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A Systematic Literature Review of Household Food Security and Overweight/Obese Status Among Low-Income Children

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The University of Southern Mississippi

A Systematic Literature Review of Household Food Security and Overweight/ Obese Status

Among Low-Income Children

By

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A Thesis

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CHAPTER 1: Introduction and Significance

Statement of the Problem

In the United States, the overweight/obese status of children has become a major health concern that continues to remain at unacceptably high levels, and has become the focus of many healthcare professionals, educators, advocates and parents. Child and adolescent obesity is often associated with adverse outcomes including various social well-being deficits, hypertension, type-2 diabetes and depression (Daniels, 2006). Approximately 17% of children and adolescents ages 2-19 years are considered obese, with body mass indexes (BMIs) at the 95th percentile or greater (Nihiser et al., 2007; Ogden, Carroll, Curtin, Lambert & Flegal, 2010). In addition, almost 32% of children are at the 85th percentile or the overweight category (Nihiser et al., 2007; Ogden, Carroll, Curtin, McDowell, Tabak & Flegal, 2006). Furthermore, research indicates that since the 1980's, childhood obesity has increased almost threefold (Ogden, Carroll, Curtin et al., 2010). However, obesity rates among preschoolers have leveled out at lower than expected levels over the past decade. In 1999-2000 American children experienced a 10.3% obesity rate which rose in 2003-2004 to 13.9%, and dropped to 10.4% in 2007-2008 (Ogden, Carroll, Curtin et al., 2010). The rate of obesity reported for children ages 2-5 years in 2009-2010 was 12.1% (Ogden, Carroll, Kit, & Flegal, 2012). Further, some states with the highest child obesity rates, such as Mississippi, are also reporting rate stabilization in preschool and school aged children (Harbaugh, Kolbo, Molaison, Hudson, Zhang & Wells, 2011; Molaison, et al., 2010).

There are several factors associated with overweight and obese status of children, including being from a low-income household (Ogden, Lamb, Carroll & Flegal, 2010). Although current studies are inconsistent among the different racial groups, children of low-income families tend to have a higher chance of being overweight as opposed to children from families in higher-income brackets (Ogden, Lamb, et al., 2010). According to Drewnowski and Darmon

(2005), foods that fall into the category of empty calories (high fat, high sugars, little nutritional value) tend to cost less and are more easily attainable than fresh produce and other energy dense foods in low-income areas. Thus, it may be concluded that diet cost and quality tend to impact dietary intake in low-income family members (2005).

Another major factor that may be associated with childhood obesity is food insecurity. Food insecurity is defined as a psychological response to the limited availability or uncertain access to food, while hunger tends to be a physiologic response that may be a consequence of food insecurity (Casey, Simpson, Gossett, Bogle, Champagne, Connell & Weber, 2006; Nord, Coleman-Jenson, Andrews & Carlson, 2010). Even with government assistance food programs such as Food Stamps, food insecurity and hunger still play a role in the lives of many in the United States (Bickel, Nord, Price, Hamilton & Cook, 2000). Research from the USDA found that 14.7% of households were deemed food insecure for some part of a 2009 study and 34.3% of these households included children (Nord et al., 2010). According to 2011 data from the USDA, food insecure households raised a minute amount to 14.9% nationally, with Mississippi and Arkansas tied for having the highest rates at 19.2% (Coleman-Jensen, Nord, Andrews & Carlson, 2012). Food insecurity in Kindergartners has been linked to negative academic performance, primarily in mathematics and reading (Jyoti, Frongillo & Jones, 2005). In addition, food insecurity has led to boys having decreased social skills and girls having a predisposition to weight gain (2005).

As previously mentioned, obesity rates among preschoolers have leveled out at a lower than expected rate over the past decade with the year 1999-2000 reaching a 10.3% obesity rate to 13.9% in 2003-2004 and dropping to 10.4% in 2007-2008 (Ogden & Carroll, 2010). For instance, longitudinal study found the overweight and obesity rates among preschoolers aged 3

to 5 years in Mississippi Head Start programs, which exclusively serve preschoolers from low-income families, to be 20.6% and 17.9% respectively in 2005, and in 2010 the overweight and obesity rates were 20.8% and 17.0% (Harbaugh et al., 2011). These rates did not stray significantly from the original data collected suggesting that the obesity trend is indeed stabilizing nationally. However, the three year olds had a significant drop in the obesity category from 20.3% to 13.1%, suggesting that parents may be acting on early childhood education about obesity and/or increased screening and intervention efforts by the state. In addition, a 2005 study conducted among African-American, low-income preschoolers in the Mississippi Head Start Program have shown a combined obesity and overweight rate of 38.5% , which exceeds the national average of 26% in low-income preschoolers (Harbaugh, Bounds, Kolbo, Molaison & Zhang, 2009; Ogden et al., 2006).

