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EXPLORING THE CONNECTION BETWEEN THE NUTRITIONAL STATUS OF LOW-INCOME FEMALE CAREGIVERS AND THEIR CHILDREN

By

Sikhoya L. Wabuyele

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ABSTRACT

EXPLORING THE CONNECTION BETWEEN THE NUTRITIONAL STATUS OF FEMALE CAREGIVERS AND THEIR CHILDREN

By

Sikhoya L. Wabuyele

Income is clearly one of the most important determinants of food quantity and quality in a household. Families that live in poverty are more likely to have insufficient food, poor quality diets and are at risk for nutrition health problems such as, iron deficiency anemia, and obesity than high-income families. The federally funded food assistance programs that target women and children provide food, cash assistance, and / or nutrition education to low-income families. The goal of this study was to explore the female caregiver-child relationship of nutrient intake, iron and weight status. Female caregivers with high fat intake, iron deficiency or overweight, were likely to have children with high fat intake, iron deficient or overweight. Nutrient intakes, iron deficiency and weight status of the female caregivers and their children were significantly positively correlation ($r= .12 - .40$, $p<.01$). The positive relationship suggests that female caregivers influence children's food intake and dietary behavior. The policy and program implication of this finding is that the relationship of caregivers' and their children's nutrient intake is an important factor to consider when implementing nutrition intervention that aims at improving dietary intake and habits. The findings of this study indirectly support nutrition intervention programs that will target the entire family's primary prevention for nutritional inadequacy, iron deficiency anemia and obesity.

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INTRODUCTION

Background

The third report on nutrition monitoring in the United States shows that low-income households are at higher risk for nutrition-related health problems compared to high-income households. Poverty is one of the leading causes of poor nutrition; poor nutrition is associated with lack of money and other resources such as food sufficiency and nutritional knowledge (NMRRP, USDA, 1995). A recent review of dietary and nutrition status of the U.S. population concluded that low-income groups are more vulnerable to nutrition-related disease. The prevalence of nutritional heath problems in low-income families is higher than in high-income families (Lin et al 2001).

Poverty exposes children and other family members to a wide array of health problems that includes food insufficiency, and poor dietary intake and eating habits. According to the Census Bureau (2000) about 11.3% of the U.S. population falls into the low-income category; approximately 287,000 individuals may be exposed to poor diets due to insufficient access to nutritious food. About four million children under age 12 do not have enough to eat in their homes, and yet another 9.2 million are at risk for a shortage of food. The nutrient intake of children who live in food-insufficient households does not meet the recommended guidelines; these children are deficient in most nutrients required for proper growth and development (Wehler, 1991).

Women and children are at highest risk for nutrition deficiencies and health risks. Iron deficiency is the most common nutrient deficiency in women and children; it is highest among low-income households. The prevalence of iron deficiency and anemia raises health concerns due to the serious health risk; iron deficiency in children is associated with developmental delays and permanent impairment to mental development (www.health.gov/healthpeople/default.htm). A report from the third National Health and Examination Survey (1988 – 1994) by Looker and colleagues (1997) showed the prevalence of iron deficiency in children in the U.S. was 3–9%, while iron-deficiency anemia was 1–3%. Among females aged 12–49, iron deficiency was 9–11%, and iron-deficiency anemia was 2–5 %. The CDC report (1997) indicated that among low-income children, 18.4% under 2 years and 16.9% ages 2–5 years had anemia. The Healthy People Objective 2010's target is to reduce iron deficiency in children ages 1–2 years to 5%, 3–4 years to 1% and female ages 12–49 to 7%.

Obesity has been associated with the development of heart disease, Diabetes Mellitus, certain cancers, and stroke. There is an increase in childhood obesity, with the highest increase among low-income children from 14% to 25–29%. Obesity has been a prevalent problem for U.S. adults, and studies have shown an increase from 12% to 33% –36% (Traino and Flegal 1995). About 280,000 deaths annually are associated with obesity, and U.S. government health care costs for disease associated with overweight and obesity have been estimated at 6.8% of the overall U.S. funds allocated. Studies show that childhood obesity may persist into adulthood; therefore, an increase in childhood obesity will result in increased heath risks for both children and adults. Deterrence of childhood obesity can reduce and prevent health-related problems, such as heart diseases in both children and adults, and can reduce health care costs.

In the 1960s there was a drastic increase in poverty that had severe consequences on nutrition-related public health problems. To address this alarming health crisis, the federal government established public food and cash assistance programs that were intended to mitigate the effect of poverty on low-income families by providing food and nutrition education. The federal government, through the U.S. Department of Agriculture, funded the food assistance programs to improve nutritional quality and prevent further development of nutritional health-related problems, and also promote growth and development among low-income groups. The primary purpose of these programs was not only to improve nutritional health status of low-income households but also to reduce government health care costs (Better Nutrition Act for Children, 1994).

The U.S. Department of Agriculture coordinates many federal and state programs that provide food and cash assistance to target low-income women and children. Some of the programs include the Special Supplemental Food Program for Women, Children and Infants (WIC), the Food Stamp Program (FSP), the Expanded Food and Nutrition Education Program (EFNEP), the National School Lunch Program (NSLP), the National School Breakfast Program (NSBP), and the Head Start Program, among others (USDA, 1997).

The Special Supplemental Food Program for Women, Infants, and Children (WIC)

WIC provides supplemental foods, nutrition and health education, and Social Services referrals to low-income pregnant mothers, postpartum women, infants, and young children up to five years of age. Food vouchers are provided for obtaining specific supplemental foods high in iron, calcium, protein, vitamin A, and vitamin C. The criteria for participation in the WIC program are based on income and nutritional status. The income requirement stipulates that an applicant's gross income must be at or below 185% of the poverty level—the equivalent of a $32,600 annual income for a family of four (effective July 1, 2001–June 30' 2002). The nutritional status requirements refer to the risk of anemia, low weight, poor pregnancy outcome, and an inadequate diet. The mission of the WIC program is to safeguard the nutritional health of low-income women and children by providing nutritious foods to supplement diets, nutrition information for good health, and referral to health care (www.fns.usda.gov/wic).

Since the start of the program in 1974, the number of participants has increased greatly from 344,000 participants per year in 1995 to 7.4 million people per month in 1997 (Owen and Owen, 1997). Studies have shown that the program has contributed substantially towards the improvement of the health status of the nation's low-income, nutritionally at-risk families (Rose et al, 1998).

The Food Stamp Program

The Food Stamp Program (FSP) was established in 1962 by the federal government to end hunger by providing cash assistance to poor families for food purchases with the goal of improving their nutrition and health status. The FSP is the cornerstone of the federal food assistance programs, and it provides essential support to needy families and those making the transition from welfare to work. FSP is the only assistance program that provides cash assistance to low-income households with income level at or less that 130% poverty level, which is equivalent to a $\leq$ $22,945 annual income for a family of four (www.fns.usda.gov/fsp).

The main purpose of FSP is to increase the nutrient intake of the at-risk population. Program evaluation reports show that FSP has increased low-income individuals' food supply, but has had little impact on participants' nutrient intake. FSP may not have achieved its goal for various reasons: 1) food stamp recipients may use the food stamps to purchase items other than food; 2) food stamps may be used to buy foods that do not improve the nutrient intake for the family members, such as "empty calorie" foods, since the program does not have any restrictions on the types of foods purchased with food stamp vouchers; 3) low-income individuals who qualify for the program and need food assistance may not be enrolled in the program (www.fns.usda.gov/fsp).

