

Background

Food insecurity and obesity

In the US, many studies have found evidence that increased obesity may be related to food insecurity – defined as “limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (Franklin et al. 2012). This finding is often described as a paradox as food insecurity is due to inadequate resources to obtain food while obesity results from overconsumption (Dinour et al. 2007). While this relationship has been fairly constant among adult women in the U.S., associations among children and adolescents are much less consistent, for reasons which are unclear (Franklin et al. 2012). With the substantial and rising prevalence of both child obesity and food insecurity, a better understanding of the mechanisms and pathways underlying this relationship may influence the effectiveness of policies and programs designed to combat these issues.

The aims of this policy brief are to:

- (1) Describe the links and possible mediators between food insecurity and child obesity;**
- (2) Explore potential approaches to decrease food insecurity and child obesity; and**
- (3) Identify policy implications and areas of future research to minimize the contribution of food insecurity on child obesity.**

To appropriately contextualize the importance of these issues, this brief first provides background on the magnitude of the childhood obesity problem in the U.S., the prevalence of food insecurity in households with children based on current definitions and instruments, and the types of programs and policies currently in place for addressing food insecurity.

Child obesity in the US: a disproportionate problem in vulnerable populations

Identifying risk factors for child obesity, particularly in the most vulnerable households, is an urgent problem. Childhood obesity is a growing problem in the US. Surveillance data indicate that at present, almost 1 in 3 children between the ages of 2-17 years are overweight or obese based on BMI-for-age percentiles, with over 12% being extremely obese (Ogden et al. 2012). These numbers represent an almost tripling in the prevalence of child obesity between 1976 and 2008 (Singh et al. 2011). Fortunately, the most recent evidence indicates that child obesity rates appear to be reaching a plateau (CDC 2013; Sekhobo et al. 2010). Not all children are at equal risk of obesity. The prevalence and severity of obesity increase with age making adolescents more susceptible than younger children. Hispanic, African American, and Native American children are more likely to be obese than are white children (Ogden et al. 2012). Children living in poverty are also disproportionately affected: the lower a household’s earnings in comparison to the federal poverty level, the greater the prevalence of obesity in children and adolescents

(IOM 2011). Finally, the education level of the head of household is negatively associated with the risk of child obesity (Singh et al. 2010).

How does child obesity affect health?

Children and adolescents who are obese very often stay obese as they age; and the more extreme the obesity in childhood, the higher the BMI when the child reaches adulthood (Freedman et al. 2007; Singh et al. 2008). Obesity has long been known to be associated with a number of different comorbidities (*Box 1*) including diabetes, asthma, osteoarthritis, and depression (NHLBI Obesity Education Initiative 1998). In addition to the most common health effects of obesity, adults with the most extreme obesity during adolescence may suffer from additional health effects including severe walking limitations, lower extremity edema, abnormal kidney function, Polycystic Ovary Syndrome (PCOS) (Inge et al. 2013). And the effects of obesity are cumulative: the longer a person is obese, the higher risk of severe health effects including death.

Box 1. Common Health Effects of Obesity

- Type 2 Diabetes
 - Insulin Resistance
- High Blood Pressure
 - Hypertension
- High Cholesterol
 - Dyslipidemia
- Heart Disease
 - Hardening of the arteries
 - Coronary artery disease
 - Heart attack
 - Stroke
- Joint problems
 - Osteoarthritis
- Obstructive sleep apnea
- Asthma
- Urinary Incontinence
- Social stigmatization
 - Depression
 - Discrimination
- Cancer
 - Breast
 - Colon

Food insecurity: lack of access to adequate food for healthy living

According to the latest reports from 2012, 20% of households with children under the age of 18 experienced some level of food insecurity, compared to 14.5% of households without children (Coleman-Jensen et al. 2013). These estimates are based on classifications of food security levels using the Core Food Security Module developed by the U.S. Department of Agriculture (*Box 2*). The survey questions were developed to capture information on the behaviors and perceptions of household members in four categories with increasing severity of food insecurity: (1) worry about having enough food; (2) reduced quantity or quality of food; (3) reduced food intake of adults; and (4) reduced food intake of children (Frongillo 1999).

