

# Food Insecurity and Risk for Obesity Among Children and Families: Is There a Relationship?

## Healthy Eating Research

Building evidence to prevent childhood obesity

A Research Synthesis, April 2010

The majority of U.S. households are food secure, meaning they have steady and dependable access to enough food to support active, healthy lives for all household members.<sup>1</sup> Unfortunately, the remaining 15 percent of U.S. households have limited or uncertain access to adequate food—they are food insecure.<sup>2</sup>

Members of these food-insecure households use a number of coping strategies, such as eating a less varied diet, participating in federal food and nutrition assistance programs, and obtaining emergency food from community food pantries and kitchens. However, an increasing proportion of households (from 3.1 percent of households in 2000 to 5.7 percent of households in 2008) are unable to avoid periodic reductions in food intake and disruptions to their normal eating patterns.<sup>3,4</sup> While most households are able to shield children from reduced food intake, in more than 500,000 households across the United States children as well as adults experience periods when their normal eating patterns are disrupted by a lack of adequate food.<sup>5</sup>

Numerous studies have linked household food insecurity to poorer nutritional, physical and mental health among adults and children.<sup>6-16</sup> In addition, research has found that food insecure children are more likely to have behavioral problems and academic difficulties.<sup>17, 18, 19, 20</sup> Food insecurity and obesity are widely viewed as separate public health problems; however, there is growing concern that these issues are related. Food insecurity may lead to weight gain because the least expensive food options to obtain a given amount of calories are typically high in calories and low in nutrients.<sup>21, 22</sup> Research suggests that high-calorie foods are easy to over-consume and promote weight gain if they are part of a regular diet.<sup>23, 24</sup> Households with limited resources tend to spend less on food overall and, more specifically, less on healthy foods that are lower in energy but more costly (e.g., fruits and vegetables).<sup>25</sup>

With obesity rates at epidemic levels among children, adolescents, and adults in the United States,<sup>26, 27</sup> it is critical to understand the relationship between food insecurity and obesity and how to address both issues. This research synthesis reviews studies that examined the seemingly contradictory relationship between food insecurity and obesity in the United States, with a focus on children and families. Given the potential implications for policy, the synthesis also explores



the role nutrition assistance programs may play in the relationship between food insecurity and obesity for youth and adults.

### Key Research Results

- Nearly 15 percent of U.S. households experience food insecurity, which disproportionately impacts populations at highest risk for obesity, including low-income households and members of racial/ethnic minority groups.<sup>28</sup>
- Although a few studies have found that children living in food-insecure households are more likely to be obese than children who are food secure,<sup>29, 30, 31</sup> most studies have found no evidence of a direct relationship.<sup>32-43</sup>
- Women who experience food insecurity are more likely to be obese compared with food secure women;<sup>44-52</sup> however, it is unclear whether food insecurity promotes increased weight gain over time.<sup>53, 54, 55, 56</sup> Research among men<sup>57-63</sup> has not consistently shown a relationship between food insecurity and weight status.



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- As the largest federal food and nutrition assistance program, the Supplemental Nutrition Assistance Program (SNAP, formerly called the Food Stamp Program) has the potential to affect obesity among low-income Americans.<sup>64</sup> However, additional research is needed to understand the pathways through which SNAP benefits might help to prevent obesity and to determine which policy changes may be needed.<sup>65</sup>
- Research does not suggest that use of SNAP benefits promotes obesity among children, adolescents<sup>66-71</sup> or adult men.<sup>72-77</sup>
- Some research suggests that long-term use of SNAP benefits may increase risk for obesity among adult women,<sup>78-84</sup> a group representing approximately 28 percent of program participants.<sup>85</sup>
- Few studies have examined whether there is a relationship between participation in other food and nutrition assistance programs and risk for obesity in youth.<sup>86-96</sup> However, there is little evidence to indicate that participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), the National School Lunch Program (NSLP) or the School Breakfast Program increases risk for obesity.<sup>97</sup>

### Details on Key Research Results

**Nearly 15 percent of U.S. households experience food insecurity, which disproportionately impacts populations at highest risk for obesity, including low-income households and members of racial/ethnic minority groups (Figure 1).<sup>98</sup>**

The U.S. Department of Agriculture conducts an annual, nationally representative survey of U.S. households to monitor the extent and severity of food insecurity. In 2008, a total of 44,000 households were surveyed about experiences and behaviors that indicate food insecurity and whether they had used nutrition assistance programs.<sup>99</sup> One adult member of each household was asked 10 questions about the eating patterns of adults in the household and the household overall. One of the questions was, “In the last 12 months, did you or other adults in your household ever not eat for a whole day because there wasn’t enough money for food?” If the household included any members ages 0 to 18, the survey asked eight additional questions about the eating patterns of those children. The food security status (see Table 1) of each interviewed household was then determined by the number of food-insecure conditions reported. While the survey is representative of U.S. households, the results likely underestimate the extent of food insecurity in the United States because homeless families and individuals were not included.

**Table 1. U.S. Department of Agriculture Categories Describing Food Security Status**

#### Food secure

- *High food security*: All household members have access at all times to enough food for an active, healthy life.
- *Marginal food security*: Household members are, at times, uncertain of having enough food because they have insufficient money and other resources for food. However, these households rarely need to reduce the quality, variety or quantity of their food intake.

#### Food insecure

- *Low food security (formerly called “food insecurity without hunger”)*: Household members are, at times, unable to acquire enough food because they have insufficient money and other resources for food. These households report reducing the quality or variety of their diet, but rarely need to reduce their food intake.
- *Very low food security (formerly called “food insecurity with hunger”)*: The eating patterns of one or more household members are, at times, disrupted and their food intake reduced because they couldn’t afford enough food.

**Adapted from:** Nord M and Coleman-Jensen A. “Food Security in the United States: Definitions of Hunger and Food Security.” U.S. Department of Agriculture, Economic Research Service. Available at [www.ers.usda.gov/Briefing/FoodSecurity/labels.htm](http://www.ers.usda.gov/Briefing/FoodSecurity/labels.htm). Accessed: March 6, 2010.

The December 2008 survey showed that 14.6 percent of U.S. households (17 million households) were food insecure. These households, at some time during the year, had difficulty providing enough food for all of their members due to a lack of resources. Approximately two-thirds of food-insecure households were able to avoid reductions in food intake by using coping strategies, such as participating in nutrition assistance programs. Among food-insecure households, 55 percent reported participating in one or more of the three largest federal nutrition assistance programs—SNAP, NSLP and WIC. Twenty percent of food-insecure households used emergency food pantries at some time during the year, and 2.6 percent ate one or more meals at an emergency kitchen.

One-third of food-insecure households (6.7 million households) reported very low food security; in these households, the food intake of some household members was reduced, and their normal eating patterns were disrupted due to a lack of resources.<sup>100</sup> Very low food security in the United States is usually not chronic, but occurs episodically throughout the year. It is estimated that between 1.1 million and 1.4 million

households (0.9 percent to 1.2 percent of all households) experience very low food security on any given day.

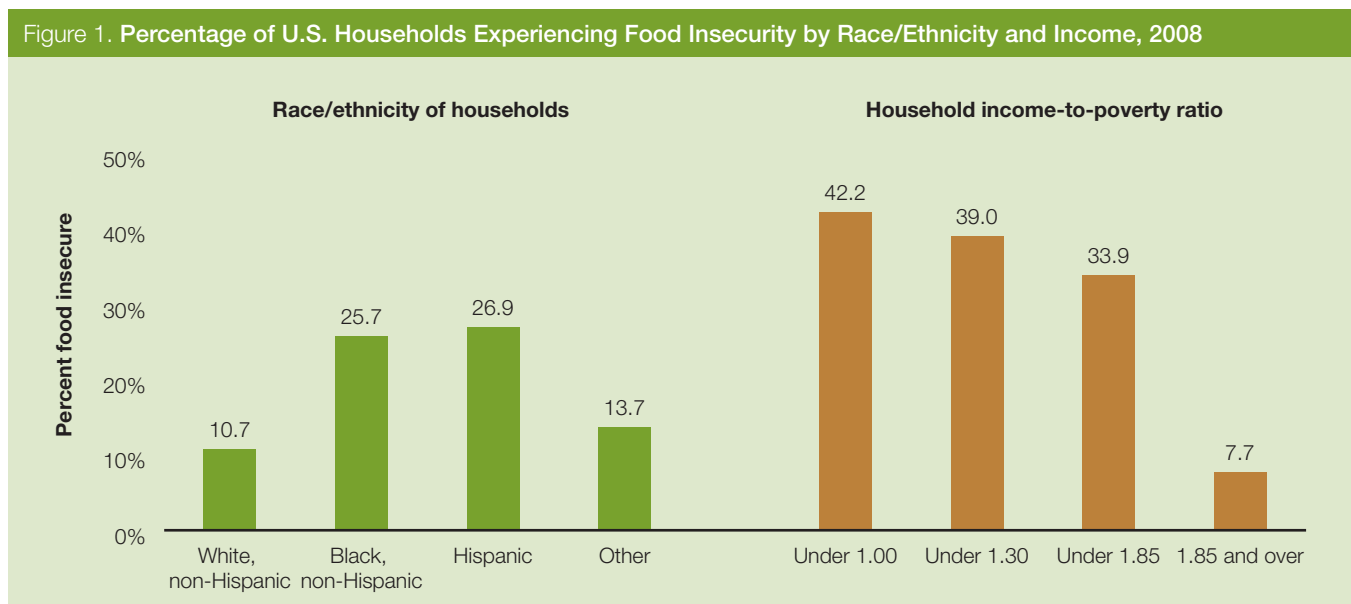
Food insecurity disproportionately impacts households with incomes below the official poverty line (42.2 percent) and households with children that are headed by a single female (37.2 percent) or male adult (27.6 percent).<sup>101</sup> Rates of very low food security and food insecurity among children follow similar patterns.<sup>102, 103</sup> More than 13 percent of households with children that are headed by a single woman experience very low food security at some time during the year. In addition, 19.3 percent of households with incomes below the poverty line experience very low food security at some time during the year.<sup>104</sup>