Children in food insecure households have been linked to adverse health and social outcomes (Vieweg, Johnson, Lanier, Fernandez & Pandurangi, 2007). Even with some perceived strides in the battle against childhood obesity, obesity and food insecurity remains highly prevalent in low-income families.

Statement of the Problem

Research studies reporting on associations between low-income children's obesity and household food security are important to understand, as they may be important variables to consider when designing future research studies and clinical interventions to reduce child obesity. Further, the contextual factors that may influence child obesity have not been fully explored (Davison & Birch, 2001; Reifsnider, Gallagher & Forgione, 2005). Thus, a systematic review process will be used to examine what is known about the relationship between low-

income children's obesity and household food security, with recommendations for future research, education and practice.

Significance

According to the American Nurses Association's scope of nursing practice, health promotion, assessment, screening, education, outcome evaluation, and referral to other professionals are needed to deal with the problem of child obesity at all family income levels (Jordan-Welch & Harbaugh, 2008). One reason that nurses are concerned with childhood obesity is that child obesity has many negative effects on the health and livelihood of the child continuing into adulthood and beyond. Consequently, the goal is to prevent and maintain a reduction in childhood obesity in order to introduce healthy life patterns that will sustain health into and through adulthood (Harbaugh, Jordan-Welch, Bounds, Blom & Fisher, 2007). Food security appears to be related to economic and family factors that play vital roles in children's nutrition. Determining levels of food insecurity may be used to improve children's access to healthful foods, and to educating parents and children about food insecurity and its influence on food choices through helpful programs (Nord, 2009). Thus, determining the relationship of food insecurity and its role in low-income children's obesity is important to nurse researchers, educators and practitioners.

CHAPTER 2: Methodology

Overview of Methods

A systematic literature review approach was used to determine the extent of knowledge regarding low-income children's BMI and household food insecurity. Recommendations were made for impending research, studies, and practices regarding the consensus of current knowledge in relation to low-income children with higher BMIs that come from a food insecure household. Current studies were analyzed, with special attention to methods and findings.

Systematic Review Question

The question answered by this review is: What are the known relationships between low-income status, household food insecurity, and child obesity?

Systematic Literature Review

A systematic literature review is a method used in many health-related disciplines to evaluate the state of science and strength of evidence on which to base practice changes (Brown, 2012). Systematic literature reviews critically appraise, evaluate and identify limitations and strengths of studies related to a specific topic. The review process starts with a comprehensive search strategy and rigorous, transparent appraisal methods. Study selection bias is limited when more than one reviewer participates and applies search standards to the review process (Dearholt & Dang, 2012).

A data base search of Medline was conducted using the search terms 'child obesity and food insecurity'. The search findings were further narrowed using 'low-income'. Various ordering of the terms were also entered into the search engine. The list of returned articles was further limited using the advanced search feature to retrieve only research studies or reviews of literature. This same search was repeated using Pub Med, CINAHL, Cochrane Libraries,

MeSH and SCOPUS. The search lists were examined by the author for duplication of articles, and to make sure all of the articles were either research or review articles. The author retrieved the 39 articles. The author, along with the aid of the of an advisor, reviewed 27 unduplicated articles and 12 articles were rejected due to irrelevance, wrong population, bias, or insufficient conclusions. This resulted in 15 research articles and 3 review/research synthesis articles included in the systematic review (See Table I).

The author read each of the studies, created summaries, and identified strengths and weaknesses of each study. Finally, an overall synthesis of findings was agreed upon by the author and the advisor.

Important Terms Defined

Though the concepts of low-income, obesity, and food insecurity were found in the literature, terms have evolved over time, and have also been refined and differentiated from other similar concepts. Another observation is that there are several different types and levels of measurement used across studies, which confound the ability to identify clear scientific relationships among the studies.

Body Mass Index and Overweight/Obese.