Children's food security is classified using additional questions if the household is determined to be food insecure and includes at least one child under the age of 18. The level of food security is determined by the number of affirmative responses to the household and child food security questions such that greater numbers of affirmative responses indicate increasing severity of food insecurity. The most severe level of food insecurity -very low food security- is often

characterized by reduced food intake in children, which results in the most harmful effects on physical and mental health (Jyoti et al. 2005). However, there is growing concern that more moderate levels of food insecurity that do not lead to decreases in intake are linked with poor diet quality in ways that may increase children's risk of obesity.

Box 2. Food Security Definitions (Adapted from IOM 2011)

- **Food Security:** access at all times to enough food for an active, healthy life
- **Food Insufficiency:** inadequate amount of food intake due to lack of resources
- **Hunger:** uneasy or painful sensation caused by lack of food
- **Food Insecurity:** limited access to adequate food due to lack of money and other resources; uncertain ability to acquire acceptable foods in socially acceptable ways

- **Classifications of food security by USDA Core Food Security Module**
 - **High food security:** no reported indications of food-access limitations
 - **Marginal food security:** one or two reports of food-access limitations
 - typically anxiety over shortage of food in the house
 - little to no change in diet or food intake
 - **Low food security:** multiple reports of food-access limitations
 - reduced quality, variety, or desirability of diet
 - little to no indication of reduced food intake
 - **Very low food security:** severe range of food insecurity
 - multiple indications of disrupted eating patterns
 - reduced food intake

Strategies used to increase food security

People use many approaches to provide food to their families. Three main categories of these methods have been described: (1) federal food and nutrition assistance programs also known as the safety net; (2) nongovernment food providers; and (3) individually developed food-acquisition coping strategies.

The Supplemental Nutrition Assistance Program (SNAP), formerly known as Food Stamps, is the largest Federal provider of food and nutrition assistance benefits and the first line of defense against food insecurity (Oliveira 2013). In fact, SNAP been estimated to provide benefits for limited durations to approximately half of all children and 90% of African American children at some point during childhood (Rank and Hirschl 2009). To be eligible for SNAP benefits, a household's income must typically be below 130% of the national poverty line (<http://www.fns.usda.gov/snap/eligibility>). Most federal food and nutrition assistance programs

for children including the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), the National School Lunch Program (NSLP), the School Breakfast Program (SBP), and the Child and Adult Care Food Program (CACFP) require the income of households with children to be below 185% of the national poverty line. Based on these income limitations, 1 in 5 food insecure children are financially ineligible for most federal food assistance programs (Gundersen et al. 2013). These households may be burdened with high expenses associated with medical bills or living in high cost areas, or may be faced with sudden financial shocks such as loss of employment or divorce.

Nongovernment food providers, including food pantries and soup kitchens, are often community-based organizations designed to provide emergency food relief and are not always limited to those meeting income limitation thresholds. Many community food providers are focused specifically on children such as the Backpack Buddies program, school food pantries, and community-sponsored summer food programs. In 2009, the households of approximately 14 million children received food assistance from a food pantry, soup kitchen, or shelter; a 50% increase in the number of children assisted from 2005 (Mabli et al. 2010).

Individually developed food-acquisition coping strategies are those informal practices used by people to ensure they have enough food for themselves and/or their household. These strategies can be in reaction to a financial hardship such as asking a family member to loan them money for food after the loss of a job, or as a means to prevent future food shortages such as buying in bulk when commonly used items are on sale (Edkin et al. 2013). Some individual coping strategies may be considered risky. Skipping meals or eating less nutritious foods may lead to long-term health problems, while eating foods past expiration date or scraping mold from food before eating may pose immediate health risks. In extreme circumstances risky behaviors may escalate into illegal activities such as stealing food or prostitution.

