

**CHILD FOOD INSECURITY IN THE UNITED STATES ASSOCIATED WITH  
CHILDREN'S HEALTH STATUS**

by

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**ABSTRACT**

Child food insecurity is a growing public issue in the United States. In the past decade, research on the relation between food insecurity and children's health in the United States has increased exponentially. The purpose of this essay is to summarize current studies and provide a comprehensive understanding of food insecurity situation among children in the United States. In summary, a positive association between mental health and food insecurity was consistently found, while evidence on physical health and food insecurity was not statistically significant among children. Food assistance programs were approved to have positive impacts on recipients. Besides, economic recession caused significant increases in food-insecure rate. Existing studies suffer from the shortage of experimental research, including the understanding of biological causality and confounders' control. Also, the evaluation of food assistance programs between recipients and non-recipients is hard due to lack of experimental studies. This essay summarized relevant literature and proposed potential explanations for the association between food insecurity and adverse health outcomes.

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## 1.0 INTRODUCTION

Although the United States is an affluent country, the children here are not exempt from poverty and food insecurity. There are many definitions of food insecurity. The United States Department of Agricultural (USDA) defines food insecurity as a state in which “consistent access to adequate food is limited by a lack of money and other resources at times during the year”(“Definitions of Food Security”). According to the definition of Life Sciences Research Office, food insecurity is “whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain”. Food security, as defined in Campbell’s research (Campbell, 1991), exists as is “1) the ready availability of nutritionally adequate and safe foods and 2) the assured ability to acquire personally acceptable foods in a socially acceptable way”. To conclude, food insecurity is described based on food availability and economic situations.

Food insecurity is a substantial public health concern in the United States (US). Food shortage may cause adverse effects long-term health and development, in particular for children. In 2014, 14 percent of US household families were food insecure. Twenty-one percent of children had uncertain access to food. (Coleman-Jensen, Nord, & Singh, 2015). Regarding the geographic distribution of food insecurity, the District of Columbia (31%) and Mississippi (29%) are the top two districts that had the highest rates of children in households without consistent access to food (C. Gundersen, A. Satoh, A. Dewey, M. Kato & E. Engelhard, 2015).

Child food insecurity varies with race, immigration status, and household members' components. African-American children are more susceptible to food insecurity than white children (2.6% vs. 0.6%) (M. Nord, 2010). Immigrant families' children have a higher risk of being in food insecurity than non-immigrant families' (Kasper, Gupta, Tran, Cook, & Meyers, 2000). The number of food insecure children who live in household income-to-poverty ratio under 1.00 is ten times of children whose household ratio above 1.85 (M. Nord, 2010).

Food insecurity does not necessarily cause hunger. When individuals do not have a dependable source of food (food-insecurity), they will frequently develop feelings of hunger. The American Institute for Nutrition (AIN) expert panel defines hunger as "potential, although not necessary, consequences of food insecurity" (Anderson, 1990). A national working group (including USDA, Centers for Disease Control, Prevention, National Center for Health Statistics) started to develop the benchmark of food insecurity and hunger measurement since 1992 (Carlson, Andrews, & Bickel, 1999). There are several measurement criteria for food insecurity and hunger measurement (Carlson et al., 1999). For example, Current Population Survey (CPS) used 18 scale items to assess food insecurity severity and define hunger. However, the criteria between hunger and food insecurity are ambiguous.

Several health problems are consistently reported to relate to child food insecurity and hunger. First, Child hunger is associated with physical health concerns, such as asthma and obesity (John T Cook et al., 2006). Youth who consistently experienced hunger had a higher risk of asthma compared with those who did not (Potestio, McIntyre, & Kirkpatrick, 2010). Children in food insecurity and hunger are more vulnerable to obesity as well (Franklin et al., 2012). Second, food insecurity and hunger are also associated with mental anxiety and depression. In an

epidemiological study, school-aged children with severe hunger were likely to have more stressful life events and higher parent-reported anxiety possibility (Weinreb et al., 2002).