The National School Food Programs

The National School Lunch Program (NSLP) and National School Breakfast Program (NSBP) were enacted in 1966 to provide food for malnourished school children from poor households. The objective of the National School Food Assistance Programs is to reduce malnutrition by increasing the nutrient intake of program participants. NSLP and NSBP continue to serve low-income school children, and reports show that they have reduced rates of student absence, increased nutrient intake, and improved children's school performance. Both programs are required by the U.S. Department of Agriculture to provide meals that meet the dietary guidelines for Americans; this means they must be used to serve food in which $\leq$ 30% energy is from total fat and $\leq$ 10% energy is from saturated fat. The lunch meals are expected to provide one-third of the children's Recommended Daily Allowance (RDA) for protein, vitamin A, vitamin C, calcium, iron, and calories. The breakfast program is required to meet one-fourth of the children's RDA for protein, vitamin A, vitamin C, calcium, iron, and calories (USDA, 1995).

NSLP participation has increased tremendously from 7.4 million children in 1946–1947 to 27.4 million children each day in fiscal year 2000. Approximately 7.55

million children participated in the NSBP each day in fiscal year 2000. NSLP and NSBP programs provide free meals for children from households with income levels at or below 130% poverty (for a family of four this is equivalent to $\$ \leq 22,945$), meals for half-price for children from households with income between 130–185% poverty level (for a family of four, this is equivalent to an income between $22,946–32,653) and pay full-price for meals for children with income over 185% poverty level. The Nutrition Initiative Team has the responsibility of teaching and motivating children to make healthy food choices and to provide the school food service with training and technical support. Reports show that school food programs have successfully improved children's nutritional quality and school performance.

The Expanded Food and Nutrition Education Program (EFNEP) and Head Start Program have objectives similar to other nutrition programs for low-income populations. Unlike other nutrition programs, however, EFNEP and Head Start Programs only provide nutrition education to enrolled participants. The programs offer nutrition education to low-income individuals (this includes both youth and adults) on nutritional knowledge, skills, and attitude and behavioral changes necessary for an adequate diet and for disease prevention. The EFNEP teaches homemakers and youth new skills in healthy food choice, preparation, storage safety, and better management of their budget related to food resources available to them, such as food stamps. Studies indicate that EFNEP has improved its participants' nutritional knowledge and intake. (USDA, 1994).

There is evidence that food assistance programs can affect the type and amount of food intake of low-income population. Reports on the effectiveness of the federally funded programs mostly indicate that the programs have improved the nutritional quality of the low-income program participants by improving their nutrient intake and their eating habits. The Food Stamp program has had a very beneficial effect on the aggregate household dietary intake (Basiotis' (1997). One strong positive outcome of nutrition programs is an increase in the quantity of food consumed. However, the effect on the quality of nutrient intake is uncertain. Increased food expenditure does not necessarily indicate a more healthful diet. WIC, SLP, and SBP have had a positive impact on the diets of their participants (at least while the participants were still in the program). FSP has the largest budget and number of recipients, yet there is no convincing body of evidence that this program improves the overall quality of participants' nutrient intake; there is some indication that the program has increased intake of certain nutrients. Other studies indicate that meals provided by the school food programs are high in dietary fat and do not meet the recommended dietary guidelines of Americans (www.fns.usda /programs).

Nutrition programs for low-income households focus on increasing food accessibility and improving their nutrient intake. The primary purpose of these programs is to decrease the prevalence of nutrition-related diseases by reducing nutrition deficiencies and improving eating habits of its participants. The few studies on familial aggregation of nutrient intake and nutrition health risks between parents and their children observe similarities in nutrient intake. The conclusion made from these studies is that parents' eating habits influence the children's nutrient intake (Oliveria et al 1992). Their influence on children's dietary intake is considerable. A better understanding of the impact can aid in designing nutrition programs for low-income families.

Problem Statement

Low-income individuals are at nutritional health risk due to poor and inadequate nutrition, poor dietary habits and lifestyle. Low-income families are disadvantaged because of inadequate income to meet their nutritional needs as well as other everyday family needs; they also lack other resources or have inadequate resources necessary for provision of nutritionally adequate diets for family members, such as knowledge on nutrition and disease.

The goal of the federal food programs is to help low-income families increase their food supplies and ultimately improve their nutritional intake and dietary habits. The USDA coordinates federal and state programs that provide food, cash assistance, and nutrition education to the low-income population. Some of these programs include: the Special Supplemental Nutrition Program for Women, Infants and Children (WIC), the Food Stamp Program (FSP); the National School Lunch Program (NSLP); the National School Breakfast Program (NSBP); the Nutrition Education Training Program; the Expanded Food and Nutrition Education Program (EFNEP); and the Head Start Program, among many others.

Nutrition programs mainly target low-income women and children because of their high vulnerability to inadequate nutrition and related health problems, such as iron deficiency, anemia, and obesity. The WIC program targets women, infants, and children due to the high prevalence of iron deficiency and iron-deficiency anemia, as well as the inadequate nutrient intake among these groups. Women are also considered to be the main meal planners in households. Therefore, they are provided with nutrition information, and they are expected to utilize the nutritional knowledge and resources acquired from nutrition programs to make positive dietary changes and eating habits for their children and other family members. Morton et al (1997) report that an increase in parental nutrition-related knowledge through nutrition programs had led to an improvement in the nutritional quality of children.

Despite the efforts of nutrition programs to alleviate nutrition problems in low-income groups, nutrition inadequacy and poor diets remain a health problem in this population. Studies have shown that there is a familial aggregation of nutrient intake and that parents, mothers, or caregivers may influence the nutrient intake, food choices, and dietary habits of their children. Parents' or caregiver's influence on children's food intake can hinder the effectiveness of low–income nutrition program interventions that target children. Therefore, it is important to examine the relationship between female caregivers' and their children's nutritional health status and how this relationship can impact nutrient intake of the children and other family members.

Research is limited on the relationship of nutrient intake and health status between parents or caregivers and their children and how this relationship may influence or improve the dietary intake and habits of the children and other family members. Little is known about familial nutrient aggregation and nutritional heath status of low-income households that participate in nutrition programs. Given these limitations, this study examines the female caregiver-children relationship in low-income households with respect to their nutrient intake and nutrition health status.

This study is designed to answer the following four research questions:

1. How does the nutritional status of children relate to their female caregivers?

2. What is the relationship of the children's breakfast consumption pattern to their female caregivers?
3. How does the children's iron-deficiency anemia relate to their female caregivers?
4. How does the children's weight status relate to their female caregivers' adiposity?

The next chapter reviews the literature related to nutrient intake and nutritional deficiencies, and how these deficiencies affect the health status of low-income population. Iron deficiency and obesity as indicators of poor nutrition and health risk will be discussed. Nutritional issues on breakfast consumption, consumption of fruits and vegetables and high-fat foods and their association to nutrition and health of low-income women and children will be explored. Following Chapter Two, Chapter Three describes the data and sample used in this study, and the statistical methods used in the data analysis. Chapter Four presents the results of the statistical analyses. The last chapter summarizes the main conclusions and offers selected policy and research implications that emerge from the study and other related studies.

Chapter Two

Nutrition Intake and Disease Risks

Nutrition Issues and Deficiencies

This chapter reviews the literature on nutritional issues in relation to low-income households, iron deficiency, obesity, and the effect of the parent-child relationship on nutrient intake. A review of the literature on fruit and vegetable consumption, breakfast consumption, and high-fat food intake as indicators of low nutrient intake is also included. This chapter also discusses the risk factors of obesity and other related disease risks, and parental influence on children's dietary intake and prenatal care.

It is clear that poor diet contributes substantially to the development of diseases, and that diet modification contributes to the prevention of these diseases. Over-consumption of certain dietary components at the expense of other nutrients has a negative effect on health. Diseases caused by dietary excess and imbalances not only rank among the leading causes of death in America, but they also play a prominent role in chronic disease epidemics currently challenging many Western nations.