Food insecurity also disproportionately impacts households headed by racial/ethnic minorities (see Figure 1). The proportion of households that experience food insecurity among those headed by Black (25.7 percent) and Hispanic (26.9 percent) adults is more than double the proportion among households headed by non-Hispanic White adults (10.7 percent).<sup>105</sup> Likewise, very low food security is experienced by 10.1 percent of Black households and 8.8 percent of Hispanic households, compared with 4.5 percent of non-Hispanic White households.<sup>106</sup>

**Although a few studies have found that children living in food-insecure households are more likely to be obese than children who are food secure,<sup>107, 108, 109</sup> most studies have found no evidence of a direct relationship.<sup>110-121</sup>**

Several research studies have examined whether there is a relationship between household food insecurity and risk for obesity among children and adolescents, including at least 16 cross-sectional<sup>122-137</sup> and four longitudinal<sup>138, 139, 140, 141</sup> studies (Table 2). This research has produced mixed results. Although results have varied across demographic groups, a few studies have found evidence relating household food insecurity to higher rates of obesity among children and adolescents.<sup>142, 143, 144</sup> Numerous other studies have found no evidence of a direct relationship.<sup>145-156</sup> Further, some studies conversely have found that children living in food-insecure households are less likely to be obese compared with children who are food secure.<sup>157, 158, 159, 160, 161</sup> A small number of studies, which included a child-specific measure of food insecurity,<sup>162-167</sup> have likewise reported conflicting results.

When examined together, these research studies addressing food insecurity and obesity suggest that the inter-relationships between household food insecurity and children’s growth are likely to be complex. For example, a nationally representative study of nearly 8,700 U.S. toddlers investigated potential pathways through which household food insecurity during the first year of life may later influence child nutritional status.<sup>168</sup>



Nord M, Andrews M, Carlson S. “Household food security in the United States, 2008.” U.S. Department of Agriculture, Economic Research Service. Economic Research Report No. 83. November 2009.

The study made use of parent-reported information on household food insecurity, infant-feeding practices and maternal depression; observations of mother-child interactions; and direct assessments of child weight and length at 24 months. The results showed:

- Food insecurity did not appear to directly affect child risk for obesity (weight for length  $\geq 95$ th percentile).
- Parents in food-insecure households exhibited less-positive parenting practices (e.g., sensitivity to infant's cues, behaviors fostering social-emotional growth) than parents in food-secure households. Less-positive parenting was further linked to poorer infant-feeding practices (e.g., non-adherence to infant feeding recommendations involving breastfeeding and the timing of introduction of solid foods).
- The results suggest that the coping strategies food-insecure households use to stave off hunger may affect parenting practices, which ultimately influence children's risk for obesity.

Another study among predominantly Hispanic and African-American adolescents (ages 10–15) in low-income families similarly found household stress may play a role in relationships between food insecurity and obesity.<sup>169</sup> Measurements of height and weight were completed for more than 1,000 adolescents, and their female caregivers were interviewed regarding the adolescent's food-insecurity status and sources of stress in the home (e.g., inadequate maternal social support network, exposure to domestic violence, lack of child or maternal health insurance). The findings of this cross-sectional study included:

- Food insecurity, maternal and family stressors were not individually related to the weight status of the adolescent. However, an increase in maternal stress was found to amplify a food-insecure adolescent's likelihood of being obese.
- The likelihood of being obese among adolescents who were food secure was not found to change when a greater number of maternal stressors were present. In contrast, as the number of maternal stressors increased in households where adolescents were food insecure, the adolescent's likelihood of being obese increased from 35 percent when only one stressor was experienced to approximately 70 percent when three stressors were experienced.
- While a mechanism linking maternal stress to obesity was not investigated in this study, it is possible that stressed mothers exhibit diminished parenting skills and are less likely than mothers with fewer stressors to provide healthy foods for meals.

**Women who experience food insecurity are more likely to be obese compared with food secure women;<sup>170–178</sup> however, it is unclear whether food insecurity promotes increased weight gain over time.<sup>179, 180, 181, 182</sup> Research among men<sup>183–189</sup> has not consistently shown a relationship between food insecurity and weight status.**

At least 13 cross-sectional<sup>190–202</sup> and four longitudinal studies<sup>203, 204, 205, 206</sup> have examined whether there is relationship between household food insecurity and weight status among adult women. Despite some inconsistencies,<sup>207, 208, 209, 210</sup> most cross-sectional studies have found that women who experience food insecurity are more likely to be obese compared with women who are food secure.<sup>211–219</sup> Longitudinal studies (see Table 2), which are better able to address the ordering of relationships, have produced conflicting results. Three longitudinal studies found no or little evidence to suggest that household food insecurity promotes increased weight gain,<sup>220, 221, 222</sup> and one study found women who were persistently food insecure gained less weight over time.<sup>223</sup>

Fewer studies have examined whether there is a relationship between food insecurity and weight status among adult men; only seven cross-sectional<sup>224–230</sup> studies and no longitudinal studies were found. Among the seven studies, two studies found that men who experienced food insecurity were more likely to be obese compared with men who were food secure,<sup>231, 232</sup> and four studies found no evidence of an association.<sup>233, 234, 235, 236</sup> One study found that men who experienced marginal food insecurity were more likely to be obese compared with men who were fully food secure.<sup>237</sup> However, men who reported low food security, including a need to adjust household food management strategies or reduce the quality of their diet, were less likely to be obese compared with men who were fully food secure.

**As the largest federal food and nutrition assistance program, the Supplemental Nutrition Assistance Program (SNAP, formerly called the Food Stamp Program) has the potential to affect obesity among low-income Americans.<sup>238</sup> However, additional research is needed to understand the pathways through which SNAP benefits might help to prevent obesity and to determine which policy changes may be needed.<sup>239</sup>**

SNAP is the largest federal food and nutrition assistance program and provides benefits to over 28 million people monthly.<sup>240</sup> In 2008, 49 percent of participants were children ( $\leq 17$  years of age, 50 percent female), 42 percent were nonelderly adults (ages 18–59; 67 percent female), and 9 percent were elderly adults ( $\geq 60$  years of age; 67 percent female).<sup>241</sup> SNAP benefits are intended to reduce

food insecurity and increase access to a nutritious diet for eligible low-income households. Research suggests that households tend to enroll in SNAP during periods when their food insecurity has worsened and that receipt of benefits leads to improvements in food security.<sup>242</sup> The average monthly benefit provided to eligible households is \$102 per person and can be used only to purchase food.<sup>243</sup> Given the large size and importance of SNAP, there is great interest in the program's potential to affect obesity among low-income Americans.

There are two main pathways through which SNAP benefits might contribute to weight gain: 1) receipt of benefits could encourage households to spend more money on high-calorie foods than they otherwise would and to consume excess calories as a result; and 2) SNAP benefits could alleviate hunger only temporarily and allow for a cycle including short-lived periods of abundance and overeating followed by deprivation.<sup>244</sup> With regard to the first pathway, a small number of studies have shown some SNAP households spend less money on food when they receive an equal level of benefits as cash.<sup>245, 246, 247</sup> However, further research is needed to determine whether higher food expenditures among SNAP participants necessarily lead to overconsumption of calories and obesity; it is alternatively possible that higher spending could lead to the selection of healthier foods (e.g., fresh fruits and vegetables). Further research is needed to determine the impact of SNAP participation on energy consumption and what strategies might be instituted in addition to current programs and policies designed to promote healthier food choices.<sup>248, 249</sup> For example, the Farmers' Market Scrip Demonstration Project allows a farmers' market to purchase one central license and provides a free point-of-sale device so that several or all farmers at the market can accept SNAP benefits for fresh produce.<sup>250</sup>

Research explicitly testing the second pathway also is lacking. There is some evidence that distorted patterns of consumption characterized by periods of inadequate intake and periods of overeating can gradually lead to increased weight.<sup>251</sup> In addition, some research has found that SNAP participants reduce their spending on food and that some participants modestly reduce their food consumption over the benefit month.<sup>252, 253, 254</sup> However, the reported reductions in food consumption were small on average, and it is possible that SNAP participants might spend most of their benefits soon after receiving them, but spread out their actual consumption of purchased foods over the course of the benefit month.