Assessing the effectiveness of food assistance programs is challenging. The US government has spent millions of dollars on food assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and the National School Lunch Program (NSLP). The evaluation of food assistance program is difficult because experimental methods are not an option for legal, ethical and practical reasons (Rose, Habicht, & Devaney, 1998). For example, it is unethical and illegal to impede eligible people to participate in food assistance programs. Multivariate statistical analyses have been used to approve the health benefits of participating in food assistance programs (Moss & Carver, 1998). Involving in NSLP is associated with the alleviation of child hunger that the risk of being in hunger decreases after participating in NSLP (Dunifon & Kowaleski - Jones, 2003).

The Economic recession has a significant influence on food insecurity. The rate of food insecurity follows closely with the incidence of poverty. The number of food-insecure U.S. households increased from 13.0 million (11.1 percent of all households) in 2007 to 17.1 million (14.6 percent) in 2008 (M. A. a. M. Nord, 2009) because of the Great Recession. Analyzing the food insecurity situation changes under economic impacts helps us better understand the association between poverty and food insecurity.

Our objective was to examine current studies regarding the food insecurity and adverse health outcomes in children in the United States, as well as emphasize the role that food assistance programs may play. We also proposed a potential role of economic recession in food insecurity. Numerous studies demonstrated the association between food insecurity and adverse

health outcomes. However, this issue is still inconclusive and debatable. The association between food insecurity and adverse health outcomes including obesity, academic disadvantage, and psychosocial dysfunction will provide a better comprehension of food-insecure influences on children's health, and underscore its public health significance in the United States.

## **2.0 REVIEW**

The impacts of child food insecurity have been established by much research. We will discuss the association between child food insecurity and health outcome in the United States in four perspectives - 1) demographics among child food insecurity, including children's race, immigration status, and household members' components, 2) contribution of child hunger to mental and physical health, 3) evaluation of the effectiveness and benefits of food assistance programs 4) potential association between economic recession and food insecurity situations.

### **2.1 DEMOGRAPHIC CHARACTERISTICS**

In this section, we will mainly review and discuss food insecurity situation regarding children's race, immigration status, and household members components. Food insecurity is not randomly assigned. In Weinreb's research (Weinreb et al., 2002), more than double of Africa-American children live in food-insecure households compared to Caucasian children (36% vs. 15%). The data in Weinreb's research were from homeless and low-income families' children in Worcester, Massachusetts. From USDA's data of counties in the United States, among the 3 percent of African-American majorities (93 African-American majorities 3144 total), 94 percent of them fell into the top 10 percent of counties that had the highest rates of food insecurity. Based on the socioeconomic disadvantages of African-American, this significant difference between races was

not surprising. Firstly, African-American households have a higher ratio of single parents than other races (Murry, Bynum, Brody, Willert, & Stephens, 2001). Secondly, African-American families are more likely to be in poverty (Conger et al., 2002).

From federal data, there were also some demographic differences in the United States (Table 1). In general, no significant changes in food insecurity were observed between 2013 and 2014 in the US (Table 1). However, a difference from 2013 to 2014 in the single-parent family was noticeable. Children who lived with single father had the highest rate of food insecurity in 2013. In 2014, the rate decreased by 22 percentage points. On the other hand, children living with a single mother had the highest rate of food insecurity in 2014, which increased by ten percentage points compared with previous year. It was very likely because of policy-level changes, as the male with children were eligible for more public health benefits after 2013. We didn't find any relevant enrollment qualification changes regarding food assistance programs from 2013 to 2014. However, food insecurity is associated with many other public benefits. More research needs to be done to demonstrate the reason for these notable changes.

From table one, families with children had higher rates of food insecurity versus those families without children. By comparing different races, non-Hispanic black population had the highest rate of food insecurity, which agreed with Weinreb's research (Weinreb et al., 2002). Residents in the southern United States had the highest rate of food insecurity. A plausible explanation is that Southern cities don't have economic advantages over other areas (Tickamyer & Duncan, 1990).