Body Mass Index (BMI) is an important screening and diagnostic tool that is used to indirectly determine the amount of body fat for the average person. BMI adjusts for height and weight with weight being calculated as weight in pounds divided by height in inches squared. Then, this number is multiplied by 703. Alternatively, weight in kilograms may be obtained and divided by height in meters squared. The BMI is then plotted on a BMI for age and gender chart published by the Centers for Disease Control and Disease Prevention (CDC). Though the

categorical labels are evolving, according to the CDC, BMI status for children is defined as follows:

1. BMI less than 5th percentile- underweight
2. BMI 5th to 84th percentile- healthy weight
3. BMI 85th to 94th percentile- at risk of overweight
4. BMI greater than 95th or greater- overweight

According to the American Medical Association terminology, which switched to using the terms overweight and obese for children to reflect the dire crisis physicians were observing, the last two categories differ from CDC terminology in that children that fall into the BMI 85th to the 94th percentile are overweight and those with BMIs above the 94th percentile are deemed obese (AMA, Nihiser et al., 2007). Discussion is underway for a resolution to the categorical differences, with indicators favoring the AMA terminology. For this study, the CDC terms have been translated into AMA terminology.

Studies in the review used a variety of other child weight measures besides BMI, including waist circumference, triceps skinfold thickness, trunk fat mass, and body fat (Gundersen, Garasky & Lohman, 2009).

Food Security.

Thirty years ago, research began to better understand such topics as food security and food insecurity, which led to the Life Sciences Research office (LSRO) developing definitions in 1990 for food security, food insecurity, and hunger (Bickel et al., 2000). The definitions are as follows:

1. Food security — “Access by all people at all times to enough food for an active, healthy life. Food security includes at a minimum: (a) the ready

availability of nutritionally adequate and safe foods and (b) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing or other coping strategies).”

2. Food insecurity — “...exists whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain.”

3. Hunger — “...the uneasy or painful sensation caused by a lack of food, is in this definition a potential, although not necessary, consequence of food insecurity. Malnutrition is also a potential, although not necessary, consequence of food insecurity.”(Andersen, 1990, p6).

Since 2006, a continuum distinguishing food secure from food insecure has been defined as high food security, marginal food security, low food security, and very low food security. The definitions are as follows:

1. “High food security (old label=Food security): no reported indications of food-access problems or limitations.
2. Marginal food security (old label=Food security): one or two reported indications--typically of anxiety over food sufficiency or shortage of food in the house. Little or no indication of changes in diets or food intake.

The use of Food Security was used to describe either the household as a unit, and was usually determined by self-report of one parent or more, a mother’s self-report of food security, or child self-report.

Low-Income.

Low-income is described using various terms in the low-income child and family literature. The levels chosen by researchers to indicate low-income status appear to be determined by available sample characteristics and determinations in large data sets. Therefore, there is no single standardized definition used from study to study. Terms used were defined in reference to national standards for at or below Poverty level, including over the poverty level by 150% or 200%. As long as the term low-income was a descriptor of the sample, the study was included in the review.

CHAPTER 3: Results

A summary of the reviewed articles is presented in Table 1.

Factors Related to Childhood Obesity

The literature is fairly clear about the many factors that are related to child and adolescent overweight and obesity. These can be best categorized by diet, activity, and psycho-social influences, including income and food insecurity. A diet rich in “refined grains, added sugars and added fats are among the lowest-cost sources of dietary energy” and play a significant role in the development of overweight and obesity status that often leads to other health disparities, which is often seen among populations of the lower socioeconomic status (Drewnowski & Darmon, 2005, p 265S). Nutrient rich foods such as fresh produce and lean meats tend to cost significantly more, which encourages those with lesser means to purchase calorically dense foods. In addition, these calorically dense foods tend to lead to overconsumption, since these high fat, high sugar and little nutritional value foods do not produce a sustained sated effect on the individual. This overconsumption inevitably leads to weight gain in the typical individual (2005). Furthermore, parents are responsible for feeding children with the appropriate portions and often resort to inexpensive, high caloric foods, if the household is from a lower socioeconomic status (Davis et al. 2007).

Drewnowski and Darmon point out that our current methods of trying to educate individuals to attain nutrient dense food might be in vain, since these foods are much costlier than the alternative, tasteful, cheaper and calorically dense counterparts (2005). According to Boumtje, Huang, Lee and Lin (2005) additional studies suggested that increased amounts of fats and oils, sodium and carbonated beverages may lead to the overweight and obese status in school-age children, while the consumption of dairy products, fruits and legumes were more

often not associated with weight gain in children. Casey, Szeto, Lensign, Bogle and Weber (2001) found that children from low-income homes who were deemed food insufficient tended to have more overweight children, as opposed to the children from higher-income brackets. In addition, these children from low-income, food insufficient homes consumed less fruits and watched more television than children from higher-income households (2001).