Links between child obesity and food insecurity: inconsistencies in the literature

Reports of direct associations between child obesity and food insecurity have been mixed consisting mostly of no associations, a few reporting positive associations and a few negative associations (Gundersen et al. 2009; Larson and Story 2011). Rather than lack of a causal relationship, differences in study designs and populations may contribute to these inconsistent results. For example, differences in findings across studies may arise due to: (1) differences in the precision or validity of child obesity and food insecurity measures (e.g. parent-reported vs. measured height/weight; household vs. individual food security); (2) differences in the severity of food insecurity under study (e.g. while moderate food insecurity may promote obesity, hunger or severe food insecurity may instead promote undernutrition); and (3) the frequently transient and sporadic nature of food insecurity, which make this exposure challenging to measure. The multifactorial causality of child obesity may also contribute to heterogeneous results. As child obesity is highly prevalent in the US, associations with food insecurity may not be apparent in part because of high background levels due to other factors among those who are more food

secure. These issues need to be taken into account when evaluating the literature on this topic with the aim of gaining insights on how to relieve food insecurity without increasing risk of child obesity.

On the other hand, associations between food insecurity and obesity may be correlative rather than causal. If so, strategies that aim to address both issues may be nonetheless be effective and appropriate. Regardless of the strength of associations between child obesity and food insecurity, it is clear that the children at highest risk of food insecurity and obesity are strikingly similar. As with obesity, being Hispanic, African American, or Native American, living in poverty, and lacking higher education are associated with food insecurity (Gundersen et al. 2013; Coleman-Jensen et al. 2013; Nord 2009; Singh et al. 2010). Food insecurity has also been found to be associated with many of the same chronic diseases as obesity later in life including diabetes, hypertension, and depression, as well as deficits in learning and behavioral problems in children (Martin et al. 2012).

Although associations between food insecurity and obesity are inconsistent in children, most studies of women living with food insecurity have reported consumption of less healthy diets and higher prevalence of overweight and obesity (Dinour et al. 2007). Links between food insecurity and childhood obesity may, in part, be mediated by effects on mothers, often the primary caregivers in these food insecure households. Children living in single parent households headed by women are three times more likely to experience food insecurity than children living in households led by married-couples (Coleman-Jensen et al. 2013). And among low income households, maternal mental health status and stress were found to be strongly associated with food insecurity and child obesity (Melchior et al. 2009; Lohman et al. 2009). Even when a direct association was not observed between food insecurity and obesity, adolescents were more likely to be obese in food insecure than in food secure households when their mothers experienced high levels of stress resulting from lack of employment, low self-esteem, and poor health (Lohman et al. 2009). A similar relationship was found for younger children who lived in low income households but only for those who were food secure (Gundersen et al. 2008). Thus, the health of mothers can have a powerful impact on the health of their children including child obesity. Teaching less risky or more effective individual coping strategies such as gardening skills or savvy food shopping tips to mothers might help increase food security and improve diet quality.

Contribution of food insecurity to obesity

A number of mechanisms are at work in food insecure households to negatively impact diet quality and thereby increase the tendency toward child obesity. The first is lack of access to nutritious and affordable food: lack of sufficient resources directly impacts the quantity and quality of food purchases. Households with limited income, which are most vulnerable to food insecurity, were reported to spend less money per person than food secure households each week (\$37.50 vs. \$50) even after accounting for financial assistance including SNAP benefits

(Coleman-Jensen et al. 2013). And for households headed by single women the average amount spent dropped to just \$33.33 per person each week. On these limited budgets, food purchasing options are often limited to items that are perceived to provide the most quantity at the lowest cost.