Low-income and Poor Nutrition

According to a study done by Kennedy and Goldberg, children's caloric consumption has been constant, and most children met other nutritional requirements but were deficient in iron and calcium (1 995). Data from 1960–1970 has revealed that children from households below poverty level income were thinner and shorter than those from high-income households. These results suggest that low-income children are susceptible to poor nutrition (Sherry 1993).

Results concerning the food consumption of low-income women from the National Foods Consumption (NFC) data for 1988 indicated a deficiency in calcium, zinc, and vitamins A, C, and E (Scrimshaw, 1993). The National School Advocate Organization that examined nutritional intake of school children reported that children consumed high amounts of cholesterol, sodium, and fewer carbohydrates. Children from low-income families had inadequate caloric intake, iron, calcium, and vitamins (Morris 1996). There is evidence that nutritional adequacy of young children's diet has decreased, with calcium intake being considerably lower than the recommended allowance (Roberts 2000).

Nutritional quality has been identified as the origin of a wide range of diseases and disabilities. Scrimshaw illustrates that eating habits and lifestyle affect dietary practices (1993). Diseases can be prevented by improved dietary intake and related lifestyles (Surgeman, 1995). The Cooking and Eating Nutrition and Shopping Survey showed that for a quarter of the low-income Hispanic women, dietary intake was less than two-thirds of the Recommended Dietary Allowance for vitamin A, thiamin, niacin, and riboflavin. About half the participants' diets were deficient in iron intake (J of Am Diet Assoc 1995). Improving low-income women's nutrition is necessary for the implementation of dietary change to meet the recommended dietary intake.

Children are a target group for the Healthy People 2000 objectives since they are nutritionally a high-risk group (DHHS, 1991). Childhood is a critical time for developing a healthful attitude and behavior patterns related to food choices and physical activity. Dietary habits and food preferences developed in childhood play an important role in growth and development, as well as in the prevention of chronic diseases later in life

(Reeds, 1996). Poor nutrition among American children is on the rise, partly due to poor eating habits that include overeating and skipping breakfast. Children of low socioeconomic status have less diverse diets, and children with single parents are likely to skip meals and eat fewer vegetables compared to those children with two parents (Wolfe, 1994). Nutritional intervention for specific age groups based on socio-demographic characteristics will help improve children's nutritional needs.

Dietary Habits

Breakfast Consumption

Breakfast, and fruit and vegetable consumption are included in this review because they are good indicators of healthy dietary habits. In the current study, however, data on fruit and vegetable consumption were unavailable; therefore, they were not included in the study analyses. Consumption of breakfast and Ready-to-Eat-Cereal (RTEC) and fruits and vegetables was also used as an indicator of nutrient adequacy because it contributes tremendously to the daily nutrient intake and intake of vitamins and minerals.

A study that assessed breakfast intake of 10-year-old children found that breakfast consumption significantly contributes to the children's mean daily intake average. Studies indicate that children who skip breakfast have significantly lower intakes in energy and micronutrients (Nicklas, 1993), vitamin A, C, vitamin B6, and iron, compared to those who had breakfast (Sampson, 1995). Children who eat more snacks were more likely to skip breakfast; this is more prevalent in children with single parents (Nicklas, 1993). This is a clear indication that breakfast consumption is vital for nutrient quality and adequacy for school children. Breakfast is referred to as the most important meal of the day. Consumption of RTEC for breakfast increases the amount of minerals and vitamins in a diet. Reduction in iron deficiency and iron-deficiency anemia in low-income children has been attributed to the increased consumption of iron-fortified RTEC provided by the WIC program to the children enrolled in the program (Hills, 1996). Breakfast skipping has been shown to increase nutrition risks due to low vitamin and mineral intake.

Fruit and Vegetable Consumption

Fruits and vegetables, a source of essential vitamins and minerals for the body, are an important part of a healthy diet. Studies have shown that nutrient and non-nutrient components of fruits and vegetables may reduce cancer risks. Barriers to fruit and vegetable intake are the largest causes of variability in the actual consumption of fruits and vegetables. Individual beliefs about the relationship between health and deficiencies of certain nutrients may influence the readiness to improve the intake of a particular nutrient.

Barriers to consumption of fruits and vegetables include poor eating habits, cost, availability, lack of nutrition knowledge, and time. There is a need to balance the benefits and barriers that influence peoples' behavior and their readiness to consume fruits and vegetables. Low-income women participants of the Expanded Food and Nutrition program (EFNEP), a federally-funded nutrition education program, perceive the consumption of fruits and vegetables as another expense that requires them to give up other foods (Reick, 1994). One of the objectives of Health People 2000 is to increase the consumption of complex carbohydrates and high-fiber foods, as well as increase servings of fruits to 4 per day and 3–5 servings per day of vegetables. According to CSFII 1985, women from 19–50 years of age consume only 2.5 servings of fruits and vegetables, below the Recommended Daily Allowance (RDA); and, only 24% of the population meets the requirement for fruits and 12% for vegetables (Kreb-Smith, 1995). Given that children have inadequate intake of dietary fiber, their fiber intake can be increased gradually by increasing the consumption of fruits, vegetables, cereal, legumes, and other whole grain products (Williams, 1995). Low-income children and women have a lower intake of fruit and vegetables, and dietary fiber than the recommended levels (Baranowsk, 1993, Wieche, 1994). Low-income women need to increase their consumption of fruits and vegetables, and whole grains to meet the recommended dietary guidelines (Thompson, 1992).

Though Americans have improved the quality of their diets over the last 30 years, they still consume excessive levels of fat and inadequate amounts of fruits and vegetables (Kimanyika, 1993). Morton and Gutherie (1994) report that progress has been made in implementing Dietary Guidelines in the U.S. except for the inadequate consumption of fruits and vegetables, and over-consumption of fats by both adults and children. A study aimed at increasing the consumption of fruits and vegetables among low-income women found that, though women were responsible for shopping and preparation of foods, they did not cook extensively. The time required and effort necessary for preparation were some of the barriers to fruit and vegetable consumption (Beto, 1997).

Influence on children's nutritional quality

Parent/caregiver's Influence

Children are part of the target group for the national health promotion for Health People Objectives 2000 because they are at high risk for poor nutritional health. Nutritional habits developed in childhood play an important role in growth and development and in the prevention of chronic diseases. Parental food practices may influence their children's dietary choices (Kennedy et al. 1995). In the Framingham children's study, Oliveria and colleagues (1992) concluded that parents or caregivers' dietary habits affect the nutrient quality of the children's diet. Children tend to eat foods that are made available by their caregivers at home. If high-fat foods are available to children, they will develop a preference for high-fat foods.

A study by Laskaezeewski et al (1980) revealed that the parental intake of total calories, saturated fat, poly-saturated fat, and carbohydrates was significantly and positively correlated with their children's intake of total calories, saturated fat, poly-saturated fat, and carbohydrates. The implication of this finding is that parent–child nutrient intake relationship is important in the nutrition intervention that intends to improve dietary intake and food habits of the family unit; thus, nutritional interventions that target low-income children need to focus on improving nutrient intake of the whole family as a unit.

The development of lifelong eating behavior is shaped by a multi-factorial process in which parents or caregivers are the key players (Nahikian-Nelms, 1997). In the attempt to change the dietary behavior of children, the interest and cooperation of caregivers is essential to achieve successful results. A caregiver's acceptance of nutritional knowledge and willingness to implement an adequate, nutritious diet associated with reduced fat intake in children may lead to prevention of nutrition-related diseases.