**Table 1. Food Security Characteristics**

Category	Food Insecurity 2013				Food Insecurity 2014			
	Individuals		Children		Individuals		Children	
	Thousands	Percent	Thousands	Percent	Thousands	Percent	Thousands	Percent
<b>All households</b>	49,078	15.8	8,585	14.0	48,135	15.4	7,949	14.0
<b>Household composition:</b>								
<b>With children &lt; 18</b>	31,797	20.1	---	---	30,975	19.4	---	---
<b>With children &lt; 6</b>	16,257	22.3	4,465	19.2	15,361	20.9	4,037	11.2
<b>Married-couple families</b>	15,546	14.3	3,976	19.9	14,843	13.5	3,323	6.8
<b>Female head, no spouse</b>	12,912	35.1	3,800	12.4	13,115	36.5	3,897	21.2
<b>Male head, no spouse</b>	2,670	25.0	646	35.3	2,526	22.0	645	12.5
<b>With no children &lt; 18</b>	17,159	11.3	---	---	17,159	11.1	---	---
<b>More than one adult</b>	12,224	10.3	---	---	12,113	10.1	---	---
<b>Race/ ethnicity of households:</b>								
<b>White non-Hispanic</b>	22,536	11.3	3,333	8.0	22,131	11.1	3,333	7.5
<b>Black non-Hispanic</b>	10,904	28.8	2,074	20.1	10,652	27.7	2,074	18.4
<b>Hispanic</b>	12,835	25.2	2,664	16.7	12,282	23.8	2,664	15.7
<b>Other</b>	2,802	12.0	514	8.8	3,070	12.7	514	8.1
<b>Under 1.00</b>	18,240	43.4	4,020	27.0	17,536	41.1	4,020	26.2
<b>Under 1.85</b>	30,417	36.9	6,110	23.4	29,681	34.9	6,110	21.6
<b>1.85 and over</b>	10,546	6.8	1,293	3.9	10,592	6.6	1,293	3.5
<b>Census geographic region:</b>								
<b>Northeast</b>	7,255	13.1	1,266	10.5	7,815	14.1	1,266	8.8
<b>Midwest</b>	9,525	14.3	1,314	8.3	9,594	14.4	1,314	10.8
<b>South</b>	20,793	17.9	3,994	14.3	19,859	16.9	3,442	12.3
<b>West</b>	11,504	15.7	2,011	11.3	10,865	14.7	2,011	9.9

Source: Calculated by USDA Economic Research Service using data from the December 2013 and 2014 Current Population Survey Food Security Supplement.

From the National Health and Nutrition Examination Survey III (NHANES III) data, Mexican-American children had the greatest risk of being in hunger than other races. In a study to compare child food insecurity in Mexican immigrant families with the children in American households, children living in Mexican immigrant families were at higher risk in child food insecurity situation (Kasper, Gupta, Tran, Cook, & Meyers, 2000). However, this study has a significant limitation, which would influence the strength of the conclusion. The covariates in the research data analyses didn't consider the confounder of household components. Castner's research (Castner, 2000) demonstrated that Latino children had a higher proportion of living in dual-parent households and smaller families. However, considering of that, Latino children still had shown a greater risk of food insecurity in Kasper's study. What other factors could cause the higher risk of being in food insecurity among children in immigrant families? The main reason is that immigrant parents were reluctant to receive the food assistance benefits, despite the fact that these American-born children are eligible for receiving public benefits, such as SNAP and Temporary Assistance for Needy Families (TANF). However, Latino families have significantly lower rate of participating in federally funded food supply programs (Castner, 2000). From a qualitative survey, Latino parents did not want to be tagged as "public charge", which would influence their immigration status and even result in deportation (Capps et al., 2004). Therefore, they did not participate in public benefits programs even if they were in need. However, the US Citizen and Naturalization Service has clarified that receiving non-cash benefits, such as SNAP, would not influence their immigration status ("Fact Sheet: Public Charge "). Unfortunately, these Latino families did not get information about these programs efficiently and correctly (Capps et al., 2004).

Based on our literature review, we found out that African-American children are the most vulnerable population among races. Children from Mexican immigrant families had higher risk of food insecurity compared with American families. Besides, single families are more likely to have difficulty meeting their food needs.

## **2.2 PHYSICAL HEALTH OUTCOMES**

Many studies investigated the contribution of child hunger and the adverse physical health consequences. There are numerous physical health outcomes from food insecurity, and several published studies point out that obesity is a substantial issue related to food insecurity. Besides, obesity is also one of the most significant public health problems in the United States. Therefore, we classified the physical health outcomes into two categories – obesity and other health outcomes.