### Research does not suggest that use of SNAP benefits promotes obesity among children, adolescents<sup>255–260</sup> or adult men.<sup>261–266</sup>

At least six cross-sectional studies<sup>267–272</sup> and three longitudinal studies<sup>273, 274, 275</sup> have examined whether there is a relationship between use of SNAP benefits and weight status among youths. With few exceptions,<sup>276, 277, 278</sup> most studies have found no evidence to indicate that use of SNAP benefits increases risk for obesity.<sup>279–284</sup> The results of two studies among youth conversely indicated that use of SNAP benefits may reduce risk for obesity for some groups.<sup>285, 286</sup>

Most cross-sectional<sup>287, 288, 289</sup> and longitudinal<sup>290, 291, 292</sup> studies similarly have found no evidence to indicate that use of SNAP benefits increases risk for obesity among adult men. The results of only one study indicated that long-term (but not short- or medium-term) use of SNAP benefits may increase risk for obesity.<sup>293</sup> This study examined the relationship between use of SNAP benefits and weight status in a sample of 3,681 males eligible for program participation over a 15-year period (1985–2000). Long-term use of SNAP benefits was associated with an increase in the obesity rate of 15 percentage points, from 15 percent to 30 percent.

### Some research suggests that long-term use of SNAP benefits may increase risk for obesity among adult women,<sup>294–300</sup> a group representing approximately 28 percent of program participants.<sup>301</sup>

At least three cross-sectional studies<sup>302, 303, 304</sup> and six longitudinal studies<sup>305–310</sup> have examined whether there is a relationship between use of SNAP benefits and weight status among adult women. Despite some inconsistencies,<sup>311, 312</sup> the results of these studies suggest that long-term use of SNAP benefits may increase risk for obesity.<sup>313–318</sup>

Use of SNAP benefits may influence the complex relationship between food insecurity and risk for obesity among some women. One illustrative study in a sample of 5,303 women ages 18–74 examined the association between changes in body weight, SNAP participation status and food security status over two years (1999 to 2001).<sup>319</sup> This study found:

- Among women who were persistently food secure, use of SNAP benefits was not related to weight change over the two years.
- Changes in food-security status over the two years were not related to changes in weight. Among women who changed food-security status, use of SNAP benefits also was not related to weight change over the two years.

- Persistent food insecurity over the two years was related to reduced weight gain. However, among women who were persistently food insecure, use of SNAP benefits was found to offset the difference and was related to an increase in weight of approximately two pounds per year.

**Few studies have examined whether there is a relationship between participation in other food and nutrition assistance programs and risk for obesity in youth.<sup>320–330</sup> However, there is little evidence to indicate that participation in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), the National School Lunch Program (NSLP), or the School Breakfast Program (SBP) increases risk for obesity.<sup>331</sup>**

Only seven studies have examined this relationship for the WIC program.<sup>332–338</sup> Another five studies have examined this relationship for free or reduced-cost participation in the NSLP or SBP.<sup>339–343</sup> The results of one cross-sectional study suggested that participation in WIC may increase risk for obesity among non-Hispanic White children, but showed no association among African-American or Hispanic children.<sup>344</sup> No evidence was found indicating that participation in the NSLP or SBP increases risk for obesity.<sup>345–352</sup> The results of three studies indicated that participation in the WIC program,<sup>353</sup> NSLP<sup>354, 355</sup> and SBP<sup>356</sup> may reduce risk for obesity for some groups.

For example, a nationally representative study in a sample of young children from low-income families examined the relationship between participation in WIC at 4 years of age and risk for obesity at ages 4, 5 and 6.<sup>357</sup> Parents of 7,310 children were interviewed every four months and reported participation in WIC, as well as their children's height and weight. The results showed participation in WIC was related to a lower risk for obesity and was not related to an increased risk for underweight. Although more research is needed, the findings of this one study suggest that participation in WIC may reduce risk for obesity through the provision of healthy foods and/or nutrition education for mothers.

Another study assessed participation in other federal nutrition assistance programs (SNAP, NSLP and SBP), household food insecurity, height and weight status for 772 school-aged children from low-income families (ages 5–12).<sup>358</sup> In this sample, children from food-secure households were more likely to be obese than children from food-insecure households. The study separately examined whether there was a relationship between participation in federal nutrition assistance programs and risk for obesity among children who were food secure

and children who were food insecure. Study findings indicated that federal nutrition assistance programs may play a protective role, particularly among girls.

- Among girls in food-secure households, participation in federal nutrition assistance programs was generally unrelated to risk for obesity. However, girls in households receiving SNAP benefits had a reduced risk for obesity.
- Among girls in food-insecure households, participation in any or all programs was related to a reduced risk for obesity.
- Among boys in both food-secure and food-insecure households, participation in any or all programs was not related to risk for obesity.

## Conclusions & Implications

Food insecurity affects 17 million U.S. households and disproportionately affects groups at the highest risk for obesity.<sup>359</sup> The majority of food-insecure households receive benefits from one or more of the three largest federal food and nutrition assistance programs (SNAP, NSLP and WIC).<sup>360</sup> Although it is unclear whether food insecurity promotes increased weight gain over time, adult women who experience food insecurity are more likely to be obese compared with women with adequate household resources for food. Women who receive SNAP benefits also may be at increased risk for obesity. Among adult men and children, most studies have found no evidence of a direct relationship between food insecurity and risk for obesity. Research does not suggest that use of SNAP benefits promotes obesity among these groups, representing the majority of program participants. Although much additional research is needed to fully understand the linkages between food insecurity, SNAP benefits and obesity in women, policy changes should be evaluated to determine the potential for SNAP and other food and nutrition assistance programs to improve the food choices of all recipients. Policies are needed that effectively promote healthy food choices and reduce risk for obesity among women participating in SNAP, without adversely impacting their children and other household participants.

## Areas Where Additional Research Is Needed

- Additional longitudinal studies are needed to better understand the relationship between food insecurity and obesity. Although eight longitudinal studies have examined the relationship between food insecurity and obesity among youth or non-elderly adults, all four longitudinal studies among children were conducted in just one of two youth cohorts, and none of the studies among adult men were longitudinal.

- There is a need for both qualitative and quantitative studies to illustrate the mechanisms through which food insecurity may promote obesity among different demographic groups. In particular, additional research is needed to understand the potential impact of both current and past experiences of food insecurity on food shopping, feeding practices, and parenting practices among mothers and fathers. There also is a need to better understand the potential influence of gender and race/ethnicity on relationships between food insecurity and obesity.
- Longitudinal studies are needed to examine why long-term participation in SNAP may be different from short- and medium-term participation in terms of effects on weight gain and risk for obesity. Researchers carrying out these studies should control for bias due to self-selection, as those who choose to participate in SNAP may have different characteristics (e.g., lower income) than those who are eligible but choose not to participate.<sup>361</sup> Further, long-term participants are likely to have different characteristics than participants who enroll for shorter periods.
- Future studies should use measured height and weight, as some research suggests the use of self-reported measurements may bias the association. One study conducted in Canada made use of both measured and self-reported data for height and weight, and it found relationships between obesity and food insecurity to be more pronounced when using the self-reported measurements.<sup>362</sup>
- A standard assessment tool and definition for determining food insecurity should be used in future research to better allow for comparisons among studies. While most studies have used a form of the U.S. Household Food Security Survey Module to assess food security, this research has not consistently defined food insecurity on the basis of responses to the module. Researchers investigating whether there is an association between food insecurity and obesity among youths also should include child-referenced measures of food insecurity.
- Research is needed to illuminate the pathways through which SNAP benefits might contribute to obesity and determine whether program changes may be needed. In particular, there is a need for evaluation studies to examine whether increasing the frequency of SNAP benefit distribution would improve the nutritional quality of participants' diets and reduce disturbances to normal eating patterns (i.e., alternating periods of under- and overconsumption).
- Although there is little evidence to indicate that participation in WIC, NSLP or SBP increases risk for obesity,<sup>363</sup> future research should be conducted to address potential areas for program improvements that may help to reduce obesity in youth.