Certain food behavioral patterns adopted during childhood and adolescence may result in chronic diseases in adulthood. Children's food preferences may be altered by parental food choices (Wagner, 1992). Caregivers in a household are expected to help their children establish healthy food behaviors and attitudes by providing a healthy diet and exemplifying desirable food behaviors and attitudes (Stanek, 1990).

Parent's food behaviors and choices influence the amount of food their children eat, the children's eating time, as well as their food likes and dislikes (Seargant, 1990). There are discrepancies in research findings about the female parents' influence over the children's food preferences and behavior. Some researchers found a significant relationship between food preferences of preschool children and their parents, others found no significant differences between the female parents of obese children and non-obese children.

Parents and caregivers have the responsibility of making decisions on food purchases and food preparation and availability to the children and other family members. Therefore, the role of caregivers in making these decisions determines the dietary quality of nutrient intake of the children. Children in a household might prefer certain foods, which may in turn influence their caregivers' decision on the type of foods to purchase. This eventually determines the dietary pattern and, hence, the quality of the children's and other family members' diet.

Staflan et al. (1996) also showed a correlation between the mothers' and daughters' nutritional attitudes, knowledge, and fat intake. To reduce fat intake in a household, there is need for a family approach rather than an individual approach, because there are similarities in family members' attitudes and knowledge regarding dietary fat. This approach will implement a quicker dietary change in a family as a whole, which will eliminate disease risk factors in a family. According to Korch, U. S. children have dietary intake that is adequate in quantity but not in quality. Parental participation in food and nutrition programs can improve nutritional status of their children (1989).

An increase in parental nutrition-related knowledge through nutrition education programs for low-income groups leads to improved diets for their children (Variyan, 2001). Role modeling and continuous communication with family members, provision of adequate nutrition, and physical exercise may not only help prevent or reduce obesity but may also alleviate dietary inadequacy that will prevent nutrition-related diseases (USA Today, 1994).

Koblinsky et al (1992) conducted a similar study with the Head Start program, a federally-funded program for low-income families. He examined the effects of the nutrition education program on the parents of the children enrolled in Head Start and the dietary intake of these children. The goal of the program was to educate the mothers on food purchasing and preparation of nutritious foods and snacks. Both groups reported that they had made recent changes in their children's diet, in their shopping behaviors, meal planning, and food preparation methods. Despite the nutrition education, women in the treatment group and the control group did not change their own diets. The only change observed was the mothers' reduced sugar and salt intake. The relationship between program participation and dietary measures showed a weak but positive correlation ($r = 0.3$, $p < 0.05$). There was no correlation between reading the newsletter and post-dietary diversity in Head Start children ($r =.25$, $p < 0.09$). Research has indicated that increased parental nutrition-related knowledge leads to an improvement of children's nutritional intake. Nutrition education programs have had a positive impact on the Head Start parents' nutrition-related behavior that resulted in an improvement of children's diets that had fewer servings than the RDA. Children should gradually change food intake and adopt an intake of not more that 30% of the calories from fat between the ages of 2–5 years.

One of the goals of the Heart Smart Promotion Program is to improve cardiovascular health not only for the children but also for the entire family. The program focuses on increasing and maintaining positive dietary behavioral change, social support, and enhancement of self-confidence (Johnson, 1995). Risk factor transformation can begin at early ages of life at home and at school. It is easier to change health behaviors in children than in adults. Health education is important in schools. However, this approach may not succeed without the involvement of the parents and or mothers. Children get most of their meals at home; it is therefore the role of the family members, parents, or meal planner to ensure that children consume high quality diets for their good health (Taubert, 1996).

Nutritional Health Status

Iron Deficiency and Iron-Deficiency Anemia

Iron deficiency is the most common known nutrition deficiency in children, adolescents, and childbearing women the United States. There is a high prevalence among low-income minority groups (Looker, 1997). About 20–24% of the low-income African-Americans and Hispanics are anemic; this is an indication that, although the prevalence has decreased, iron-deficiency anemia is still a major problem. There has been less attention towards under-nutrition, especially among poor children, which has resulted in increased illnesses among the poor (Pollitt, 1994).

A study that examined incidences of anemia in Head Start children found that over 24% of 467 children had low levels of iron intake. More black children were anemic, with the highest percentage of 27.3% versus that for white children. This implies that anemia is a serous health problem in low-income families. This study concluded that nutrition programs have not met the nutritional needs of low-income children in terms of avoiding iron deficiency and iron-deficiency anemia (Francis et al, 1993). Iron deficiency has been attributed to early introduction of cow's milk to infants, consumption of unfortified infant formula, low birth weights, and low economic status cereal.

Hunter reported that iron deficiency and iron-deficiency anemia among infants is decreasing because of increased use of iron-enriched formula and other baby foods. Despite that, there are approximately 240,000 children in America between ages 1–2 years that are anemic, and about 3.3 million American women of child-bearing age are anemic due to a deficiency in dietary intake. Iron-deficient pregnant woman are not only at risk for pre-term deliveries, but also for low birth weight babies. The decreased prevalence of iron deficiency in high-risk infants and children may be achieved through use of iron-fortified infant formula and other fortified children's foods.

The third National Health and Nutrition Examination Survey (NHANES III) 1988–1994 revealed that 9% of 1–2 years old and 9–11% adolescents and women of childbearing age were deficient in iron. Of these, 3% of the children, 2% of the adolescents, and 5% of the women were found to have iron-deficiency anemia. A study by Sanjur et al. (1990) also showed that toddlers were deficient in iron. Recent studies indicate that anemia in infancy and early childhood continues to improve, but the existing deficiencies need to be addressed (Sherry, 1997).

A study done in the U.K. by Harbottle and Duggan (1992) on preschool children investigated whether diet affects the iron status of children. They found that a more diverse and adequate dietary pattern was observed among children with normal iron status. This was a cross-sectional study to determine whether dietary deficiency exists between iron-deficient and non-deficient children. There is a high prevalence of iron deficiency in children, adolescent girls, and women of childbearing age. One of the risks of iron deficiency in children is its effect on brain development and increased risk of pre-term delivery and low birth rate weight babies in women. Iron deficiency has declined in children due to the consumption of iron-fortified foods in the United States.

A study by Bountry and Needlman (1999) of African American children ages 15–60 months on the relationship between diet and microcytic anemia found that dietary inadequacy was associated to iron microcytic anemia. Iron-deficiency anemia is a public health problem in both developed and undeveloped countries. Approximately 30% of children and woman of childbearing age and pregnant woman have iron-deficiency anemia. It affects both high-income and low-income populations. Attention needs to be given to the inadequate of iron intake, especially at different life stages, and when the individuals are most at risk. Studies have shown that dietary factors other than low iron intake can contribute to IDA. Some food constituents inhibit iron absorption. (Althaimeen et al, 1999).

Kirchiner (1998) reported that the promotion of breastfeeding and the use of iron-fortified formula and foods have almost eliminated iron deficiency in infants. In his study, he concluded that the significant prevalence of iron deficiency is in children between ages 1 to 3 years due to change of diet from breast milk and iron-fortified formula to regular cow's milk and adults non-iron fortified cereals that are low in iron.

The Special Supplement Program for Women, Infants, and children (WIC) is a federally-funded program that has positively contributed towards reducing iron deficiency (Scholl et al 1994). WIC program provides food supplements high in iron to low-income pregnant women, their infants and children of ages 1–5 years. Participation in the WIC program has resulted in a reduction in iron deficiency, increased birth weight, and improved nutritional status of low-income children (Krieger et al 1999).

Obesity

In recent years, an increasing trend toward child obesity has become a health concern in the United States. Kim et al. used NHANES II data to evaluate the dietary patterns of U.S. children. The findings revealed that children ages 2 and over consumed 35–36% energy from total fat, and 13–18% from saturated fat, both of which were above the recommended levels. Black children had a higher intake of cholesterol than white children. Similar results have been found in other studies, such as the Bogalusa Heart and the Lipid Research Clinical Preventive Studies; unfortunately, investigations to date have not been successful.