### **2.2.1 Obesity**

In the past 30 years, the prevalence of obesity has become a substantial public health issue in the US (Flegal, Carroll, Ogden, & Johnson, 2002). The growing trend of obesity among children is even more severe than adults. The prevalence of child obesity was nearly tripled among these children in age 6 to 11 years old in the past 30 years (Ogden, Flegal, Carroll, & Johnson, 2002). Obesity has been linked to numerous poor health outcomes such as high blood pressure, diabetes and heart disease (Mokdad et al., 1999). Many studies pointed out that the increasing trend of

obesity was related to food insecurity. The increase in both child hunger and obesity seems paradoxical. However, several studies have shown they were related.

Dietz conducted the first case study demonstrating the correlation between food insecurity and obesity (Dietz, 1995). A little girl was found to be obese and yet also experienced food insufficiency. Analysis of the case led to two principal explanations for the obesity under food insecurity. Firstly, families bought cheaper food with a higher caloric value due to poverty. Secondly, children without stable food supplies were more likely to binge (Dietz, 1995). Although it was a qualitative study between food insecurity and obesity, further studies to examine the relationship started since then.

After the case study by Dietz, there was various research conducted on large populations to establish the association between obesity and food insecurity. In a longitudinal study examining the relationship between food insecurity and obesity in preschool children, children in food-insecure families had a higher risk of child obesity as compared with those were not (odds ratio (OR)=1.22,  $P<0.05$ ) (Metallinos-Katsaras, Must, & Gorman, 2012). In this study, investigators chose maternal weight status, maternal age, maternal education, household size, child's age, and birth weight as covariates in the analysis. Based on previous studies that maternal weight status could significantly influence child weight (Townsend, Peerson, Love, Achterberg, & Murphy, 2001), two analytical models were developed separately in the study (with or without maternal weight status). In the maternal weight status adjusted analysis model, the odds of children with obesity is 1.34 times of children without obesity ( $P=0.03$ ) (Metallinos-Katsaras, Must, & Gorman, 2012). Comparing with unadjusted maternal weight status model (OR=1.22), adjusted model showed a higher influence on child obesity. This study provided us prospective evidence of the association between food insecurity and child obesity, as well as the

maternal factors influences on child weight. In another research, the NHANES III survey data from 1988 to 1994 were applied and it was found that food insufficiency was positively associated with obesity in female non-Hispanic white girls (K. Alaimo, C. M. Olson, & E. A. Frongillo, 2001b). From this results, non-Hispanic white girls in food-insecure households had higher BMIs (body mass index) than those in food-secure. However, these two study outcomes were not substantial evidence to demonstrate the correlation between food insecurity and hunger. The main reason is that these two studies were based on questionnaire data. Selection bias is possible, given the sampling technique applied.

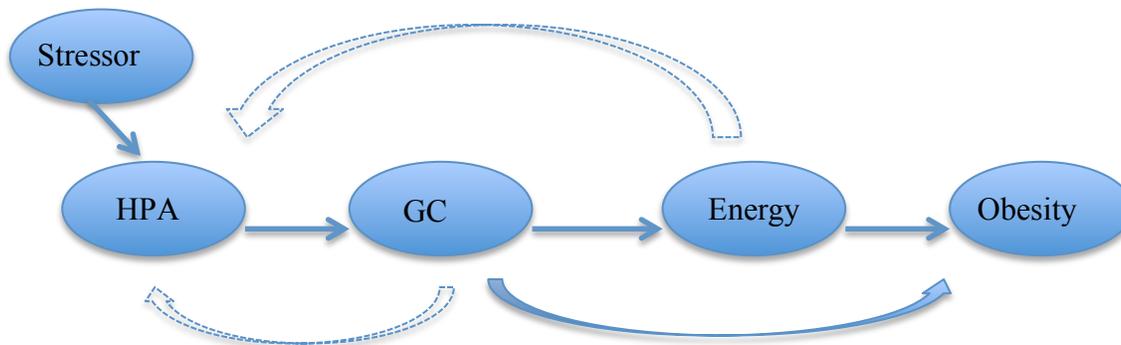
There are two plausible main explanations for the association between food insecurity and obesity: energy-dense food consumption and mental stress. First, food insecure people are more likely to consume energy-dense food. Individuals in poverty attempt to select less expensive but more energy-dense foods to maintain dietary energy. Energy-dense foods composed of refined grains, added sugars, or fats may represent the lowest-cost option to the population in poverty (Drewnowski & Specter, 2004) because energy density (MJ/kg) is reversely associated with energy cost (\$/MJ). In Basiotis' behavioral model (Basiotis, 1992), household members faced with diminishing incomes first consumed less expensive foods to maintain energy intakes at a lower cost. Thus, Obesity is expected to affect the poor population, disproportionally (Drewnowski & Specter, 2004). In NHANES III, investigators have already started to use criteria of energy consumption as an indicator to explore food insecurity. Table 2 is an example of NHANES III to assess food security among the population. It is crucial to understand food details, such as the vegetable and protein consumption in meals, to help identify food insufficiency.