In addition to a poor diet, a lack of physical activity has a strong correlation to overweight in children. Singh, Kogan, Van Dyck and Siahpush (2008) found that sedentary children from underprivileged homes are quadruple times more likely to become obese. Besides eating less healthy diets, another reason may be that parental concerns about neighborhood safety have been shown to negatively impact children's physical activity in poor, inner-city communities (Weir, Etelson & Brand, 2006). According to the National Longitudinal Study of Adolescent Health, a study found that the more physical activity locations in an area greatly increased physical activity and reduced the chances of obesity in adolescents (Findings from Active Living Research: The Effects of Age and Place on Physical and Obesity in Adolescents, 2009). Young children, including preschoolers, receive many benefits from physical activity; however, these children are not receiving enough daily physical activity and both the childcare facility and the parents share a role in promoting the physical activity of the preschoolers in order to shape their future health preserving behaviors (Tucker, van Zandvoort, Burke & Irwin, 2011). For instance, a study found that children have a lower body mass at age 8 years if the child had a greater level of activity at age 5 years, as opposed to the 5 year-olds who were the least active (Findings from Active Living Research: Children's Activity Levels at Age Five Are a Predictor of Fat Mass Later in Life, 2009). According to Boumtje and colleagues (2005), it is suggested that physical exercise may be the best approach to combating obesity; however, this would

require extensive attention from the parents and guardians and members of the community to enact successful activities for children (2005). Thus, increasing physical activity and decreasing sedentary behaviors may deter weight gain in children and adolescence (Must & Tybor, 2005).

In addition, obesity and overweight status in children appear to be influenced by socioeconomic status (Vieweg, 2007). In Chester County, Virginia, researchers found a significant relationship between a high BMI and a low socioeconomic status (SES) when the researchers analyzed a group of kindergarten, third, seventh and tenth grade students. About 28-38% of students had a BMI greater than or equal to the 85th percentile (2007). However, another study indicated that most children who are obese do not live in low-income households (under 130% of the poverty level), and only 38% of children and adolescents living in low-income households are obese (Ogden, Lamb, et al., 2010).

An interesting ethnic/racial difference in response to food security support was found in the literature. Yu, Lombe, and Nebbitt (2010) found that food insecurity was much higher in African American households (48%) that participated in a food stamp program, when compared to Caucasian households (29%) participating in the same program. Further, Caucasian households were found to score significantly lower in food insecurity when receiving supplemental informal food supports than African Americans who also received supplemental food supports. Also, household food security was not associated with child food security in both population subsets; though, the food stamp programs were found to be positively associated with the food security of children (2010).

Food Insecurity Prevalence

The USDA collects data on food security and hunger in the annual report, Food Security Status of U.S. Households, with the most recent report being released in 2010 on data collected

from 2009. The report revealed that 14.7% percent of households were food insecure with about 5.7% of households being ranked as very low food secure. Furthermore, 10.6% of households that included children were rendered food insecure. Where rates of food insecure households seem to be higher than the national average was in African-American or Hispanic households under or near the poverty line with children that were headed by single parents in the Southern region on the U.S. (Nord, 2010). Specifically, African-American households had a 24.9% rate of food insecurity, while Hispanic households had a 26.9% rate. In addition, single mother households had a rate of 36.6% food insecurity. Rates including all ethnic/racial groups indicate that households in the South had a household food insecurity rate of 15.9%, and there was a 15.5% household food insecurity rate in the West, which were the highest areas in the nation (Nord, 2010).

Food Insecurity in Households with Children: Prevalence, Severity, and Household Characteristics found that almost 16% of households in 2007 were found to be food insecure. In 2007, 0.8% of households with children (323,000 households with children) were found to be in the very low food security level (Nord, 2009). Children in food insecure households were usually not being completely deprived of food, since the parents or guardians relied on low cost food to feed the children. In addition, a large portion of children from food insecure households received Federal assistance from programs such as the Food Stamp Program and the National School Lunch Program (2009). In households with very low food security, younger children tended to be sheltered from food insecurity as opposed to older children. Only 9% of children aged 0-4 was found to be from very low food secure households, as compared to 33% of 13-15 year olds from households that was deemed to have very low food security (2009).