Factors associated with obesity in children (as well as in adults) include total fat intake and educational level. Kim's explanation of the role of dietary fiber in obesity is that fiber reduces satiety, which may have a potential effect on weight reduction. Prevention of childhood obesity may result from consumption of recommended dietary fiber (Kimm, 1995). Research confirms that obesity and high blood cholesterol levels in United States' children are higher than optimal levels (Ernst 1994).

A study of the weight status of children participating in the supplemental food program for Women Infants and Children (WIC) showed that preschool children were overweight. But the WIC program was not associated with the increased overweight among the preschool aged children (MMWR, 1996). These results indicated that the diets of children in their homes and outside their homes might have contributed to the increased overweight in the WIC preschool children. A Head Start study that screened for growth, obesity, wasting and stature in children indicated that children enrolled in the program are at a high risk for obesity.

A study conducted on the quality and adequacy of dietary intake of students participating in the National School Lunch (NSLP) and School Breakfast Program (SBP) revealed that the students' dietary intake does not meet the Recommended Dietary Allowance (RDA). Inadequate dietary consumption, in school and at home, contributes to children's poor dietary intake (Osganian, 1995). The NSLP and SBP are associated with excess energy intake from fat, sodium, and low-fiber intake (Brownner, 1996). School Food Programs should meet the recommended nutrition guidelines to improve the nutritional quality of national school meals and the children's overall dietary intake.

Fisher and Birch reported that children's fat preferences and consumption were strongly related to parental adiposity. The reason children of heavier parents preferred high-fat foods and consumed high percentages of energy from fats might be related to the availability and exposure to high-fat foods (1995). An obesity prevention program for African American women and their daughters of ages 8–12 years reported that mothers improved their own eating patterns more than their daughters'. This finding supports the importance of effective parent-child prevention programs in high-risk populations (Fitzgibbon, 1995).

In summary, low-income women and children are more at risk for nutritional health problems than those living in high-income households. Low-income children and women have: nutrient intake lower than the recommended levels, a higher prevalence of iron deficiency and iron-deficiency anemia, and a higher intake of energy from total and saturated fat than the recommended allowance. Increased prevalence of obesity in low-income children and women is due to over-consumption of dietary fat and physical inactivity. The parent-child relationship of nutrient intake and health risks indicated the parental influence on children's dietary intake and eating patterns eventually affects children's nutrition and health status.

Chapter Three

Methodology

The source and description of the data used in this thesis and the statistical methods used to analyze the data are discussed in this chapter. The sample used for this thesis was selected from the Third National Health and Nutrition Examination Survey (NHANES III) 1988-1994. A brief explanation of NHANES III subjects and sampling design is given. The subjects, research study design and sampling, sample selection criteria, and statistical method of data analysis are also presented.

Description of the Third National Health and Nutrition Examination Survey (NHANES III), 1988–1994

The National Health and Nutrition Examination Survey (NHANES III) 1988–1994 was conducted and data were provided by the National Center for Health and Statistics (NCHS) and the Center for Disease Control (CDC) on a CD-ROM. NHANES is conducted periodically to assess the health and nutrition status of the civilian non-institutionalized population of the United States. Goals of the NHANES III include: 1) to estimate the prevalence of selected diseases and risk factors, and 2) to investigate and document reasons for secular trend of certain diseases and risk factors.

The survey contains data on individuals' dietary recall and the laboratory file includes data on the subjects' blood analyses. Subjects who did not provide complete dietary information as defined by the National Center for Health Statistics (NCHS) were excluded from the study. Five data files were used to obtain information used in the current study.

Description of the Study Subjects, Research Design and Sampling, and the Sample Selection Criteria

Subjects

The subjects for the analyses in this thesis study were a subgroup of a National Health and Nutrition Examination Survey (NHANES III) 1988–1994 with income level at or below 185% poverty level (for a family of four with annual income at or below $32,653). A sub-sample was created of children aged 2–9 years and female caregivers of childbearing age (15-49 years) with complete and reliable 24-hour dietary recall information. The female caregivers had at least one live birth and also had at least one child sampled from the same household.

A female caregiver is a low-income female of childbearing age. These females include all women ages 20–49 and girls' ages 15–19 years with at least one live birth living in the same household with a child aged 2–9 years. A total of 990 children aged 2–9 years were matched to 990 female caregivers with poverty level of at or below 185%. Data collected from the subjects and used in this study included: dietary information, biochemical, and anthropometric measurements. Adults provided self-reported, one-day dietary recall information. A proxy respondent provided children's dietary recall information. A proxy respondent is a family member, 17 years of age or over (preferably a parent or a guardian) living in the same household.

Research Design and Sampling

The current study was undertaken using a cross-sectional study design for the four study questions (see Chapter 1). This included an assessment of nutrient intake and breakfast consumption of the children and their female caregivers, as well as a determination of whether there was a female caregiver-child relationship in dietary adequacy, breakfast consumption, iron, and weight status.

Two separate datasets were created from the NHANES III data: the children's dataset and the female caregivers' dataset. The children's and the female caregivers' datasets included information on socio-demographics, dietary intake, anthropometrics, and blood analysis for iron biomarkers. The socio-demographic variables were sex, age, family's Income Poverty Ratio, Participation in the Women Children and Infant supplement program (WIC), and family size. The children's data file was then merged with the female caregivers data file to create a final data file that was used in this study.

Dataset selection. (See the appendix B for Criteria for excluded cases)

Two data sets were then created:

- Children's data with 2,393 children (aged 2–9 years) from households with at least a female caregiver in the sample, and
- Female caregivers' data with 1,923 female caregivers (ages 15–49 years) from households including at least one child 2–9 years of age.

Among the 2,393 children with at least a female caregiver in the household, households with multiple children were selected. To obtain one child per household from the 2,393 children, a random selection was performed and a total of 1,704 children were selected. The family sequence number was used to match the child to female caregivers in a household. In other words, a child and female caregiver with the same family sequence number came from the same household. Using a merging function in SPSS, female caregiver–child pairs were obtained by merging the children's dataset and female caregivers' dataset.

> The final sample was intended to consist of one child matched to one female caregiver per household. Three hundred twenty-nine children had more than one possible female caregiver in the household. To select only one female caregiver from each household, certain criteria were used (see appendix C).

Out of 1,704 female caregiver-child pairs from 1,704 households, a total of 990 low-income female caregiver-child pairs with an income at or below 185% poverty level were used in the current study. The final data consisted of matched pairs of low-income children and their female caregivers living in the same household selected from NHANES III 1988-1994 with complete and reliable 24-hour dietary recall information.

Statistical Analysis

The Statistical Package for the Social Science (SPSS) Version 7.5 was used in all current study analyses because it is suitable for the study and user-friendly. Descriptive and correlation analyses were used to answer the four research questions in this study. Descriptive analyses included the mean, standard deviation, and frequency distributions. For the research questions one, three, and four mean $\pm$ Standard deviation was used to determine the groups' mean nutrient intake or iron markers measurements. BMI scores were then compared to the recommended guidelines. These comparisons enabled the generalized conclusions on whether the group had met the dietary guidelines for each variable that was being measured. Frequency distributions for variables in all the four research questions were performed to determine

- the nutrient adequacy level (those above and below recommended guidelines)
- consumption of breakfast and RTEC (consumers and skippers)
- iron deficiency (deficient and not deficient), and
- weight status (normal, overweight, and obese).