**Table 2. Third National Health and Nutrition Examination Survey**

Component	Criteria for Score of 0	Criteria for Score of 10
Grains	0 servings	6-11 servings
Vegetables	0 servings	3-5 servings
Fruits	0 servings	2-4 servings
Milk	0 servings	2-3 servings
Meat	0 servings	2-3 servings
Total fat	>44% calories fat	<31% calories fat
Saturated Fat	>14% calories	<10% calories
Cholesterol	>449 mg	<300 mg
Sodium	>4,799 mg	<2,400 mg
Variety	4 different categories a day	7 different categories a day

Source: Third National Health and Nutrition Examination Survey. People with consumption or intakes between the maximum and minimum ranges or amounts were assigned scores proportionately.

In the second explanation, some evidence from animal studies suggested that food insecurity is a stressor which could lead to a preference for energy-dense foods (Adam & Epel, 2007; Dallman et al., 2003). Comfort foods model theory (Dallman et al., 2003) suggested that stress activated the hypothalamic-pituitary-adrenal (HPA) axis, releasing cortisol which can change metabolic effects. Chronic stimulation to HPA axis resulted in excess canonical glucocorticoids (GCs) exposure which may play a potential role in the development of visceral obesity (Adam & Epel, 2007). In Dallman’s model, under long-term stressor, there was marked diminution of the efficacy of glucocorticoids (GCs) feedback. Under chronic stress (Figure 1), the feedback inhibition in HPA was not only from GCs but also was a consequence of metabolic effects of GC increasing abdominal energy stores (Dallman et al., 2003).



**Figure 1. Chronic Effects of GC on HPA**

### **2.2.2 Asthma and Anemia**

Asthma and anemia associate with food insecurity. They are predominant public health issues among children. Besides they are relatively more research and studies to demonstrate the association between asthma and anemia and food insecurity than other diseases.

Anemia is in high prevalence among children in hunger (McIntyre, Connor, & Warren, 2000). In a cross-sectional study, food-insecure children were found to be more likely to have Iron Deficient with Anemia (IDA) than food-secure children (Skalicky et al., 2006). This study established the correlation between depressed iron status and child food insecurity (Skalicky et al., 2006). After adjusting possible confounders (whether the caregiver was U.S.-born, caregiver education, employment, and welfare status, household size and whether the child was ever breastfed), food insecure children had 2.4 times ( $P=0.02$ ) odds of having IDA compared with food secure children (Skalicky et al., 2006). There is little literature evidence that demonstrates the biological or physiological causality between food insecurity and IDA.

As for the asthma conditions, a long-term survey by the Canadian National Longitudinal Survey of Children and Youth (NLSCY) validates the association between asthma and child hunger. (Kirkpatrick, McIntyre, & Potestio, 2010). The study was conducted using questionnaires to assess children health. In consideration of possible reporting bias, Person Most Knowledgeable (PMK) was a variable indicating whether people filled out the survey other than their biological mothers. Stratified analyses were also conducted to assess the relationship between hunger and health outcomes to eliminate gender as a confounder. The result of this study pointed out that a higher risk of poor health status was observed among children who had

experienced food insecurity compared with those who never had, after adjusting for baseline health. Asthma was not approved to be related with experiencing hunger. Table 3 is the statistical analysis outcome of this study. From Table 3, food-insecure children have 2.48 times ( $P < 0.05$ ) odds of poor general health, compared with those were food-secure. As for asthma, children were 40 percent more likely to have asthma if they were ever in food insecurity. However, this outcome was not statistically significant ( $P > 0.05$ ). This study also applied PMK to control reporting bias, which was from parents-reported general health outcomes on behalf of children. In Table 3, PMK did not show any significant difference between biological and non-biological mother in poor general health and asthma (OR=0.91 and 1.02, respectively). However, general health was poorly defined in this literature. (Kirkpatrick et al., 2010)