Although they have an unorthodox relationship, both food insecurity and obesity rates have increased. According to Drewnoski and Specter (2004), food insecurity is related to the better taste of energy dense food, because the researchers found that poverty is related to lower food costs and this reduction in food cost is related to a high fat, high caloric food intake which leads to weight gain (2004). Food insecure, adult women tend to have a greater chance of being overweight/obese than food secure women, while no relationship of the sort has been found for men (Healthy Eating Research A National Program of the Robert Wood Johnson Foundation, 2010). These findings have parenting and gender implications for children.

Association of Childhood Obesity and Household Food Insecurity

Childhood overweight and obesity status tend to share a relationship with household food insecurity. This relationship was first raised in 1995 when Dietz investigated an case about a young, 7 year-old African American girl who belonged to a household with limited amounts of food during certain points each month, and the girl's mother would feed her inexpensive, high fat/ high caloric foods in order to compensate for the lack of resources to costlier, more nutritious foods (Dietz, 1995). Dietz then speculated that this act may be due to an "adaptive response to food shortages when the family lacked financial resources where in turn there was an increase in the consumption of low-cost, high fat foods resulting in increased body mass". (1995, p 766)

An earlier study by Casey et al. (2001), found food insecure children from low-income families to consume the same amount of nutrients as that of children from higher incomes. Moreover, food insecure children from low-income families have a greater chance of being overweight than children from higher incomes, but the researchers could not link these findings specifically to a real state of food insufficiency. However, this is one of the first studies where these issues were researched in a nationally representative sample using the Continuing Survey

of Food Intakes by Individuals (CSFII) survey. This survey was conducted by the USDA from 1994-1996 (2001).

Another large source of national data was collected using the National Health and Nutrition Examination Survey (NHANES) III that spanned across 1988-1994 and consisted of a large sample (over 9,000) of white, black, and Mexican-American children and adolescents. This study only found food insufficiency to be negatively associated with overweight status in older, white non-Hispanic girls (Alaimo, Olsom, & Frongillo, 2001).

Bronte-Tinkew et al. (2004) examined 2 years from the data of the national Early Childhood Longitudinal Study—Birth Cohort (ECLS-B) where a representative sample of children were examined at ages 9 months, 2 years, 4 years, kindergarten, and first grade. The research found that the structural equation model that was instituted by Bronte-Tinkew et al. found that food insecurity worked indirectly with the parents' feeding styles and that this influenced child overweight.

In 2006, a study Casey et al., used child food insecurity measurements and the National Health and Nutrition Examination Survey 1999-2002 found that between an approximately thirty to forty percent of children are at risk for being overweight in various food insecure categories. This study found that children's food insecurity is strongly related with being "at risk for overweight or greater for children aged 3 to 5 and 12 to 17 years, boys and girls, white and Mexican American (but not black), and in families with income \leq 100% poverty level (Casey, 2006)." In addition, children's overweight status was significantly related to children's food insecurity in the 12 to 17 age group, girls, white children and family incomes at the \leq 100% of the poverty level (Casey, 2006). The study also found that being at risk for overweight (BMI

≥85%) or overweight (BMI ≥95%) among African-American proved to be the same regardless of the food security status (Casey, 2006).

Research conducted by Gundersen, Garasky, and Lohman (2009) found that the insignificance of food insecurity and obesity to be accurate for white, black, and Hispanic girls and boys through the examination of the 2001 to 2004 NHANES sample. The sample included 2,516 children between 8-17 years of age that were deemed <200% of the poverty line. Five measures were used to determine obesity in children and these were BMI, waist circumference, triceps skinfold, trunk fat mass, and percentage of body fat. The research found that children from food-insecure households were not any more likely to be obese than children of food-secure households in any of the 5 measurements (2009).

Research involving 1,031 children aged 10-15 years old from the Three-City Study with 7.7% of these children being food insecure found that there was no difference in weight categories and food security (Gundersen, Lohman, Eisenmann, Garasky & Stewart, 2008).

Research conducted in Canada (Dubois, Farmer, Girard, & Porcherie, 2006) found that a relationship might exist between overweight/ obese preschoolers and food insecurity in low-income families. In fact, the research found that family food insecurity more than tripled the chances for preschoolers to become obese.