Children's Dietary Intake in Relationship to their Female Caregivers'

A frequency distribution of children and female caregivers was generated by their demographic variables. The demographic variables were age, sex, and race-ethnicity, participation in WIC Program, Income Poverty Ratio, and family size. Dietary intake for both children and caregivers of total energy, percent energy from fat, saturated fat, and carbohydrates, dietary fiber, calcium, iron, vitamin A, and vitamin C intake were examined and compared to the Recommended Dietary Allowance (RDA). Nutrient intake of $< 70\%$ of the RDA and $\geq 70\%$ RDA for each nutrient were determined.

Intake of total fat, saturated fat, carbohydrates, and fiber were compared to Dietary Guidelines for Americans for total fat $< 30\%$, saturated fat $<10\%$, carbohydrates $<55\%$, and fiber $\geq$ 25g/day for ages 5 years and over. The percentage of the sample group that had $\geq 30\%$ total fat intake, $\geq 10\%$ saturated fat, $> 55\%$ carbohydrates, and $<$ 25g/day dietary fiber was obtained. Nutrition intake as a percentage of the Recommended Dietary Allowance (RDA) was classified into tertiles[1] for energy, vitamin A, vitamin C, calcium, and iron. Total fat, saturated fat, and carbohydrates as a percentage total energy intake in kilocalories from total fat, saturated fat, and carbohydrates.

A relationship distribution was performed by children's and female caregivers' nutrient tertile groups (nutrient intake were divided into three equal parts; the lowest, middle, and top third). Children in the first, second, and third tertiles for nutrient intake were compared to their female caregivers in the first, second, and third tertiles. The Chi-square was calculated to determine differences among the tertile groups. The correlation coefficiency was calculated between the children's nutrient intake and the female caregivers' intake. The female nutrient intake of total energy, energy from total fat, saturated fat, carbohydrates, dietary fiber, calcium, iron, vitamin A and C, and children's intake of total energy, energy from total fat, saturated fat, carbohydrates, dietary fiber, calcium, iron, vitamin A, and C were all included in the correlation analyses.

Children's Breakfast Consumption Patterns Related to their Female Caregiver

A frequency distribution of breakfast consumption, and Ready-to-Eat Cereal (RTEC) was listed, breakfast consumption (yes = 1, No = 0), RTEC (yes = 1, No = 0) for both children and female caregivers by their age, race-ethnicity, Poverty Income Ratio (PIR), participation in WIC, and family size. Pearson Chi-square was computed to determine whether there is a relationship between children breakfast-and-RTEC-consumers and the female caregivers breakfast-and-RTEC-consumers.

The frequency distribution of the breakfast-consumers and breakfast-skippers for both children and female caregivers was generated. A similar distribution was performed for breakfast-RTEC-consumers and RTEC-consumers. Statistical correlation was performed to determine the caregiver-child relationship of breakfast consumption. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated to determine how well the correlation model classified cases.

Children's Prevalence of Iron Deficiency and Iron-Deficiency Anemia vis-à-vis their Female Caregivers

Iron deficiency and iron-deficiency anemia was estimated by biochemical measures of iron status used in other studies and Looker et al study (1999), (see appendix). Free erythrocyte protoporphyrin, serum ferritin and transferrin saturation were used as measures for calculating iron deficiency. Based on laboratory tests, to be iron-deficient, a person had abnormal values of two or more bio-makers. Hemoglobin was used to measure iron-deficiency anemia. A combination of low hemoglobin levels and iron deficiency (two or more abnormal values of iron indicators) was indicators of iron-deficiency anemia.

The subjects were classified by the measurement of the iron variables using the cut-point value for each variable. The subjects were categorized into two groups, above cut-point = 1 and below cut-point = 0. Children's and female caregivers' serum ferritin, erythrocyte protoporphyrin, transferrin saturation, and hemoglobin measure for ages 2–5 years were grouped as, serum ferritin met yes = 1 and No = 0, erythrocyte protoporphyrin met, yes = 1 and No = 0, transferrin saturation met, yes = 1 and No = 0 and Hemoglobin met, yes = 1 and No = 0.

The subject that had two or more iron measures less than the cut-point value was defined as iron-deficient. All three measures above the cut-point = 0, one of iron measures below cut-point = 1, two of the iron measures above cut-point = 2, and three of the measures below the cut-point = 3. Hemoglobin variable was combined with the iron deficiency, if an individual had hemoglobin less than the cut-point and was iron-deficient, then that person had iron-deficiency anemia, iron-deficiency anemia = 2 and not iron-deficiency anemia = 1.

The objective was to assess the sample and determine individuals who were iron-deficient and those who were anemic. The dependent variables were children's no iron deficiency, iron deficiency, and iron-deficiency anemia, which were coded as 0, 1, and 2, respectively. The frequency distribution for iron deficiency and iron-deficiency anemia were generated using the iron values as continuous variables.

The mean values of the children's and female caregivers' serum ferritin (ng/ml), free erythrocyte protoporphyrin (ug/dl), transferrin saturation (%), and hemoglobin (g/dl) were calculated by age group. Percent frequency distribution of those above and below recommended cut-point value was determined. Pearson correlation was performed using continuous variables of iron makers between the children's serum iron, free erythrocyte protoporphyrin, transferrin saturation, and hemoglobin values and female caregivers' serum ferritin, free erythrocyte protoporphyrin, transferrin saturation, and hemoglobin values. R value was used to assess the strength of the relationship's significance.

Relationship between Children's Weight Status and their Female Caregivers' Adiposity (the state of fatness)

The variables used to measure children's weight status were weight-for-height percentile and triceps skinfold measurements: $\geq 85^{th}$ percentile for weight-for-height and triceps skinfold measurement are both considered overweight (NCHS, standard reference measures). The female caregivers' weight status was determined by the Body Mass Index (BMI) measures and triceps skinfold measurements. BMI is calculated as weight (kg) / height $(m)^{2.}$ Children's weight-for-height was calculated using the weight and height measures collected during the survey. Individuals with weight-for-height$< 85^{th}$ percentile = 0 and those with weight-for-height$\geq 85^{th}$ percentile = 1. Distributive statistics was performed for the children's weight-for-height and triceps skinfold measurement by age, gender, race-ethnicity, Poverty Income ratio (PIR), participation in federal assisted program WIC, and family size. A chi-square test was run to determine if there were differences in the children's weight status by their demographic variables and the significance of the differences. The significance level of social demographic variables was determined by the p-value (p, 0.5, significant). Similarly, the children's triceps skinfold measurements were grouped as $< 85^{th}$ percentile = not overweight, and $\geq 85^{th}$ percentile overweight (NCHS reference) by their socio-demographic characteristics. Chi Square was performed to determine the level of significance in the differences by the socio-demographic variables.

BMI is often used to distinguish between the obese and the non-obese subjects. Weight and height values were used to generate BMI scores (BMI = weight (kg) /height^2 (m)^2) for each female. Descriptive statistics for female caregivers' BMI scores were calculated to determine those who were not overweight, the overweight, and the obese. BMI score references used were: not overweight $\leq$ 24.9, overweight 25 – 29.9 and obese $\leq$ 30 (also used in the National Center for health services (NCHS). These were coded as not overweight = 1, overweight = 2, and obese = 3. The female caregivers BMI was classified by their age, race-ethnicity, PIR, participation in WIC, and family size. Chi square analyses were performed.

Female caregivers' triceps skinfold measurements were also used as a measure of overweight. Female caregivers' triceps skinfold measurements were categorized as not overweight < 85th percentile, and overweight $\geq$ 85th percentile (NCHS reference standard). Chi Square was computed to determine the significance of the difference. The female caregivers' triceps skinfold were also grouped by their socio-demographic variables.