**Table 3. Child Hunger Experience and Health Outcome**

Variables	Odds Ratio(95% Confidence Interval)	
	Poor General Health	Asthma
<b>Hunger</b>		
Ever hungry	2.48(1.32-4.64)	1.41(0.79-2.51)
Never hungry	1.00(Reference)	1.00(Reference)
<b>Sex</b>		
Female	1.15(0.87-1.50)	0.66(0.52-0.84)
Male	1.00(Reference)	1.00(Reference)
<b>Identity PMK</b>		
Biological mother	0.91(0.65-1.26)	1.02(0.78-1.24)
Individual other than biological mother	1.00(Reference)	1.00(Reference)

**Source: Human Resources Development Canada**

In conclusion, food insecurity is related to obesity, asthma and anemia. As for obesity, there was various research consistently approved the association between them. Also, there was a biological causality to demonstrated their association. On the other hand, from present studies,

the association between food insecurity and asthma/anemia outcomes was hard to establish, since most of the results were not statistically significant. Besides, experimental research was sparse between them.

### **2.3 MENTAL HEALTH OUTCOME**

Children who experienced hunger are more likely to show psychosocial dysfunction and academic disadvantages. In an epidemiology study conducted in Pittsburgh, researchers found that there was a significant association between psychosocial functioning problems and child hunger (Ronald E. Kleinman et al., 1998). Psychosocial factors include anxiety, eating disorder and mood disorder. In this research, investigators used Pediatric Symptom Checklist (PSC) as a screening measure for all parents to estimate the hunger situation to identify children's psychosocial dysfunction, which was proved to be efficient for school-age children (Jellinek et al., 1988). Twenty-one percent of hungry children were classified as psychosocial dysfunction by PSC, compared with 6 percent of at-risk for hunger children and 3 percent of not hungry children (Ronald E. Kleinman et al., 1998). Although PSC score is not clinical indications for particular mental diseases, these findings implied the importance of the awareness of mental health and food insecurity (Ronald E. Kleinman et al., 1998).

The association was established between household food insecurity and children's health-related quality of life, after adjusting variables of child age, ethnicity, gender, and family income (P. H. Casey et al., 2005). Health-related quality of life is a "multidimensional construct includes physical, emotional, social, and school functioning and allows measurement of function that transcends the presence of symptoms or specific conditions"(P. H. Casey et al., 2005) In this

study, children's health-related quality of life differed from age groups. Teenagers (aged 12-17 years) in food insecure households were more severe in psychosocial functioning than children (aged 3-8 years). African-American children also had the worst psychological conditions compared with other races. A positive relationship between hunger status and academic achievement has been found in most observational studies using American national data. For instance, Kleinman observed that students who reported low nutritional intake had a higher risk to have bad academic performances (grade point averages (GPAs), reading, math, social studies, and science), comparing with students from the same school but with better nutrition and food intake (Ronald E Kleinman et al., 2002). Children may also experience anxiety due to skipping or unpredictable meals (Whitaker, Phillips, & Orzol, 2006). Housing and other basic material needs among children in low socioeconomic levels also resulted in higher level of stress (Buckner, Bassuk, Weinreb, & Brooks, 1999).

There was an interesting animal experimental study that was conducted on bonnet macaque females and their offspring to demonstrate a causal association between food insecurity and behavior problems (Rosenblum & Pully, 1984). Bonnet macaque females were randomly assigned into three groups: low foraging demand, high foraging demand, and variable foraging demand to simulate the food insecurity situation. Bonnet macaques in the low food-secure group had the highest levels of dominance patterns, and were less likely to groom. Also, they had the lower level of social playing, and more inclined to be depressed (Rosenblum & Pully, 1984).