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**Table 2. Longitudinal Studies that Assess the Relationship between Food Insecurity in U.S. Households and Weight Status**

Reference	Sample	Food Security Measure	Outcome Measure	Summary of Results
<b>CHILDREN AND ADOLESCENTS</b>				
Bhargava et al, 2008	ECLS–Kindergarten Cohort, n=7,635 children assessed at baseline in kindergarten with follow-up assessments in first, third and fifth grades	Parent interview responses to the U.S. Household Food Security Survey Module	Measured height and weight	Household food insecurity did not predict body weight, BMI, or Z-scores of BMI over two-year intervals between first grade and fifth grade.
Bronte-Tinkew et al, 2007	ECLS–Birth Cohort; n=8,693 children assessed at 9 months and 24 months of age	Parent interview responses to the Household Food Security Survey Module	Measured length and weight  Obesity defined by weight for length $\geq$ 95th percentile	Independent of demographic factors, household food insecurity was not directly associated with risk for obesity.  Household food insecurity was related to less-positive parenting practices. Positive parenting practices influenced good infant feeding practices, and good infant feeding practices were associated with lower risk for obesity.
Rose and Bodor, 2006	ECLS–Kindergarten Cohort, n=12,890 children assessed at baseline in kindergarten and at follow-up in first grade	Parent interview responses to the U.S. Household Food Security Survey Module	Measured height and weight  Obesity defined by a BMI $\geq$ 95th percentile  High weight gain defined as $>$ 85th percentile of the change in BMI distribution	Household food insecurity was not predictive of obesity at follow-up in first grade, but was related to a lower risk for high weight gain between kindergarten and first grade. The cross-sectional analysis at baseline showed food insecurity was related to a lower risk for obesity.
Jyoti et al, 2005	ECLS–Kindergarten Cohort, n=11,400 children assessed at baseline in kindergarten and at follow-up in third grade	Parent interview responses to the U.S. Household Food Security Survey Module	Measured height and weight	Children from persistently food-insecure households had a 0.35 kg/m <sup>2</sup> greater gain in BMI and a 0.65 kg greater gain in weight compared with children from persistently food-secure households; in stratified analyses, differences were significant only among girls.  Becoming food insecure was associated with greater gains in weight and BMI among boys, but nonsignificantly with smaller weight and BMI gains among girls

ECLS = Early Child Longitudinal Study  
 PSID = Panel Study of Income Dynamics  
 BMI = Body Mass Index (Weight [kg]/Height [m<sup>2</sup>])

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Table 2. Longitudinal Studies that Assess the Relationship between Food Insecurity in U.S. Households and Weight Status

Reference	Sample	Food Security Measure	Outcome Measure	Summary of Results
<b>ADULTS</b>				
Olson and Strawderman, 2008	Bassett Mothers Health Project, n=463 women in rural New York followed from early pregnancy until two years postpartum	Baseline: three interview items from the Institute of Medicine's Nutrition Questionnaire  Follow-up: three items from the U.S. Household Food Security Survey Module that were included on a mailed survey	Measured height and weight  Obesity defined by a BMI>30 kg/m <sup>2</sup>  Major weight gain defined by weighing 10 lbs more at follow-up than in early pregnancy	Food insecurity in early pregnancy was not related to risk for obesity at two years postpartum.  Women who were obese in early pregnancy had an increased risk of becoming food insecure at two years postpartum.  Women who were both obese and food insecure in early pregnancy were at greatest risk for a major weight gain over the pregnancy and postpartum period.
Jones and Frongillo, 2007	PSID (1999 and 2001), n=5,595 women, ages 18-74	Interview responses to the U.S. Household Food Security Survey Module	Self-reported height and weight  Overweight defined by a 25≤BMI<30 kg/m <sup>2</sup>  Obesity defined by a BMI>30 kg/m <sup>2</sup>  Clinically significant weight gain defined as >5 lbs over two years	There were no significant differences in the percentages of women who gained a clinically significant amount of weight by food insecurity status, regardless of baseline weight status.  Overweight women who were on a weight-gain trajectory during the two-year period gained less if they were food insecure versus food secure. A similar relationship was not observed among obese women.
Whitaker and Sarin, 2007	Fragile Families and Child Wellbeing Study, n=1,707 urban women with preschool children born between 1998 and 2000	Interview responses to the U.S. Household Food Security Survey Module	Measured height and weight when their child enrolled in the study was age three years (baseline) and age five years (follow-up)  Obesity defined by a BMI>30 kg/m <sup>2</sup>	Baseline food security status was not related to risk for obesity or change in weight over the two-year follow-up period.  Change in food security status was not related to change in weight.
Jones and Frongillo, 2006	PSID (1999 and 2001), n=5,303 women, ages 18-74	Interview responses to the U.S. Household Food Security Survey Module	Self-reported height and weight	Compared with women who were persistently food secure, women who were persistently food insecure gained less weight over time.  When food insecurity preceded weight change, but did not persist, there was no effect of food insecurity status on weight change.

ECLS = Early Child Longitudinal Study  
 PSID = Panel Study of Income Dynamics  
 BMI = Body Mass Index (Weight [kg]/Height [m<sup>2</sup>])