A study conducted by Metallinos-Katsaras, Sherry, and Kallio (2009) found that household food insecurity without hunger had no correlation to overweight among low-income 2 to 5 year old girls and boys that were participating in the Special Supplementation Nutrition Program for Women, Infants, and Children (WIC); however, there was a correlation between overweight and food insecurity with hunger among girls aged 2 through 5 years old with odds being 47% higher than food secure households (2009). As previously mentioned, Jyoti et

al.(2005) found that there was a significant relationship between kindergarten food insecurity, BMI and weight among girls; however, this was not the case for boys.

A study, *A Longitudinal Study of Food Insecurity on Obesity in Preschool Children*(2012), examined a diverse, low income group of 28, 353 children that were participating in Massachusetts's Women, Infants, and Children (WIC) from 2001-2006. This sample included 24.9% of infants and 23.1% of infants and children living in food-insecure households with 17.1% of these children being considered obese in order to determine the correlation with or without hunger in respect to food-insecure households with weight status in two to five year-olds. The study found that households that were deemed food insecure without hunger were related to childhood obesity and these finding are associated with maternal weight status where the mothers were either overweight or obese before pregnancy (2012).

Another study that employed a sample from WIC where 201 mother-infant pairs were included and 83% of the sample were not born in the United States with the majority of the sample being Hispanic. Also, 35% of these mothers were from food-insecure households. The study found that non-US born mothers that have less than a secondary education, suffer from depression, and are overweight or obese tend to be among the mothers from food-insecure households. This study found that food-insecure households of maternal feeding patterns that were restrictive and controlling were related to the infant becoming overweight in the future (Gross, Mendelsohn, Fierman, Racine & Messito, 2012).

Research looking into the relationship between maternal BMI, child BMI, and food insecurity (Crawford, Lamp, Nicholson, Krathwohl, Hudes & Townsend, 2007) was conducted on a sample of 123 Latino mother-infant pairs from a California WIC. Of the 123 children, 27% were above or equal to the 95th percentile, with the mother's BMI and children's BMI showing a

strong relationship. This study found no correlation in between the mother's past or present weight with food insecurity or security; however, mothers from food-insecure households were more likely to be concerned with how much their children were consuming and tended to offer decreased meal portions (2007).

Another study conducted by Dubois et al. (2011) examined food insecurity in Québec and Jamaica using data from two separate surveys of children ages 10-11. In the developed Canadian province of Québec, 26% of the children in the survey were deemed overweight or obese, while 9% of children were from food-insecure households. Whereas in the less developed country of Jamaica, 11% of children in the survey were found to be overweight or obese and 26% were from food-insecure households. In Québec, girls were the only sample from the survey found to be overweight or obese, while being from a food-insecure household. There was not any difference between genders and food-secure or insecure households for the survey of Jamaica children, while children from food-secure households in Jamaica had a significantly lower chance of being overweight as opposed to those from food-insecure households (2011).

According to *Food Insecurity and Gender are Risk Factors for Obesity* by Martin and Ferris (2007), a convenience sample of 200 parents and 212 children ages 2-12 in a community in Hartford, Connecticut found that the relationship of household food-insecurity and having an obese parent resulted in the daughter having twice the chance for being obese. However, children from extreme poverty were less likely to be overweight as opposed to higher income households.

A review of literature by Dinour, Bergen, and Ming-Chen (2007) proposed a linkage between the food stamp program in relation to the food insecurity and obesity relationship. In regards to children, the study found that coping strategies such as physiological changes do occur

in response to the association of the food stamp program's role in both obesity and food insecurity (2007).

A literature review by Eisenmann, Gundersen, Lohman, Garasky and Stewart (2010) examined the relationship between food insecurity and overweight and obesity in children and adolescence. The review summarized studies from 1995 to 2009. Major findings were that studies showed mixed associations between child obesity and food insecurity, including positive, negative, and null associations that were difficult to interpret. They also concluded that small sample sizes were a problem in earlier studies that did show positive relationships, while larger studies subsequently tended to find no associations between child obesity and food insecurity.

Eisenmann et al.'s (2010) review differs from this review in that low-income was not specifically identified as a variable in the review. However, given the relationships between low-income, child overweight, and food insecurity, readers will find similarities in articles reviewed by Eisenmann, et al. (2010) and this review.

Another research review or synthesis was reported by Robert Wood Johnson (Healthy Eating Research: A National Program of the Robert Wood Johnson Foundation, 2010). Findings from studies including men, women and children were included. The major findings of this report were that most studies have not found direct relationships between food insecurity and obesity among children and that there is no evidence that use of Federal or State Nutrition Assistance Programs(associated with low-income) increases the risk of obesity among children.