According to the observational study evidence and animal studies, there is a potential association between food insecurity and behavior problems. However, no causality has been approved.

## 2.4 FOOD SUPPORT PROGRAMS

It is difficult to remediate people in hunger status, because they have lower productivity and are more susceptible to diseases. Federal and state governments and legislators have worked together and put substantial efforts to help children in food insecurity. The actions taken to relieve child food insecurity situations in the United States have been proved to help those children and families in food insecurity (John T. Cook, Frank, Berkowitz, & Black, 2004). There are numerous food support programs in the United States to help these children in food insecurity. In this essay, we will mainly review some relevant research on the Supplemental Nutrition Assistance Program (SNAP) and Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

SNAP (used to be called Food Stamps Program) is the largest food assistance program in the United States that is “the most critical component of the safety net against hunger because it provides basic protection for citizens of all ages and household status” (U.S. Department of Agriculture, Food and Nutrition Service). There are many studies to show the benefits of SNAP to alleviate food insecurity. A study shows that women who participated in SNAP were shown to improve maternal depression condition (P. Casey et al., 2004), after adjusting for study site, race, insurance type, education, and low birth weight. Maternal depression was reported more commonly in families whose food stamps were sanctioned (OR=1.56, P<0.05), while compared with families whose food stamps were not reduced. The results demonstrated that the SNAP attenuated the association between positive maternal depression and food insecurity. Moreover, there was another study discovering the relationship between food insecurity alleviation and SNAP recipients (DePolt, Moffitt, & Ribar, 2009). In Depolt’s study, investigators collected a rich set of measurements that have typically been omitted from other studies. In addition to the

measures of hardships and program participation, the questionnaire included income, wealth, social resources, disability, physical health and family structure to account for selection bias between food assistance program participant and non-participants. Their findings were reinforced by more comprehensive consideration of covariates. In DePolt's study, the association between food insecurity and participation in SNAP was significant. Nevertheless, the data in this study were only from three cities in the United States, which is hard to represent the situations in the United States.

WIC is a supplemental food program in the United States developed by the United States Department of Agriculture. It provides food, nutrition counseling, health care screening and special nutritional supplies for infants, children, and women. Families not receiving WIC assistance had higher rates of food insufficiency ("Policy Basics: Special Supplemental Nutrition Program for Women, Infants, and Children," 2015). In Moss' study, all the infants in this study were recruited from emergency room department; demographic characteristics, like age, gender and race, were also controlled in the study (Moss & Carver, 1998). Participation in the WIC program during pregnancy and infancy associated with a reduced risk of endogenous (OR=0.68) and exogenous infant deaths (OR=0.62), after control for insurance status, health behaviors, birth weight, and preterm status (Moss & Carver, 1998). Regarding infant health, there were two explanations for the benefits of the WIC program. Firstly, they could get food from WIC packages. Secondly, infants have better access to health care.

There are a growing number of studies to investigate the United States food assistance programs benefits on food-insecure populations. For example, studies that evaluate the Head Start, and the School Lunch and Breakfast Programs, have shown small but significant benefits that children who participated in these types of programs have better grades and fewer of school

skipping or dropping (Alaimo et al., 2001; Meyers, Sampson, Weitzman, Rogers, & Kayne, 1989). There was a study demonstrated that food-insecure children who had joined in Head Start and Free Lunch program had better school achievements and health status than those did not (Vermeersch, 1980). Women, infants, and children who did not participate in food supply programs were more likely to be underweight, short and poor health, compared with food program assistance recipients (Vermeersch, 1980).

Nevertheless, the current studies and research of food assistance program evaluation have two limitations. Firstly, randomized control trials cannot be used to demonstrate the causality between food assistance programs and food insecurity alleviation, because of legal, ethical and practical reasons. Generally, well-designed and implemented randomized controlled trials are considered the "gold standard" for evaluating an intervention's effectiveness. However, this option is eliminated out. Secondly, the self-selection between food assistance program participants and non-participants is a potential bias in analysis. For example, SNAP participants are less food secure than non-participants who are otherwise similar in measured characteristics.