## Endnotes

1. Nord M, Andrews M and Carlson S. *Household Food Security in the United States, 2008*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2009. [www.ers.usda.gov/Publications/ERR83/ERR83.pdf](http://www.ers.usda.gov/Publications/ERR83/ERR83.pdf) (accessed December 2009).
2. Nord M et al. *Household Food Security 2008*.
3. *ibid*.
4. Nord M, Andrews M and Carlson S. *Household Food Security in the United States, 2007*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2008. [www.ers.usda.gov/Publications/ERR66/ERR66.pdf](http://www.ers.usda.gov/Publications/ERR66/ERR66.pdf) (accessed February 2008).
5. Nord M et al. *Household Food Security 2008*.
6. Nord M. *Food Insecurity in Households with Children. Prevalence, Severity, and Household Characteristics*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2009. [www.ers.usda.gov/Publications/EIB56/EIB56.pdf](http://www.ers.usda.gov/Publications/EIB56/EIB56.pdf) (accessed November 2009).
7. Champagne CM, Casey PH, Connell CL, et al. "Poverty and Food Intake in Rural America: Diet Quality Is Lower in Food Insecure Adults in the Mississippi Delta." *Journal of the American Dietetic Association*, 107(11): 1886–1894, 2007.
8. Seligman HK, Bindman AB, Vittinghoff E, et al. "Food Insecurity Is Associated with Diabetes Mellitus: Results from the National Health Examination and Nutrition Examination Survey 1999–2002." *Journal of General Internal Medicine*, 22(7): 1018–1023, 2007.
9. Kushel MB, Gupta R, Gee L, et al. "Housing Instability and Food Insecurity as Barriers to Health Care among Low-Income Americans." *Journal of General Internal Medicine*, 21(1): 71–77, 2006.
10. Cook JT and Frank DA. "Food Security, Poverty, and Human Development in the United States." *Annals of the New York Academy of Science*, 1136: 193–209, 2008.
11. Walker JL, Holben DH, Kropf ML, et al. "Household Food Insecurity Is Inversely Associated with Social Capital and Health in Females from Special Supplemental Nutrition Program for Women, Infants, and Children Households in Appalachian Ohio." *Journal of the American Dietetic Association*, 107(11): 1989–1993, 2007.
12. Laraia BA, Siega-Riz AM, Gunderson C, et al. "Psychosocial Factors and Socioeconomic Indicators Are Associated with Household Food Insecurity among Pregnant Women." *Journal of Nutrition*, 136(1): 177–182, 2006.
13. Weigel MM, Armijos RX, Hall YP, et al. "The Household Food Insecurity and Health Outcomes of U.S.-Mexico Border Migrant and Seasonal Farmworkers." *Journal of Immigrant and Minority Health*, 9(3): 157–169, 2007.
14. Stuff JE, Casey PH, Szeto KL, et al. "Household Food Insecurity Is Associated with Adult Health Status." *Journal of Nutrition*, 134(9): 2330–2335, 2004.
15. Kropf ML, Holben DH, Holcomb JP, et al. "Food Security Status and Produce Intake and Behaviors of Special Supplemental Nutrition Program for Women, Infants, and Children and Farmers' Market Nutrition Program Participants." *Journal of the American Dietetic Association*, 107(11): 1903–1908, 2007.
16. Cook JT, Frank DA, Berkowitz C, et al. "Food Insecurity Is Associated with Adverse Health Outcomes among Human Infants and Toddlers." *Journal of Nutrition*, 134(6): 1432–1438, Jun 2004.
17. Nord M. *Food Insecurity*.
18. Cook JT et al. "Food Security" 193–209.
19. Murphy JM, Wehler CA, Pagano ME, et al. "Relationship between Hunger and Psychosocial Functioning in Low-Income American Children." *Journal of the American Academy of Child and Adolescent Psychiatry*, 37(2): 163–170, 1998.
20. Alaimo K, Olson CM and Frongillo EA. "Food Insufficiency and American School-Aged Children's Cognitive, Academic, and Psychosocial Development." *Pediatrics*, 108(1): 44–53, 2001.
21. Ludwig DS and Pollack HA. "Obesity and the Economy: From Crisis to Opportunity." *Journal of the American Medical Association*, 301(5): 533–535, 2009.
22. Drewnoski A and Specter SE. "Poverty and Obesity: The Role of Energy Density and Energy Costs." *American Journal of Clinical Nutrition*, 79(1): 6–16, 2004.
23. Hartline-Grafton HL, Rose D, Johnson CC, et al. "Energy Density of Foods, but Not Beverages, Is Positively Associated with Body Mass Index in Adult Women." *European Journal of Clinical Nutrition*, 63(12): 1411–1418, 2009.
24. Rolls BJ. "The Relationship between Dietary Energy Density and Energy Intake." *Physiology and Behavior*, 97(5): 609–615, 2009.
25. Drewnoski A et al. 6–16.
26. Ogden CL, Carroll MD, Curtin LR, et al. "Prevalence of High Body Mass Index in US Children and Adolescents, 2007–2008." *Journal of the American Medical Association*, 303(3): 242–249, 2010.
27. Flegal KM, Carroll MD, Ogden CL, et al. "Prevalence and Trends in Obesity among US Adults, 1999–2008." *Journal of the American Medical Association*, 303(3), 2010.
28. Nord M et al. *Household Food Security 2008*.
29. Jyoti DF, Frongillo EA and Jones SJ. "Food Insecurity Affects School Children's Academic Performance, Weight Gain, and Social Skills." *Journal of Nutrition*, 135(12): 2831–2839, 2005.
30. Bhattacharya J, Currie J and Haider S. "Poverty, Food Insecurity, and Nutritional Outcomes in Children and Adults." *Journal of Health Economics*, 23(4): 839–862, 2004.
31. Alaimo K, Olson CM and Frongillo EA. "Low Family Income and Food Insufficiency in Relation to Overweight in US Children." *Archives of Pediatrics and Adolescent Medicine*, 155(10): 1161–1167, 2001.
32. Gunderson C, Garasky S and Lohman BJ. "Food Insecurity Is Not Associated with Childhood Obesity as Assessed Using Multiple Measures of Obesity." *Journal of Nutrition*, 139(6): 1173–1178, 2009.
33. Bhargava A, Jolliffe D and Howard LL. "Socio-Economic, Behavioral and Environmental Factors Predicted Body Weights and Household Food Insecurity Scores in the Early Childhood Longitudinal Study - Kindergarten." *British Journal of Nutrition*, 100(2): 438–444, 2008.
34. Feinberg E, Kavanagh PL, Young RL, et al. "Food Insecurity and Compensatory Feeding Practices among Urban Black Families." *Pediatrics*, 122(4): e854–e860, 2008.
35. Gunderson C, Lohman BJ, Garasky S, et al. "Food Security, Maternal Stressors, and Overweight among Low-Income US Children: Results from The National Health and Nutrition Examination Survey (1999–2002)." *Pediatrics*, 122(3): e529–e540, 2008.
36. Whitaker RC and Orzol SM. "Obesity among US Urban Preschool Children. Relationships to Race, Ethnicity, and Socioeconomic Status." *Archives of Pediatrics and Adolescent Medicine*, 160(6): 578–584, 2006.
37. Casey PH, Simpson PM, Gossett JM, et al. "The Association of Child and Household Food Insecurity with Childhood Overweight Status." *Pediatrics*, 118(5): e1406–1413, 2006.
38. Winicki J and Jemison K. "Food Insecurity and Hunger in the Kindergarten Classroom: Its Effect on Learning and Growth." *Contemporary Economic Policy*, 21(2): 145–157, 2003.
39. Kaiser LL, Melgar-Quinonez HR, Lamp CL, et al. "Food Security and Nutritional Outcomes of Preschool-Age Mexican-American Children." *Journal of the American Dietetic Association*, 102(7): 924–929, 2002.
40. Martin KS and Ferris AM. "Food Insecurity and Gender Are Risk Factors for Obesity." *Journal of Nutrition, Education, and Behavior*, 39(1): 31–36, 2007.
41. Bronte-Tinkew J, Zaslow M, Capps R, et al. "Food Insecurity Works through Depression, Parenting, and Infant Feeding to Influence Overweight and Health in Toddlers." *Journal of Nutrition*, 137(9): 2160–2165, 2007.
42. Casey PH, Szeto K, Lensing S, et al. "Children in Food-Insufficient, Low-Income Families: Prevalence, Health, and Nutrition Status." *Archives of Pediatrics and Adolescent Medicine*, 155(4): 508–514, 2001.
43. Cutts DB, Pheley AM and Geppert JS. "Hunger in Midwestern Inner-City Young Children." *Archives of Pediatrics and Adolescent Medicine*, 152(5): 489–493, 1998.
44. Hanson KL, Sobal J and Frongillo EA. "Gender and Marital Status Clarify Associations between Food Insecurity and Body Weight." *Journal of Nutrition*, 137(14): 1460–1465, 2007.
45. Wilde PE and Peterman JN. "Individual Weight Change Is Associated with Household Food Security Status." *Journal of Nutrition*, 136(5): 1395–1400, 2006.
46. Holben DH and Pheley AM. Diabetes Risk and Obesity in Food-Insecure Households in Rural Appalachian Ohio. *Preventing Chronic Disease*, 3(3), 2006. [www.cdc.gov/pcd/issues/2006/jul/05\\_0127.htm](http://www.cdc.gov/pcd/issues/2006/jul/05_0127.htm) (accessed February 2009).
47. Kaiser LL, Townsend MS, Melgar-Quinonez HR, et al. "Choice of Instrument Influences Relations between Food Insecurity and Obesity in Latino Women." *American Journal of Clinical Nutrition*, 80(5): 1372–1378, 2004.
48. Centers for Disease Control and Prevention. "Self-Reported Concern About Food Security Associated with Obesity - Washington, 1995–1999." *Morbidity and Mortality Weekly Report*, 52(35): 840–842, 2003.
49. Adams EJ, Grummer-Strawn L and Chavez G. "Food Insecurity Is Associated with Increased Risk of Obesity in California Women." *Journal of Nutrition*, 133(4): 1070–1074, 2003.
50. Basiotis PP and Lino M. "Food Insufficiency and Prevalence of Overweight among Adult Women." *Family Economics and Nutrition Review*, 15(2): 55–57, 2003.
51. Townsend MS, Pearson J, Love B, et al. "Food Insecurity Is Positively Related to Overweight in Women." *Journal of Nutrition*, 131(6): 1738–1745, 2001.
52. Olson CM. "Nutrition and Health Outcomes Associated with Food Insecurity and Hunger." *Journal of Nutrition*, 129 (2S Suppl): S21S–S24S, 1999.
53. Olson CM and Strawderman MS. "The Relationship between Food Insecurity and Obesity in Rural Childbearing Women." *Journal of Rural Health*, 24(1): 60–66, 2008.
54. Jones SJ and Frongillo EA. "Food Insecurity and Subsequent Weight Gain in Women." *Public Health Nutrition*, 10(2): 145–151, 2007.
55. Whitaker RC and Sarin A. "Change in Food Security Status and Change in Weight Are Not Associated in Urban Women with Preschool Children." *Journal of Nutrition*, 137(9): 2134–2139, 2007.
56. Jones SJ and Frongillo EA. "The Modifying Effects of Food Stamp Program Participation on the Relation between Food Insecurity and Weight Change in Women." *Journal of Nutrition*, 136(4): 1091–1094, 2006.
57. Hanson KL et al. 1371460–1465.
58. Wilde PE et al. "Individual Weight Change" 1395–1400.
59. Holben DH et al. Diabetes Risk and Obesity.