Physical access to affordable, healthy foods may also be a limitation. Many low income neighborhoods have few grocery store options and increased numbers of convenience stores and fast food restaurants that offer few healthy food options (Larson and Story 2009). In addition, if the household lacks reliable transportation, they may experience added difficulty in shopping outside of their neighborhood. When healthier foods such as fresh produce and meats are available in neighborhood stores, the prices are often inflated resulting in low demand or the quality may be compromised due to improper storage.

A healthy food environment can have positive impacts on maintaining healthy weight (Cullen et al. 2007). In particular, having fruits and vegetables on hand is associated with a lower chance of obesity for the children and adults living in the home (Jago et al. 2007). However, the combination of lack of resources and limited physical access results in less healthy food purchases. Lower income households, who are at increased risk of food insecurity, tend to purchase foods that are more nutrient poor and energy dense with added fats and sugars making up a higher proportion of the diet (Darmon and Drewnowski 2008). At the same time, they also purchase less whole grains, lean meats, and fruits & vegetables than more affluent households, because these foods are often more expensive than more highly processed shelf-stable foods (Drewnowski and Specter 2004). As a result, the meals served in food insecure households tend to include less nutritious foods including fewer fruits and vegetables (Bruening et al. 2012). In addition, energy dense foods may be viewed as more desirable while under stress leading to higher intakes, and further increasing the risk of obesity (Drewnowski and Specter 2004).

In addition to diet quality, factors such as stress, low levels of physical activity, and limited access to medical care may increase susceptibility to obesity in food insecure children. More research is needed to better understand how these mechanisms contribute to obesity and how to design effective public health interventions to reverse this trend. The following sections provide some examples of successful approaches to improving diet quality in food insecure children.

Approaches to increase access to healthy foods in food insecure households

Decreasing barriers to obtaining healthier foods is the key to decreasing food insecurity as well as child obesity. Participation in federal safety net programs have been found to be effective in alleviating the effects of food insecurity resulting in improved food security levels (Frank et al. 2010; Nord 2012). However, their impacts on obesity are more mixed. For example, girls living in households that participated in at least one safety net program were found to have a reduced risk for obesity, while boys' risk for obesity was not affected (Jones et al. 2003). Because safety net programs have the potential to reach so many children, improvements to these programs are

warranted that focus on creating healthier dietary habits to combat child obesity while simultaneously improving food security.

Although SNAP participants' diets are similar to most Americans, lower consumption of vegetables and higher consumption of energy dense snack foods have been observed in the lowest income families who are most vulnerable to both food insecurity and obesity (Cole and Fox 2008). Decreased intakes of nutrient rich foods may be due to the three barriers mentioned above: lack of financial resources, limited physical access, and unhealthy home food environment. Healthier foods are often not available or are more expensive at the stores where low income families are able to shop. High food costs have been found to be associated with increased child food insecurity and thus decreased intake of healthy foods (Mullany et al. 2013). In addition, lack of familiarity with how to select, prepare, and eat fresh foods may also limit demand in areas serving low income consumers. To address these barriers, therefore, interventions aimed at increasing diet quality should make healthy foods more affordable and accessible, as well as increasing the acceptance of and familiarity with healthier foods by target populations.

Making fresh fruits and vegetables more affordable has been found to be associated with decreased weight status in settings across the US. (Powell et al. 2013). Therefore, many federal safety net programs have made changes to several of their programs to increase access to fruits and vegetables by extending benefits to farmers markets, community supported agriculture (CSA) programs, and other places where fresh produce is sold such as roadside stands. To further decrease barriers many farmers markets now accept payment via electronic benefit transfer (EBT) cards from SNAP participants to make purchases directly from local farmers. Communities are using incentives to further increase access to healthy, local foods for SNAP participants. For example, the New York City's Health Bucks program provides SNAP recipients an incentive of \$2 for every \$5 they spent at area farmers markets (Baronberg et al. 2013). The use of EBT cards at NYC farmers markets has increased dramatically; however because the types of foods purchased are not tracked, it remains unclear whether their purchases included more fruits and vegetables. In San Diego County, a farmers market accepting EBT was founded in a low access neighborhood in 2008 (Lindsay et al. 2013). The Fresh Fund Incentive Program matches up to \$20 of SNAP participants' purchases each month. In a short time, more eligible people enrolled in SNAP and participants of Fresh Fund reported purchasing and eating more fruits and vegetables. Numbers of other similar incentive programs are being formed in cities across the U.S.