Frequency distribution of children's weight-for-height (< 85th percentile and $\geq$ 85th percentile) by their female caregivers skinfold measures and BMI scores was determined. Pearson correlation analysis was run to determine the relationship between the children's weight variables and their female caregivers.' Female caregivers' weight variables were independent variables and children's weight variables were dependent variables. Pearson correlation coefficients (r) were calculated between the children's weight-for-height and triceps skinfold values and female caregivers' BMI and triceps skinfold values.

The subjects in this study were a low-income sub-sample with income level of ≤185% that participated in the NHANES III with complete and reliable dietary information. The final sample for the study was 990 child–caregiver pairs living in the same household. Dietary information, anthropometric, and biochemical measures were used in the analysis for the study questions. Twenty-four hour dietary intake included nutrient intake of energy: total fat, saturated fat, carbohydrates, and dietary fiber; anthropometric measures used to determine weight status were weight-for-height, BMI, and skinfold measures; and biochemical measures used to determine iron deficiency and iron-deficiency anemia were serum ferittin, erythrocyte protoporphyrin, transferrin saturation, and hemoglobin. Descriptive statistics, chi-square, and correlation analyses were used in the data analysis.

Chapter Four

Results

The outcome of descriptive statistics analyzes for children and female caregivers nutrient intakes and intake adequacy when compared to the recommended guidelines are presented first. The distributive analysis includes the mean and standard deviation of the children's and female caregivers' nutrient intakes and frequency distribution of $< 70\%$ RDA of calorie intake, calcium, iron, vitamin A and vitamin C, and $\geq 30\%$ energy from total fat, $\geq 10\%$ saturated fat and $\geq 55\%$ energy from carbohydrates. Then, correlation analyses of the female caregiver-child relationship of nutrient intake, breakfast, iron deficiency anemia, and weight status are presented.

Socio-Demographic Characteristics

The subjects in this study included 990 female caregiver-child pairs from the same household with income level of $\leq$ 185% poverty level with the annual income of $\$\leq 32,653$ for a family of four. Table 1 shows a summary of socio-demographic variables included in this study. The children were categorized into two age groups, ages 2 – 4 year old (n = 562) and 5 – 9 years old (n = 428). There was an even distribution of boys and girls with the majority of the children were black (n= 410), 403 Mexican Americans and 134 white. Of 990 children, only 199 responded that they participated in the WIC program (468 were non-WIC participants and 322 children did not indicate whether or not they participated in WIC). The age of female caregivers ranged from 15 – 49 year old.

Table 1. Socio-demographic characteristics of children and female caregivers in the study

	n	%
Children: age (y)		
2 - 4	562	56.8
5 - 9	428	43.2
Children		
Gender		
Boys	508	51.3
Girls	482	48.7
Female caregivers: age (y)		
15 - 19	144	2.2
20 - 29	411	45.6
30 - 39	397	40.5
40 - 49	38	11.7
Children's race-ethnicity		
Whites, non-Hispanic	134	13.5
Blacks, non-Hispanic	410	36.7
Mexican Americans	403	35.0
Others[1]	43	25.2
WIC[2] Participants		
yes	199	20.1
no	323	47.1
unknown	468	32.6
Family size		
2	27	5.8
3	138	13.9
4	236	23.8
5+	559	56.5

[1] All Hispanics and non Hispanics that are not white, black or Mexican Americans

[2] The Special Food Supplemental Program for Women Infants and Children (WIC)

Out of 990 female caregivers, only 22% were teenage female caregivers ages 15–19years; 45%, 20 – 29 years; 41%, 30 – 39 years, and 12%, 40 – 49 year.

First Research Question:

How does the children's nutrient intake and adequacy relate to their female caregivers?

Nutrient intake of children and female caregivers was based on the 24-hour dietary recall information. Most of the children's mean caloric intake was close to 100% RDA and greater than 70% of the Recommended Allowance (table 2, appendix D). 21% of the children had energy intake less than 70% of the RDA. There was no difference of energy intake by the children's race-ethnicity, participation in WIC, or family size. However, there was significant difference in energy intake by the children's age-group; 19% of the 2 – 4 year old children had their total energy intake less that 70% RDA compared to the 23% for the 5 – 9 year old with energy intake less that 70% RDA. More girls had less recommended energy intake (< 70% RDA, 24%) compared to boys (18 %).

Children's average energy intake from total fat was 34% for all children ages 2 – 9 years. This was above the recommended guidelines of < 30%. There was no significant difference of energy intake from total fat between white children, black or Mexican Americans. The total fat intake of children who participated in WIC did not differ from the fat intake of the non-participants, and the family size did not have an effect on the child's total fat intake. Similar results were observed with the children's intake of energy from saturated fat. Children's saturated fat intake was above the recommended guidelines of < 10%, the mean intake was 12%. There was no deference between the children's saturated fat intake by the children's age group, gender, race-ethnicity participation in WIC or household family size.

The children's mean carbohydrate intake was 53.5 ± 9.3 (Table 3, appendix E). The only significant difference ($p<0.01$) observed among those children that consumed more that 55% energy from intake carbohydrates was by their race-ethnicity groups; 50% of white children, 41% blacks, 39% Mexican Americans, and 45% others had energy intake above 55% energy form carbohydrates. Mean dietary fiber intake for the children was about 11.1 ± 6.6, 42% of the children had less that the recommended dietary fiber intakes. Children ages 5 – 9 years old had less dietary fiber intake 48% (n= 562), compared to the 2- 4 years that had only 38% (n=428) with less intakes of dietary fiber. The results indicated a significant difference between the children's dietary fiber intake by their age, gender and family size.

The average children's intakes of calcium, iron, vitamin A and vitamin C are over 100% RDA (Table 4 & 5, appendices E & F). 23% of the children in this study had calcium intakes less than 70% of the RDA with highest number of children from age group 5 – 9 years (33%, n=428). A higher number of girls consumed <70% RDA of calcium 30%, than boys (25%). Black children consumed less that 70% RDA (35%) calcium, followed by white children, 26% then Mexican Americans, 24%. Iron intake among all children averaged 117 ± 67, which was above 100% RDA, and 29% of the children consumed less that 70% RDA. Girls had less calcium intake compared to boys, and Mexican American children had the highest deficiency of dietary iron intake with 27%, 21% and 19% in white and black children, respectively. Children from households with high family size had lower iron intakes (24%, < 70% RDA) that those with fewer people in the household (12%, < 70% RDA). The intakes of iron among children were significantly different by the children's age group, sex, and ethnicity. The only difference noted in the vitamin A intake was that black children had less intake compared to white and Mexican American children. Overall, 24% of the children consumed less vitamin A than recommended, with the highest number of children from age group 5 – 9 years. Vitamin C was the least deficient nutrient among all children compared other nutrients. Only 16% of the children had less that 70% RDA of vitamin C compared to 23% calcium, 29% iron, and 24% vitamin A.

The female caregivers caloric intake was also close to 100% RDA, 85.9±37.4 (Table 5, appendix G) but lower than the children's mean caloric intake, 97.2±35.4. 36% of female caregivers had less than 70% RDA energy intake. Teenage women had slightly higher energy intake (95.5±48), compared to other age groups. There was no difference of caloric intake among different race-ethnicity, age groups, WIC participants and non-WIC participants, families with different family sizes. The caregivers' energy from total fat intake was 34% and 12% saturated fat; both were higher than the recommended allowance. Female caregivers differed significantly in their energy intake from total fat; black women had the highest total fat intake of 35%, whites 34%, and Mexican American 33%. Women enrolled in WIC Program had slightly higher fat intake (36%) and saturated fat intake (13%) compared to non-WIC participants.