60. Centers for Disease Control and Prevention. "Self-Reported Concern" 840–842.
61. Townsend MS et al. 1311738–1745.
62. Webb AL, Schiff A, Currihan D, et al. "Food Stamp Program Participation but Not Food Insecurity Is Associated with Higher Adult BMI in Massachusetts Residents Living in Low-Income Neighborhoods." *Public Health Nutrition*, 11(12): 1248–1255, 2008.
63. Laraia BA, Siega-Riz AM and Evenson KR. "Self-Reported Overweight and Obesity Are Not Associated with Concern About Enough Food among Adults in New York and Louisiana." *Preventive Medicine*, 38(2): 175–181, 2004.
64. *The Food Assistance Landscape: FY 2008 Annual Report*. Washington: U.S. Department of Agriculture and Economic Research Service, 2009, [www.ers.usda.gov/Publications/EIB6-6/EIB6-6.pdf](http://www.ers.usda.gov/Publications/EIB6-6/EIB6-6.pdf) (accessed November 2009).
65. Ver Ploeg M and Ralston K. *Food Stamps and Obesity. What Do We Know?* Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2008, [www.ers.usda.gov/Publications/EIB34/EIB34.pdf](http://www.ers.usda.gov/Publications/EIB34/EIB34.pdf) (accessed December 2009).
66. Jones SL, Jahns L, Laraia BA, et al. "Lower Risk of Overweight in School-Aged Food Insecure Girls Who Participate in Food Assistance: Results from the Panel Study of Income Dynamics Child Development Supplement." *Archives of Pediatrics and Adolescent Medicine*, 157(8): 780–784, 2003.
67. Ver Ploeg M, Mancino L, Lin BH, et al. "U.S. Food Assistance Programs and Trends in Children's Weight." *International Journal of Pediatric Obesity*, 3(1): 22–30, 2008.
68. Bhattacharya J and Currie J. *Youths at Nutritional Risk: Malnourished or Misnourished?* Cambridge, MA: National Bureau of Economic Research, 2000, <http://escholarship.org/uc/item/0dz4t9mq> (accessed November 2009).
69. Gibson D. "Food Stamp Program Participation and Health: Estimates from the NLSY97." In: Mitchell R, ed. *Social Awakening. Adolescent Behavior as Adulthood Approaches*. New York: Russell Sage Foundation, 2001.
70. Hofferth SL and Curtin S. "Poverty, Food Programs, and Childhood Obesity." *Journal of Policy Analysis and Management*, 24(4): 703–726, 2005.
71. Boumtje PI, Huang CL, Lee JY, et al. "Dietary Habits, Demographics, and the Development of Overweight and Obesity among Children in the United States." *Food Policy*, 30(2): 115–128, 2005.
72. Chen Z, Yen ST and Eastwood DB. "Effects of Food Stamp Participation on Body Weight and Obesity." *American Journal of Agricultural Economics*, 87(5): 1167–1173, 2005.
73. Kaushal N. "Do Food Stamps Cause Obesity?: Evidence from Immigrant Experience." *Journal of Health Economics*, 26(5): 968–991, 2007.
74. Ver Ploeg M, Mancino L and Lin BH. *Food and Nutrition Assistance Programs and Obesity: 1976–2002*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2007, [www.ers.usda.gov/Publications/ERR48/](http://www.ers.usda.gov/Publications/ERR48/) (Accessed February 2009).
75. Zagorsky JL and Smith PK. "Does the U.S. Food Stamp Program Contribute to Adult Weight Gain?" *Economics and Human Biology*, 7(2): 246–258, 2009.
76. Meyerhoeffer CD and Pylpychuk Y. "Does Participation in the Food Stamp Program Increase the Prevalence of Obesity and Health Care Spending?" *American Journal of Agricultural Economics*, 90(2): 287–305, 2008.
77. Gibson D. "Food Stamp Program Participation Is Positively Related to Obesity in Low Income Women." *Journal of Nutrition*, 133(7): 2225–2231, 2003.
78. Gibson D. "Food Stamp Program Participation" 2225–2231.
79. Jones SJ et al. "Modifying Effects" 1091–1094.
80. Chen Z et al. 1167–1173.
81. Zagorsky JL et al. 246–258.
82. Meyerhoeffer CD et al. 287–305.
83. Gibson D. "Food Stamp Program Participation is Positively Related to Low Income Women" 2225–2231.
84. Gibson D. "Long-Term Food Stamp Program Participation Is Positively Related to Simultaneous Overweight in Young Daughters and Obesity in Mothers." *Journal of Nutrition*, 136(4): 1081–1085, 2006.
85. Baum C. *The Effects of Food Stamps on Obesity*. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, 2007.
86. Wolkwitz K and Trippe C. *Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2008*. Washington, DC: U.S. Department of Agriculture, Food Nutrition Service, September 2009. SNAP-09 CHAR, [www.fns.usda.gov/ora/MENU/published/SNAP/FILES/Participation/2008Characteristics.pdf](http://www.fns.usda.gov/ora/MENU/published/SNAP/FILES/Participation/2008Characteristics.pdf) (accessed November 2009)
87. Jones SL et al. "Lower Risk of Overweight" 780–784.
88. Bhattacharya J et al. *Youths at Nutritional Risk*.
89. Gibson D. "Food Stamp Program Participation Is Positively Related to Obesity in Low Income Women" 2225–2231.
90. Hofferth SL et al. 703–726.
91. Boumtje PI et al. 115–128.
92. Ver Ploeg M et al. *Food and Nutrition Assistance*.
93. Kimbro RT and Rigby E. "Federal Food Policy and Childhood Obesity: A Solution or Part of the Problem?" *Health Affairs*, 29(3): 411–418, 2010.
94. Centers for Disease Control and Prevention. "Nutritional Status of Children Participating in the Special Supplemental Nutrition Program for Women, Infants, and Children—United States, 1988–1991." *Morbidity and Mortality Weekly Report* 45(3):65–69, 1996, [www.cdc.gov/mmwr/preview/mmrwhtml/00040033.htm](http://www.cdc.gov/mmwr/preview/mmrwhtml/00040033.htm) (accessed March 2009).
95. Bitler M and Currie J. *Medicaid at Birth, WIC Take up, and Children's Outcomes*. RAND Corporation, 2004: [www.rand.org/pubs/working\\_papers/2005/RAND\\_WR172.pdf](http://www.rand.org/pubs/working_papers/2005/RAND_WR172.pdf) (accessed November 2009).
96. Black MM, Cutts DB, Frank DA, et al. "Special Supplemental Nutrition Program for Women, Infants, and Children Participation and Infants' Growth and Health: A Multisite Surveillance Study." *Pediatrics*, 114(1): 169–176, 2004.
97. Cole N and Fox MK. *Nutrition and Health Characteristics of Low-Income Populations. Volume II, WIC Program Participants and Nonparticipants*. Washington, DC: U.S. Department of Agriculture, Economic Research Service, 2004, [www.ers.usda.gov/publications/efan04014-2/](http://www.ers.usda.gov/publications/efan04014-2/) (accessed November 2009).
98. Rose D, Bodor JN and Chilton M. "Has the WIC Incentive to Formula-Feed Led to an Increase in Overweight Children?" *Journal of Nutrition*, 1361086–1090, 2006.
99. Nord M et al. *Household Food Security 2008*.
100. Nord M et al. *Household Food Security 2008*.
101. Nord M et al. *Household Food Security 2008*.
102. Nord M et al. *Household Food Security 2008*.
103. Nord M et al. *Household Food Security 2008*.
104. Nord M et al. *Household Food Security 2008*.
105. Nord M et al. *Household Food Security 2008*.
106. Nord M et al. *Household Food Security 2008*.
107. Jyoti DF et al. 2831–2839.
108. Bhattacharya J et al. "Poverty" 839–862.
109. Alaimo K et al. "Low Family Income" 1161–1167.
110. Gundersen C et al. "Food Insecurity" 1173–1178.
111. Bhargava A et al. 438–444.
112. Feinberg E et al. e854–e860.
113. Gundersen C et al. "Food Security" e529–e540.
114. Whitaker RC et al. "Obesity among US" 578–584.
115. Casey PH et al. "The Association of Child" e1406–1413.
116. Winicki J et al. "Food Insecurity and Hunger" 145–157.
117. Kaiser LL et al. "Food Security" 924–929.
118. Martin KS et al. 31–36.
119. Bronte-Tinkew J et al. 2160–2165.
120. Casey PH et al. "Children in Food-Insufficient" 155508–514.
121. Cutts DB et al. 489–493.
122. Bhattacharya J et al. "Poverty" 839–862.
123. Alaimo K et al. "Low Family Income" 1161–1167.
124. Gundersen C et al. "Food Insecurity" 1173–1178.
125. Feinberg E et al. e854–e860.
126. Gundersen C et al. "Food Security" e529–e540.
127. Whitaker RC et al. "Obesity among US" 578–584.
128. Casey PH et al. "The Association of Child" e1406–1413.
129. Winicki J et al. "Food Insecurity and Hunger" 145–157.
130. Kaiser LL et al. "Food Security" 924–929.
131. Martin KS et al. 31–36.
132. Casey PH et al. "Children in Food-Insufficient" 155508–514.
133. Cutts DB et al. 489–493.
134. Jones SL et al. "Lower Risk of Overweight" 780–784.
135. Matheson DM, Varady J, Varady A, et al. "Household Food Security and Nutritional Status of Hispanic Children in the Fifth Grade." *American Journal of Clinical Nutrition*, 76(1): 210–217, 2002.
136. Metallinos-Katsaras E, Sherry B and Kallio J. "Food Insecurity Is Associated with Overweight in Children Younger Than 5 Years of Age." *Journal of the American Dietetic Association*, 109(10): 1790–1794, 2009.
137. Buscemi J, Beech BM and Relyea G. "Predictors of Obesity in Latino Children: Acculturation as a Moderator of the Relationship between Food Insecurity and Body Mass Index Percentile." *Journal of Immigrant and Minority Health*, Epub ahead of print, May 27 2009.
138. Jyoti DF et al. 2831–2839.
139. Bhargava A et al. 438–444.
140. Bronte-Tinkew J et al. 2160–2165.
141. Rose D and Bodor J. "Household Food Insecurity and Overweight Status in Young School Children: Results from The Early Childhood Longitudinal Study." *Pediatrics*, 117(2): 464–473, 2006.
142. Jyoti DF et al. 2831–2839.
143. Bhattacharya J et al. "Poverty" 839–862.
144. Alaimo K et al. "Low Family Income" 1161–1167.
145. Gundersen C et al. "Food Insecurity" 1173–1178.
146. Bhargava A et al. 438–444.
147. Feinberg E et al. e854–e860.
148. Gundersen C et al. "Food Security" e529–e540.
149. Whitaker RC et al. "Obesity among US" 578–584.
150. Casey PH et al. "The Association of Child" e1406–1413.
151. Winicki J et al. "Food Insecurity and Hunger" 145–157.
152. Kaiser LL et al. "Food Security" 924–929.
153. Martin KS et al. 31–36.
154. Bronte-Tinkew J et al. 2160–2165.
155. Casey PH et al. "Children in Food-Insufficient" 155508–514.

