td>0.856</td>
<td>1.362+</td>
<td>0.963</td>
<td>0.833</td>
<td>0.959</td>
</tr>
<tr>
<td>College degree</td>
<td>0.893</td>
<td>1.279</td>
<td>1.162</td>
<td>0.467</td>
<td>—</td>
</tr>
<tr>
<td>Born in the US</td>
<td>1.382*</td>
<td>1.175</td>
<td>0.617**</td>
<td>0.638</td>
<td>0.213</td>
</tr>
<tr>
<td>Household size</td>
<td>0.951</td>
<td>1.015</td>
<td>1.089</td>
<td>0.916</td>
<td>1.029</td>
</tr>
<tr>
<td>Family lived in home &lt; 1 yr</td>
<td>1.001</td>
<td>0.892</td>
<td>1.167</td>
<td>0.952</td>
<td>0.195</td>
</tr>
<tr>
<td>Family lived in home 10+ yrs</td>
<td>1.148</td>
<td>1.053</td>
<td>0.719</td>
<td>0.913</td>
<td>18.999**</td>
</tr>
<tr>
<td><strong>Prenatal/at-birth characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low birthweight</td>
<td>0.87</td>
<td>0.94</td>
<td>0.965</td>
<td>2.289**</td>
<td>—</td>
</tr>
<tr>
<td>Mother smoke prenatally</td>
<td>0.690**</td>
<td>1.466**</td>
<td>1.045</td>
<td>1.325</td>
<td>2.911</td>
</tr>
<tr>
<td>Breastfed</td>
<td>1.079</td>
<td>1.146</td>
<td>0.738*</td>
<td>1.19</td>
<td>0.579</td>
</tr>
<tr>
<td><strong>Economic well-being</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family poverty-to-income ratio</td>
<td>1.174+</td>
<td>0.985</td>
<td>0.888</td>
<td>0.673</td>
<td>0.205+</td>
</tr>
<tr>
<td>SNAP receipt past 12 months</td>
<td>0.904</td>
<td>0.998</td>
<td>1.269</td>
<td>0.719</td>
<td>0.674</td>
</tr>
<tr>
<td>Medicaid receipt by the child</td>
<td>0.94</td>
<td>1.047</td>
<td>0.907</td>
<td>1.525</td>
<td>0.926</td>
</tr>
<tr>
<td>Family owns or is buying home</td>
<td>1.078</td>
<td>0.967</td>
<td>1.112</td>
<td>0.546+</td>
<td>0.281+</td>
</tr>
<tr>
<td><strong>Sample Size</strong></td>
<td>983</td>
<td>474</td>
<td>498</td>
<td>120</td>
<td>8</td>
</tr>
</tbody>
</table>

*Note: Estimates are weighted. Taylor linearized standard errors were used to compute the t-statistic. Reference categories include child is non-Hispanic White, child is age 4, and household reference person has a college degree.

** Significant at 1 percent; * Significant at 5 percent + Significant at 10 percent
REFERENCES