CHAPTER 4: Discussion

Although the discussion began in 1995 as to whether or not the association of food insecurity and childhood obesity is valid, resulting studies have often been filled with mixed results that are either positive, negative, or nullify the whole association entirely. The different findings in current research make it difficult to conclude that there is an association due to a lack of consistent measurements and results throughout all of the studies and research at hand. For instance determinants of childhood overweight or obesity status in this study included, CDC and AMA definitions of childhood overweight/obesity status, BMI, measures of waist circumference, triceps skinfold thickness, trunk fat mass, and body fat. Thus, consistent food insecurity measurements must be implemented at the child and adolescent level and accepted throughout academic studies.

Next, more research is needed regarding childhood obesity and potential causative factors such as, food insecurity and poverty. Even though many of the more recent studies with larger samples do not associate childhood obesity and food insecurity, there is still a relationship to some degree between the two. Identifying the nature of this relationship has been a challenge for researchers. Thus, future research should focus on addressing the child's exposure to food insecurity whether it is seldom, often, chronic, short term, long term, etc. in relation to the child's weight.

Also, these studies have shown that further investigation into parenting styles, feeding styles, and family stressors may be warranted, since there seems to be some effect on childhood obesity. Similarly, there are several factors that have been known to facilitate childhood overweight/obesity status such as, over consumption of calorically dense foods, sedentary

lifestyle, lower socioeconomic status, time spent watching television, and lack of availability of recreational facilities among other influences should be addressed.

Though work has been ongoing since 2009 in trying to understand the relationships between child obesity, low-income, and food insecurity, the overall assessment of the state of the science is that these relationships warrant further investigations. Specifically, there is a need to parse out the various personal (age, gender, ethnicity/race), psychological and sociological variables related to child obesity. Further, interventions at the family and parent levels need to be further developed and evaluated.

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Table 1: Summary of Articles Reviewed, Ordered by Appearance in Article/Construct

Authors/Date	Questions/ Objectives/Hypotheses	Design	Findings	Instruments	Notes
Dietz, 1995	Hypothesized an adaptive process between childhood obesity and consumption of inexpensive, non-nutritive foods	Case Study	Mother fed 7-year old obese African-American girl inexpensive, high caloric food, was on Government Food Stamp Program.	Interview of daughter.	Dietz first proposed the relationship of food insecurity and childhood obesity
Casey et al., 2001	Examine a sample of children and adolescents living food-insufficient households and compare to a variety of factors including overweight status.	Cross-Sectional Study	Children from low-income families were found to consume the same amount of nutrients and to have a greater chance of being overweight than children from higher incomes.	Data collected from CSFII 1994-1996 of 5,699 children and adolescents aged 0-17.	Researchers could not link these findings specifically to a real state of food insufficiency .
Alaimo et al., 2001	Explore associations between multiple factors family income, food insufficiency, and overweight status in children and adolescents.	Cross-sectional	Food insufficiency was found to be negatively associated with overweight status in older, white non-Hispanic girls.	Data collected from NHANES-III 9,196 children and adolescents (4,185 boys and 5,011 girls) aged 2-16.	Suggested longitudinal quantitative and qualitative research.
Bronte-Tinkew et al., 2004	Inspect direct and indirect associations between food insecurity and overweight status among toddlers.	Structural Equation Modeling	There was an association between feeding practices and toddlers' overweight status.	Data collected from ECLS-B using a cohort of toddlers from 9-24 months.	Depression was determined to be a factor on parenting styles that affect child health outcomes.
Casey et al., 2006	Assess the association of household and child food insecurity with overweight status of children.	Cross-sectional	An association between food insecurity and overweight status.	Data collected from NHANES 1999-2002 with 6,995 (3,553 boys and 3,442 girls) ages 3 to 17.	