156. Cutts DB et al. 489–493.
157. Rose D et al. “Household Food Insecurity” 464–473.
158. Jones SL et al. “Lower Risk of Overweight” 780–784.
159. Matheson DM et al. 210–217.
160. Metallinos-Katsaras E et al. 1790–1794.
161. Buscemi J et al. “Predictors of Obesity.”
162. Whitaker RC et al. “Obesity among US” 578–584.
163. Casey PH et al. “The Association of Child” e1406–1413.
164. Rose D et al. “Household Food Insecurity” 464–473.
165. Lohman BJ, Stewart S, Gundersen C, et al. “Adolescent Overweight and Obesity: Links to Food Insecurity and Individual, Maternal, and Family Stressors.” *Journal of Adolescent Health*, 45(3): 230–237, 2009.
166. Gundersen C, Lohman BJ, Eisenmann JC, et al. “Child-Specific Food Insecurity and Overweight Are Not Associated in a Sample of 10- to 15-Year Old Low-Income Youth.” *Journal of Nutrition*, 138(2): 371–378, 2008.
167. Smith C and Richards R. “Dietary Intake, Overweight Status, and Perceptions of Food Insecurity among Homeless Minnesotan Youth.” *American Journal of Human Biology*, 20(5): 550–563, 2008.
168. Bronte-Tinkew J et al. 2160–2165.
169. Lohman BJ et al. 230–237.
170. Hanson KL et al. 1371460–1465.
171. Wilde PE et al. “Individual Weight Change” 1395–1400.
172. Holben DH et al. Diabetes Risk and Obesity.
173. Kaiser LL et al. “Choice of Instrument” 1372–1378.
174. Centers for Disease Control and Prevention. “Self-Reported Concern” 840–842.
175. Adams EJ et al. 1070–1074.
176. Basiotis PP et al. 55–57.
177. Townsend MS et al. 1311738–1745.
178. Olson CM. “Nutrition and Health Outcomes” 129521S-524S.
179. Olson CM et al. “Relationship between Food Insecurity” 60–66.
180. Jones SJ et al. “Food Insecurity” 145–151.
181. Whitaker RC et al. “Change in Food” 2134–2139.
182. Jones SJ et al. “Modifying Effects” 1091–1094.
183. Hanson KL et al. 1371460–1465.
184. Wilde PE et al. “Individual Weight Change” 1395–1400.
185. Holben DH et al. Diabetes Risk and Obesity.
186. Centers for Disease Control and Prevention. “Self-Reported Concern” 840–842.
187. Townsend MS et al. 1311738–1745.
188. Webb AL et al. 1248–1255.
189. Laraia BA et al. “Self-Reported Overweight” 175–181.
190. Hanson KL et al. 1371460–1465.
191. Wilde PE et al. “Individual Weight Change” 1395–1400.
192. Holben DH et al. Diabetes Risk and Obesity.
193. Kaiser LL et al. “Choice of Instrument” 1372–1378.
194. Centers for Disease Control and Prevention. “Self-Reported Concern” 840–842.
195. Adams EJ et al. 1070–1074.
196. Basiotis PP et al. 55–57.
197. Townsend MS et al. 1311738–1745.
198. Olson CM. “Nutrition and Health Outcomes” 129521S-524S.
199. Webb AL et al. 1248–1255.
200. Laraia BA et al. “Self-Reported Overweight” 175–181.
201. Olson CM, Bove CF and Miller EO. “Growing up Poor: Long-Term Implications for Eating Patterns and Body Weight.” *Appetite*, 49(1): 198–207, 2007.
202. Stuff JE et al. 43–61.
203. Olson CM et al. “Relationship between Food Insecurity” 60–66.
204. Jones SJ et al. “Food Insecurity” 145–151.
205. Whitaker RC et al. “Change in Food” 2134–2139.
206. Jones SJ et al. “Modifying Effects” 1091–1094.
207. Webb AL et al. 1248–1255.
208. Laraia BA et al. “Self-Reported Overweight” 175–181.
209. Olson CM et al. “Growing up Poor” 198–207.
210. Stuff JE et al. 43–61.
211. Hanson KL et al. 1371460–1465.
212. Wilde PE et al. “Individual Weight Change” 1395–1400.
213. Holben DH et al. Diabetes Risk and Obesity.
214. Kaiser LL et al. “Choice of Instrument” 1372–1378.
215. Centers for Disease Control and Prevention. “Self-Reported Concern” 840–842.
216. Adams EJ et al. 1070–1074.
217. Basiotis PP et al. 55–57.
218. Townsend MS et al. 1311738–1745.
219. Olson CM. “Nutrition and Health Outcomes” 129521S-524S.
220. Olson CM et al. “Relationship between Food Insecurity” 60–66.
221. Jones SJ et al. “Food Insecurity” 145–151.
222. Whitaker RC et al. “Change in Food” 2134–2139.
223. Jones SJ et al. “Modifying Effects” 1091–1094.
224. Hanson KL et al. 1371460–1465.
225. Wilde PE et al. “Individual Weight Change” 1395–1400.
226. Holben DH et al. Diabetes Risk and Obesity.
227. Centers for Disease Control and Prevention. “Self-Reported Concern” 840–842.
228. Townsend MS et al. 1311738–1745.
229. Webb AL et al. 1248–1255.
230. Laraia BA et al. “Self-Reported Overweight” 175–181.
231. Wilde PE et al. “Individual Weight Change” 1395–1400.
232. Centers for Disease Control and Prevention. “Self-Reported Concern” 840–842.
233. Holben DH et al. Diabetes Risk and Obesity.
234. Townsend MS et al. 1311738–1745.
235. Webb AL et al. 1248–1255.
236. Laraia BA et al. “Self-Reported Overweight” 175–181.
237. Hanson KL et al. 1371460–1465.
238. U.S. Department of Agriculture and Economic Research Service. *The Food Assistance Landscape*.
239. Ver Ploeg M et al. Food Stamps and Obesity.
240. U.S. Department of Agriculture and Economic Research Service. *The Food Assistance Landscape*.
241. Wolkwitz K and Trippie C. *Characteristics of Supplemental Nutrition Assistance Program Households: Fiscal Year 2008*. Washington, DC: U.S. Department of Agriculture, Food and Nutrition Service, 2009, [www.fns.usda.gov/ora/MENU/published/SNAP/FILES/Participation/2008Characteristics.pdf](http://www.fns.usda.gov/ora/MENU/published/SNAP/FILES/Participation/2008Characteristics.pdf) (accessed November 2009).
242. Nord M and Golla AM. *Does SNAP Decrease Food Insecurity? Untangling the Self-Selection Effect*. Washington: U.S. Department of Agriculture, Economic Research Service, 2009, [www.ers.usda.gov/Publications/ERR85/](http://www.ers.usda.gov/Publications/ERR85/) (accessed November 2009).
243. U.S. Department of Agriculture and Economic Research Service. *The Food Assistance Landscape*.
244. Ver Ploeg M et al. Food Stamps and Obesity.
245. Fraker TM, Martini AP and Ohls JC. “The Effect of Food Stamp Cash out on Food Expenditures: An Assessment of the Findings from Four Demonstrations.” *The Journal of Human Resources*, 30(4): 633–649, 1995.
246. Breunig R, Dasgupta I, Gundersen C, et al. *Explaining the Food Stamp Cash-out Puzzle*. Washington: Food and Rural Economics Division, Economic Research Service, U.S. Department of Agriculture, 2001, <http://www.ers.usda.gov/publications/janr12/janr12.pdf> (accessed December 2009).
247. Whitmore D. *What Are Food Stamps Worth?* Princeton, NJ: Industrial Relations Section, Princeton University, 2002, [www.irs.princeton.edu/pubs/pdfs/468.pdf](http://www.irs.princeton.edu/pubs/pdfs/468.pdf) (accessed December 2009).
248. Guthrie JF, Lin BH, Ver Ploeg M, et al. *Can Food Stamps Do More to Improve Food Choices?* Washington: U.S. Department of Agriculture, Economic Research Service, 2007, [www.ers.usda.gov/Publications/EIB29/EIB29\\_AW/Article.pdf](http://www.ers.usda.gov/Publications/EIB29/EIB29_AW/Article.pdf) (accessed December 2009).
249. *Supplemental Nutrition Assistance Program Healthy Incentives Pilot*. Washington: United States Department of Agriculture: Food and Nutrition Service, 2009, [www.fns.usda.gov/snap/HIP/default.htm](http://www.fns.usda.gov/snap/HIP/default.htm) (accessed February 2010). (No authors given.)
250. *Accepting SNAP Benefits at Farmers’ Markets*. Washington: United States Department of Agriculture: Food and Nutrition Service, 2009, [www.fns.usda.gov/snap/eat/fm.htm](http://www.fns.usda.gov/snap/eat/fm.htm) (accessed February 2010). (No authors given.)
251. Ver Ploeg M et al. Food Stamps and Obesity.
252. Wilde PE, McNamara PE and Ranney CK. *The Effect on Dietary Quality of Participation in the Food Stamp and WIC Programs*. Washington: U.S. Department of Agriculture: Food and Rural Economics Division, Economic Research Service, 2000, [www.ers.usda.gov/publications/janr9/janr9.pdf](http://www.ers.usda.gov/publications/janr9/janr9.pdf) (accessed December 2009).
253. Shapiro JM. “Is There a Daily Discount Rate? Evidence from the Food Stamp Nutrition Cycle.” *Journal of Public Economics*, 89(2–3): 303–323, 2005.
254. Wilde PE and Ranney CK. “The Monthly Food Stamp Cycle: Shopping Frequency and Food Intake Decisions in an Endogenous Switching Regression Framework.” *American Journal of Agricultural Economics*, 82(1): 200–213, 2000.
255. Jones SL et al. “Lower Risk of Overweight” 780–784.
256. Ver Ploeg M et al. “U.S. Food Assistance Programs” 22–30.
257. Bhattacharya J et al. *Youths at Nutritional Risk*.
258. Gibson D. “Food Stamp Program Participation” 2225–2231.
259. Hofferth SL et al. 703–726.
260. Boumtje PI et al. 115–128.
261. Chen Z et al. 1167–1173.
262. Kaushal N. 968–991.
263. Ver Ploeg M et al. *Food and Nutrition Assistance Programs*.
264. Zagorsky JL et al. 246–258.
265. Meyerhoeffer CD et al. 287–305.
266. Gibson D. “Food Stamp Program Participation” 2225–2231.
267. Jones SL et al. “Lower Risk of Overweight” 780–784.
268. Ver Ploeg M et al. “U.S. Food Assistance Programs” 22–30.
269. Bhattacharya J et al. *Youths at Nutritional Risk*.
270. Gibson D. Food Stamp Program Participation and Health: Estimates from the NLSY97. In: Mitchell R, ed. *Social Awakening. Adolescent Behavior as Adulthood Approaches*. New York: Russell Sage Foundation; 2001.
271. Hofferth SL et al. 703–726.
272. Boumtje PI et al. 115–128.