WIC has two components designed to increase access to fruits and vegetables: cash value vouchers and the Farmers Market Nutrition Program (FMNP). WIC packages include cash value vouchers of \$10 for women and \$6 for children for purchase of fruits and vegetables (<http://www.fns.usda.gov/sites/default/files/Snapshot-WIC-Children-WomenFoodPkgs.pdf>). The Farmers Market Nutrition Program (FMNP) provides coupons to WIC recipients to make

purchases at local farmers markets along with nutrition education designed to assist in selection and preparation of fresh produce (<http://www.fns.usda.gov/fmnp>). Participants of FMNP reported higher purchase and consumption of vegetables consumption and perceived diet quality were increased in recipients of the FMNP compared to those receiving standard WIC benefits (Kropf et al. 2007; Racine et al. 2010). Some organizations are now bringing the farmers markets to underserved neighborhoods where transportation barriers might keep people from purchasing healthy foods through mobile farmers markets that accept FMNP and other EBT benefits (<http://publichealth.nc.gov/hnc2020/stories/BringingANewMiniMobileFarmersMarketRockinghamCounty.pdf>).

The Healthy Hunger-Free Kids Act of 2010 has laid out changes to the major child nutrition programs to increase the healthiness of foods served to students during school hours (http://www.fns.usda.gov/cnd/governance/legislation/CNR_2010.htm). As part of this Act, the nutrition standards of the NSLP and SBP were revised by the USDA for the first time in 30 years to better meet nutrient requirements of children. The servings of fruits and vegetables, whole grains, and low fat dairy sources were increased, saturated fat and sodium decreased, and portion sizes were changed to provide age-appropriate caloric intake (<http://www.letsmove.gov/healthy-schools>).

Two other initiatives to increase access and acceptance of fruits and vegetables in school children are the Salad Bars to Schools Program (<http://saladbars2schools.org/>) and the Fresh Fruit and Vegetable Program (FFVP). Salad Bars to Schools has added almost 3000 salad bars in public schools and aims to eventually add at least 6000 across the country. FFVP introduces fresh fruits and vegetables as snack options to students attending elementary schools with the highest percentages of students receiving free and reduced-price school meals (i.e., NSLP and SBP) (<http://www.fns.usda.gov/ffvp>). The USDA provides funding to participating schools to purchase and serve fresh produce free to students outside of the NSLP and SBP.

Nongovernment food providers

Although food pantries and other nongovernment food providers were originally intended to provide food after emergency situations and for short durations, many clients are now regularly visiting the same pantries to supplement their monthly food supplies (Martin et al. 2013). Because food providers rely on food donations and many are ill equipped to store fresh foods, poor diet quality has been reported among regular pantry visitors (Robaina and Martin 2013; Duffy et al. 2009). The Freshplace intervention is designed to improve the diet quality of participants by providing fresh food options from which clients can make their own choices, along with monthly counseling sessions and assistance locating other community services (Martin et al. 2013). Freshplace aims to increase food security by addressing the underlying cause, poverty. In the first year, Freshplace was found to decrease the prevalence of very low food security and increase fruit and vegetable consumption compared to clients receiving traditional pantry services.

Individual coping strategies

The coping strategies employed by the head of household, especially when that person is a single mother, significantly impact the food security and obesity status of the adults and children in the home. Mothers determine the healthiness of the home food environment by the types of food purchases they make (Cullen et al. 2007); parenting styles impact children's food choices and their relationships with food (McCurdy et al. 2010); and the stress of poverty and acquiring adequate food for the household can negatively affect mother's mental health leading to negative consequences for their children's health (Dinour et al. 2007). Interventions promoting healthy coping strategies could ease the stress of financial constraints and lead to decreased food insecurity and child obesity.