Gundersen et al., 2009	Using other measures, such as, waist circumference, triceps skinfold thickness, trunk fat mass, and body fat, besides BMI to indicate child obesity in relation to food insecurity	Cross-sectional	There was no association between food insecurity and the obesity status of children.	Data 2001 to 2004 NHANES sample that included 2,516 children between 8-17 years of age that fell in the range of <200% of the poverty line.	
Gundersen et al., 2008	To examine food insecurity and obesity among 10-15 year olds.	Cross-sectional	There was no difference in weight categories and food security.	Data was collected from the Cross-sectional Three-City Study of 1,031 (533 girls and 498 boys) adolescents aged 10-15 years old.	There was only 7.7% of the sample of children that were deemed food insecure.
Dubois et al., 2006	To examine a relationship between overweight/obese preschoolers and food insecurity in low-income families.	Longitudinal Study	The study found that there is an increased odds of 2 to three time of being overweight from a food insufficient family during pre-school years.	Data collected from Longitudinal Development in Quebec (1998–2002) with 2,103 Caucasian (49% girls) ages 1.5–4.5.	At 4.5 years of age, there was an association to be found between birth weight and family food insufficiency in relation to being overweight.
Metallinos-Katsaras et al., 2009	To study the relationship between overweight and household food insecurity with/without hunger in low-income children.	Cross-sectional	A correlation was found between overweight and food insecurity with hunger among girls aged 2 through 5 years old with odds being 47% higher than food secure households	Data collected from the Special Supplemental Nutrition Program for Women, Infants, and Children where 8,493 children ages 1 month to 5 years were measured for weight, height, and household food insecurity.	

Jyoti et al., 2005	To study the relationship the food insecurity over time related to changes in reading and mathematics test performance, weight, BMI, and social skills in children.	Longitudinal Study	There was a significant relationship between kindergarten food insecurity, BMI and weight among girls.	Data collected from ECLS-K 11,180 (5,682 boys and 5,498 girls) with Children entering kindergarten in 1998. The study followed the children through the third grade.	
Metallinos-Katsaras et al., 2012	To determine the association between household food insecurity with and without hunger in infancy and later childhood with weight status at 2 to 5 years.	Longitudinal study	There was a significant correlation between household food insecurity without hunger is prospectively related to child obesity.	Data collected from Massachusetts WIC program participants between September 2001 and August 2006 of over 28,353 children.	
Gross et al., 2012	To define the association between household food insecurity and maternal feeding styles, infant feeding practices, and perceptions and attitudes about infant weight in low-income mothers.	Cross-sectional study	The study found that food-insecure households of maternal feeding patterns that were restrictive and controlling were related to the infant becoming overweight in the future.	WIC sample of 201 mother-infant pairs where over 80% of mothers were of Hispanic origins.	
Crawford et al., 2007	Investigate associations between past and current food insecurity and child feeding practice among low-income Mexican-American families.	Cross-sectional	No correlation in between the mother's past or present weight with food insecurity or security	A sample of 123 Latino mother-infant pairs from a California WIC.	Mothers from food-insecure households were more likely to be concerned with how much their children were consuming and tended to offer decreased meal portions

Dubois et al.,	This study presents a comparative gender-based analysis of the association between household food insecurity and overweight among 10-to-11-year-old children living in Québec and Jamaica.	Cross-sectional	In Québec, girls were only found to be overweight or obese, while being from a food-insecure household.	Data was collected in 2008 from the Québec Longitudinal Study of Child that included 1,190 10-year old children and the Development and the Jamaica Youth Risk and Resiliency Behaviour Survey was collected 2007 included 1,674 10-11-year-old children in Jamaica.	There was not any difference between genders and food-secure or insecure households for the survey of Jamaica children, while children from food-secure households in Jamaica had a significantly lower chance of being overweight as opposed to those from food-insecure households
Martin and Ferris., 2007	Examine the associations between adult obesity, childhood overweight, and food insecurity	Cross-sectional	The relationship of household food-insecurity and having an obese parent resulted in the daughter having twice the chance for being obese.	A convenience sample of 200 parents and 212 children ages 2-12 in a community in Hartford, Connecticut.	Children from extreme poverty were less likely to be overweight when compared to higher income households.
Dinour et al., 2007	Proposed a linkage between the food stamp program in relation to the food insecurity and obesity relationship.	Review of Literature	The study found that coping strategies such as physiological changes do occur in response to the association of the food stamp program's role in both obesity and food insecurity.		Focused on low-income samples
Eisenmann et al., 2010	Reviewed relationships between food insecurity and child obesity. Did not	Review of Literature	Found mixed findings.		

	explicitly include low-income				
Healthy Eating Research, 2010, Robert Wood Johnson	Synthesized the research on relationships between food insecurity and obesity in US. Included studies involving children, women, and men.	Research Synthesis	<p>Most studies have identified no direct relationship between food insecurity and obesity among children.</p> <p>There is no evidence that use of Supplemental Nutrition Assistance Program benefits increases the risk of obesity among children.</p>		Focused on low-income samples