273. Gibson D. "Long-Term Food Stamp Program Participation Is Positively Related to Simultaneous Overweight in Young Daughters and Obesity in Mothers." *Journal of Nutrition*, 136(4): 1081–1085, 2006.
274. Gibson D. "Long-Term Food Stamp Program Participation Is Differentially Related to Overweight in Young Girls and Boys." *Journal of Nutrition*, 134(2): 372–379, 2004.
275. Kimbro RT et al. 411–418.
276. Gibson D. "Simultaneous Overweight" 1081–1085.
277. Gibson D. "Overweight in Young Girls and Boys" 372–379.
278. Kimbro RT et al. 411–418.
279. Jones SL et al. "Lower Risk of Overweight" 780–784.
280. Ver Ploeg M et al. "U.S. Food Assistance Programs" 22–30.
281. Bhattacharya J et al. *Youths at Nutritional Risk*.
282. Gibson D. "Food Stamp Program Participation and Health: Estimates from the NLSY97"
283. Hofferth SL et al. 703–726.
284. Boumtje PI et al. 115–128.
285. Jones SL et al. "Lower Risk of Overweight" 780–784.
286. Gibson D. "Overweight in Young Girls and Boys" 372–379.
287. Chen Z et al. 1167–1173.
288. Kaushal N. 968–991.
289. Ver Ploeg M et al. *Food and Nutrition Assistance Programs*.
290. Zagorsky JL et al. 246–258.
291. Meyerhoeffer CD et al. 287–305.
292. Gibson D. "Food Stamp Program Participation" 2225–2231.
293. Baum C. *The Effects of Food Stamps on Obesity*. Washington: U.S. Department of Agriculture, Economic Research Service, 2007.
294. Jones SJ et al. "Modifying Effects" 1091–1094.
295. Chen Z et al. 1167–1173.
296. Zagorsky JL et al. 246–258.
297. Meyerhoeffer CD et al. 287–305.
298. Gibson D. "Food Stamp Program Participation" 2225–2231.
299. Gibson D. "Simultaneous Overweight" 1081–1085.
300. Baum C. *Effects of Food Stamps*.
301. Wolkwitz K et al. *Characteristics*.
302. Chen Z et al. 1167–1173.
303. Kaushal N. 968–991.
304. Ver Ploeg M et al. *Food and Nutrition Assistance Programs*.
305. Jones SJ et al. "Modifying Effects" 1091–1094.
306. Zagorsky JL et al. 246–258.
307. Meyerhoeffer CD et al. 287–305.
308. Gibson D. "Food Stamp Program Participation" 2225–2231.
309. Gibson D. "Simultaneous Overweight" 1081–1085.
310. Baum C. *Effects of Food Stamps*.
311. Kaushal N. 968–991.
312. Ver Ploeg M et al. *Food and Nutrition Assistance*.
313. Chen Z et al. 1167–1173.
314. Zagorsky JL et al. 246–258.
315. Meyerhoeffer CD et al. 287–305.
316. Gibson D. "Food Stamp Program Participation" 2225–2231.
317. Gibson D. "Simultaneous Overweight" 1081–1085.
318. Baum C. *Effects of Food Stamps*.
319. Jones SJ et al. "Modifying Effects" 1091–1094.
320. Jones SL et al. "Lower Risk of Overweight" 780–784.
321. Bhattacharya J et al. *Youths at Nutritional Risk*.
322. Gibson D. "Food Stamp Program Participation and Health: Estimates from the NLSY97"
323. Hofferth SL et al. 703–726.
324. Boumtje PI et al. 115–128.
325. Ver Ploeg M et al. *Food and Nutrition Assistance*.
326. Kimbro RT et al. 411–418.
327. Centers for Disease Control and Prevention. "Nutritional Status of Children" 65–69.
328. Bitler M et al. *Medicaid at Birth*.
329. Black MM et al. 169–176.
330. Cole N et al. *Nutrition and Health Characteristics*.
331. Rose D et al. "Has the WIC" 136: 1086–1090.
332. Gibson D. "Food Stamp Program Participation and Health: Estimates from the NLSY97."
333. Ver Ploeg M et al. *Food and Nutrition Assistance*.
334. Kimbro RT et al. 411–418.
335. Centers for Disease Control and Prevention. "Nutritional Status of Children" 65–69.
336. Bitler M et al. *Medicaid at Birth*.
337. Cole N et al. *Nutrition and Health Characteristics*.
338. Rose D et al. "Has the WIC" 136:1086–1090.
339. Jones SL et al. "Lower Risk of Overweight" 780–784.
340. Bhattacharya J et al. *Youths at Nutritional Risk*.
341. Hofferth SL et al. 703–726.
342. Boumtje PI et al. 115–128.
343. Kimbro RT et al. 411–418.
344. Rose D et al. "Has the WIC" 136: 1086–1090.
345. Jones SL et al. "Lower Risk of Overweight" 780–784.
346. Bhattacharya J et al. *Youths at Nutritional Risk*.
347. Gibson D. "Food Stamp Program Participation and Health: Estimates from the NLSY97."
348. Hofferth SL et al. 703–726.
349. Boumtje PI et al. 115–128.
350. Ver Ploeg M et al. *Food and Nutrition Assistance*.
351. Centers for Disease Control and Prevention. "Nutritional Status of Children" 65–69.
352. Bitler M et al. *Medicaid at Birth*.
353. *ibid*.
354. Jones SL et al. "Lower Risk of Overweight" 780–784.
355. Kimbro RT et al. 411–418.
356. Jones SL et al. "Lower Risk of Overweight" 780–784.
357. Bitler M et al. *Medicaid at Birth*.
358. Jones SL et al. "Lower Risk of Overweight" 780–784.
359. Nord M et al. *Household Food Security 2008*.
360. *ibid*.
361. Burstein NR, Patrabansh S, Hamilton WL, et al. *Understanding the Determinants of Supplemental Nutrition Assistance Program Participation*. Alexandria, VA: Office of Research and Analysis, Food and Nutrition Service, 2009. Available at: [www.fns.usda.gov/ora/MENU/Published/snap/FILES/Participation/Determinants.pdf](http://www.fns.usda.gov/ora/MENU/Published/snap/FILES/Participation/Determinants.pdf) (accessed December 2009).
362. Lyons AA, Park J and Nelson CH. "Food Insecurity and Obesity: A Comparison of Self-Reported and Measured Height and Weight." *American Journal of Public Health*, 98(4): 751–757, 2008.
363. Rose D et al. "Household Food Insecurity" 464–473.

### **About Healthy Eating Research**

*Healthy Eating Research* is a national program of the Robert Wood Johnson Foundation. Technical assistance and direction are provided by the University of Minnesota School of Public Health under the direction of Mary Story, Ph.D., R.D., program director, and Karen M. Kaphingst, M.P.H., deputy director. The Healthy Eating Research program supports research to identify, analyze and evaluate environmental and policy strategies that can promote healthy eating among children and prevent childhood obesity. Special emphasis is given to research projects that benefit children in low-income and racial/ethnic populations at highest risk for obesity.

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