Based on previous analysis, implementation of food assistance program could still be improved. For example, 91 percent of the families who were eligible for WIC in the Moss' study had enrolled in the program. Although it was a high coverage for families in need, there are still some food-insecure families that are not in the program (Moss & Carver, 1998). There are two recommendations regarding the improvement of food assistance program. 1) Paperwork could be further simplified. Some programs require complex documentation, and only eligible children (those in poverty) may participate. Simplification of document could reduce the difficulty of enrollment. 2) The way to provide assistance need to be improved. In a report in 2008, some

children in hunger would rather not get free lunch, because the free lunch was served in separate windows in their school (Harwell & LeBeau, 2010).

In conclusion, significant benefits of participating food assistance programs were demonstrated by the studies in our review. However, the study methods could still be improved for more accurate evaluation.

## **2.5 ECONOMIC RESSESION IMPACTS ON FOOD INSECURITY**

At the end of 2007, the Great Recession occurred in the United States. The unemployment rate of 4.3 percent observed in 2007 rose to a peak of 10 percent at the end of 2009. A study by Draze points out that economic stagnation was highly related to food insufficiency (Dreze, Sen, & Hussain, 1995). The total number of individuals in food insecurity was shown to increase by 3.6 percent, from 2007 to 2008 when the Great Recession started. There are two plausible explanations: unemployment and price volatility. First, more people experienced food insufficiency due to the increased unemployment rate at that time. From previous research (Harrison, Sharp, & Manolo-LeClair, 2007), unemployed individuals are more vulnerable to food insecurity. Unstable employment may compound with the experience of food insecurity by rendering more stress for households (Wunderlich & Norwood, 2006). Second, inflation happened when economy recesses. The rate of inflation in 2008 in the United States was the highest in past 17 years (Young, 2008). With the food price increasing, people have less

purchasing power, which leads to adverse dietary consequences for low-income households. For example, people would purchase energy-dense but nutrient-poor food.

In reverse, food insecurity burdens economy by causing increased health care spending such as obesity and poor educational outcomes in children (C. Gundersen, Kreider, & Pepper, 2011). The health-related expenditures related to household food insecurity, include the costs of disease and special education. In 2014, a new study by researchers at Brandeis University and the Center for American Progress demonstrated the costs of health-related issues caused by food insecurity was estimated to be 106.07 billion dollars.

In summary, economic recession has a substantial negative influence on food insecurity rate in the Unites States.

### **3.0 CONCLUSION AND LIMITATION**

This essay reviewed relevant literature to demonstrate the association between food insecurity and adverse health outcomes for children in the United States, as well as how economic collapse could influence food insecure status. Meanwhile, we analyzed the effectiveness and benefits of food assistance programs, the primary strategy the United States government implement to alleviate food insecurity.

Child hunger varied according to different races, immigration status and household components. Certain demographic characteristics were related to a higher ratio of food-insecure children. African-American children had a significantly higher risk to be in food insecurity situation; Children lived with single father were the most vulnerable population among all types household compositions.

The association of how child hunger negatively affected children's health, short or long term, was not established. Most works of literature demonstrated the association based on observational studies. However, in child food insecurity observational studies, there were a bunch of unobservable covariates that could influence outcomes. Long-term child health insecurity was hard to track; thus it was difficult to establish its correlation with child hunger. There was also possibilities that other household features, which the research did not control, caused children to have adverse health outcomes.

Food assistance programs have demonstrated significant benefits in child food insecurity alleviation. We could conclude that food assistance programs are potentially an effective method to relieve food insecurity among children. We also discovered food insecurity was significantly deteriorated after the Great Recession in the United States. This phenomenon implied that fiscal situation and food insecurity are related with each other.

In conclusion, the association between child food insecurity and adverse health outcomes has been verified by a rich amount of literature. However, the causality between them was hard to demonstrate due to lack of experimental studies. Nevertheless, It is noteworthy that researchers have already perceived that food insecurity is a significant issue and they have done lots of investigations on food insecurity and health outcomes. Federal and state government has established a mature data system to record the food insecurity situation in the United States. In most studies, researchers could get large populations to perform statistical analysis in order to find out possible correlations between food insecurity and influential factors. Besides, American governments implemented domestic food assistance programs, which increased food security and reduced hunger by providing food, a healthful diet, and nutrition education to people in need.

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