The Expanded Food and Nutrition Education Program (EFNEP) is a USDA funded program that has been delivered through county cooperative extension agencies across the US since 1969 (<http://www.csrees.usda.gov/nea/food/efnep/efnep.html>). Peer educators offer nutrition education to resource limited community members, who are also at increased risk of food insecurity and obesity. EFNEP classes are offered in a variety of areas to parents and youth in an effort to improve the nutrition knowledge, skills, and attitudes of participants on topics such as shopping for healthy foods on a budget, preparation of healthy meals, and healthy snacking (Serrano et al. 2011).

More research is needed to better understand the coping strategies of limited resource households, especially those led by single mothers. Interventions could then be focused on promoting the use of healthy coping strategies to help alleviate the stress of living in poverty. In addition, stress management classes and adequate mental health resources for mothers and children to respond to conditions that frequently coexist with poverty including anxiety and depression could further improve food security and weight outcomes in children (McCurdy et al. 2010).

Policy Implications

This policy brief has provided an overview of the overlap between food insecurity and obesity in children; the programs designed to improve access to affordable healthy foods; and programs targeted at food insecure children to encourage healthier eating habits to combat child obesity. Reports of associations between food insecurity and child obesity are mixed indicating that the link may not be causal in nature but rather due to common underlying causes. One clear contributor is poverty, which disparately affects children belonging to minority races. Children living in poverty often lack access to healthy foods and safe places to play. Aside from deficits in financial resources, the stress of making ends meet exerts its toll on many single mothers living

in poverty. Excessive stress has been linked with anxiety and depression in both the mothers and children, which has further been associated with increased weight status.

Not all people living in poverty suffer the same negative health consequences. Some employ healthier coping strategies and have access to more social resources than others. Therefore, more research is needed, particularly consisting of longitudinal or prospective studies, to better understand the relationship between food insecurity and child obesity. The focus of these studies should be on the most vulnerable populations including African American, Hispanic, and Native American children, as well as on the unique role mothers play in food choices and healthy weight outcomes. The following recommendations summarize potential areas of focus to concurrently improve food insecurity and child obesity.

1) ***Increase participation in federal food and nutrition assistance programs:*** Increased resources for food allow families to purchase adequate quantities of food, as well foods of higher nutritional value. Encourage parents or other heads of households to enroll all eligible household members in safety net programs. More research is needed to identify the barriers to participation of specific programs especially the WIC program, which has had decreasing participation even during the recent economic downturn. Some evidence has suggested that converting WIC vouchers to an EBT system similar to SNAP would encourage participation.

2) ***Increase the availability of affordable, healthy foods in communities at risk for food insecurity and child obesity:*** An integrated approach is necessary to increase physical access to healthy foods in underserved neighborhoods. Suggested approaches include: subsidies for local produce farmers; incentives for retailers to locate in underserved areas; assistance to current retailers to update storage facilities for stocking fresh fruits and vegetables; acceptance of WIC and SNAP at farmers markets and other local food markets including mobile farmers markets and CSAs; and assistance for establishment and maintenance of community gardens.

3) ***Increase the acceptance of healthy foods by children at high risk of obesity:*** Introduce children to healthy foods in school and through community outreach programs to increase acceptance and preference for healthy foods. Suggested approaches include nutrition education and cooking classes through expansion of Youth EFNEP, FFVP, school salad bars, and school gardens.

4) ***Empower mothers of food insecure children:*** Mothers have powerful influences over the current and future health of their children. Teaching mothers how to shop for, store, and prepare affordable, healthy meals help improve their self-efficacy in serving healthier meals. In addition, other stressors associated with poverty should be addressed such as access to mental health resources, parenting classes, and financial education. More research is needed to better understand maternal stressors and how to lessen the effects of stress on mothers and their children.

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