The average dietary fiber intake for the caregivers was 14g/ day; this is half of the recommended intake 25g/day (Table 6, appendix H). White female caregivers had 14g fiber, blacks 12g/day and Mexican Americans 17g/day. 90% of the white women, 94% black and 78% Mexican Americans had less that 25g of dietary fiber intake. Mean calcium (81%) iron (83%) vitamin A (57%) intakes for the caregivers were also close to 100% RDA and vitamin C (162%) over 100% RDA but slightly lower than the children's mean intakes (Table 7, appendix I). There was significant difference of female caregiver calcium, iron, vitamin A and C intakes by their age groups.

In general, nutrient intake was moderately positively correlated between the female caregivers and the children. There was a statistically significant correlation ($p < .01$) with correlation co-efficiency (r) ranging from .12-.40 for all the nutrients in the study (Table 21, Appendix P).

Table 8. Relationship between children and their female caregivers' tirtiles

	Female caregivers' intake				
	Mean	tertile[1] %	tertile2 %	tertile %	p
Children's intakes					
Energy (% RDA[2])					0.00
tertile 1	63.1 ± 13.3	41.1	33.3	25.	
tertile 2	92.8 ± 7.9	33.7	35.5	30.	
tertile 3	136.5 ± 27.9	27.1	30.5	42.	
Total Fat (% Kcal)					0.00
tertile 1	24.7 ± 4.3	45.9	32.5	21.	
tertile 2	34.1 ± 1.7	30.3	34.3	35.	
tertile 3	41.9 ± 4.1	22.5	33.5	44.	
Sat. Fat (% Kcal)					0.00
tertile 1	8.8 ± 1.7	42.8	32.8	24.	
tertile 2	12.4 ± 0.8	40.5	40.5	31.	
tertile 3	16.5 ± 2.3	25.7	29.5	0.	
Cho (% Kcal)					0.00
tertile 1	43.4 ± 4.9	42.5	32.6	24.	
tertile 2	52.9 ± 2.1	34.0	32.6	33.	
tertile 3	63.2 ± 5.7	26.1	33.2	40.	
Fiber (g)					
tertile 1	5.7 ± 1.8	39.2	34.4	26.	0.00
tertile 2	10.5 ± 1.4	35.5	35.0	29.	
tertile 3	18.8 ± 5.8	25.5	32.7	41.	

[1]Three parts intake (tertile1-33.3%; tertile 2- 66.6%, and tertile 3-99.9%)

[2]Recommended Dietary Allowance,

p value is by X^2 test

Table 9. Relation between children's vs. female caregivers' tertiles

		Female caregivers' intake			
		Tertile[1]1 %	tertile2 %	tertile3 %	P
Children's intakes					
Vitamin C (% RDA[2])					0.00
tertile 1	72.4 ±35.2	41.7	35.2	23.1	
tertile 2	193 ±39.1	33.0	34.2	32.8	
tertile 3	436.4 ±176.1	25.8	28.8	45.3	
Vitamin A (% RDA)					0.03
tertile 1	50.2 ±20.1	43.2	33.8	23.0	
tertile 2	114.7 ±19.7	34.3	37.0	28.7	
tertile 3	281.3 ±236.5	22.4	29.8	47.8	
Ca (% RDA)					0.00
tertile 1	47.1 ±15.8	43.3	32.9	23.8	
tertile 2	91.7 ±12.8	32.2	37.0	30.8	
tertile 3	164.5 ±48.7	29.6	27.6	42.8	
Fe (% RDA)					0.01
tertile 1	90.4 ±47.8	36.6	34.4	29.0	
tertile 2	120.5 ±56.8	33.2	33.6	33.2	
tertile 3	153.5 ±83.5	27.2	34.9	37.9	

[1] Three part intake (tertile1-33.3%; tertile 2- 66.6%, and tertile 3-99.9%)

[2]Recommended Dietary Allowance,

p value by X^2 test

Second research question:

How does the children's breakfast and Ready-To-Eat-Cereal (RTEC) consumption relate to their female caregivers?

Most of the children in this study consumed breakfast (90%) and only 10% skipped breakfast, 11% of the black and 12% Mexican American children did not consume breakfast, yet only 5.6% of the white children skipped breakfast meal. The Black and Mexican American children who skipped breakfast are twice the number of white children. Children who participated in WIC Program consumed breakfast and RTEC at for breakfast, 91% and 44.2%; more than non-WIC participants, 88% and 30%. 51% whites children, 37% Mexican Americans, and 26% blacks consumed RTEC for breakfast (Table 10).

Table 10. Percent children who consumed breakfast and RTEC[1] by race-ethnicity, WIC[2] participation, and family size

	n	Breakfast consumption no	Breakfast consumption yes	Breakfast RTEC no	Breakfast RTEC yes
Age (y)					
All	990	10	90	42.3	57.7
2 - 4	562	7	93	41.9	58.1
5 – 9	428	13.4	86.6	42.7	57.3
Race-ethnicity					
White	134	5.6	94.4	49.0	51.0
Black	410	10.5	89.5	56.7	43.3
Mexican Americans	403	12.1	87.9	63.1	36.9
Others	43	12.7	87.3	70.4	29.6
WIC participation					
Yes	199	9.2	90.8	55.8	44.2
No	468	12.3	87.7	69.9	30.1
Family Size					
2	27	8.5	91.5	58.5	41.5
3	138	10.4	89.6	58.3	41.7
4	236	10.3	89.7	57.6	42.4
5+	559	9.8	90.2	57.4	42.6

[1]Ready To Eat Cereal

[2] The Special Food Supplemental Program for Women Infant and Children (WIC)

Table 11 shows that 73% female caregiver ate breakfast and only 10% ate RTEC for breakfast. Again, more white female caregivers consumed breakfast and RTEC compared to Black and Mexican American female caregivers; 80%, 67% and 73% respectively. A higher percentage of Black women skipped breakfast (33%) than Mexican Americans (27%) and whites (20%). More children consumed breakfast and RTEC (n=990, 90% and 58%) compared to the female caregivers (n=990, 73% and

11%). Female caregivers skipped breakfast and did not consume RTEC often compared to the children living in the same household. There was a and significant positive relationship between female caregivers' and their children's breakfast and RTEC consumption with a correlation coefficient of r=.2. A high specificity was calculated (92.6%) and a low sensitivity (19.3%) was found (table 12, appendix J).

Table 11. Percent female caregivers who consumed breakfast and RTEC[1] by age-group, race-ethnicity, WIC[2] participation, and family size

		Breakfast consumer		Breakfast RTEC[1]	
	n	yes	no	yes	no
Age (y)					
All	990	73.2	26.8	10.6	89.4
15-19	22	64.0	36.0	12.0	88.0
20-29	451	70.2	29.8	11.1	88.9
30-39	410	74.7	25.3	10.5	89.5
40-49	116	77.6	22.4	9.6	90.4
Race-Ethnicity					
White	144	80.4	19.6	16.0	84.0
Black	411	67.5	32.5	9.6	90.4
Mexican Americans	397	73.5	26.5	8.6	91.4
Others	38	78.8	21.2	4.5	95.5
WIC[2]					
Yes	116	35.4	64.6	10.8	89.2
No	152	66.7	33.3	12.5	87.5

[1]Ready To Eat Cereal
[2]The Special Food Supplemental Program for Women Infant and Children (WIC)

Third Research Question:

How does the children's iron deficiency and iron deficiency anemia relate to their female caregivers'?

Iron deficiency biomarkers used in the study were transiferrin saturation, serum ferritin, and erythrocyte protoporphyrin. An individual with two or three of these measures below the cut-point value was considered iron deficient (check appendix K for cut-point values). If an iron deficient person had low hemoglobin levels, this person was considered to have iron deficiency anemia (table13, and table 14, Appendix K). 3% (27) of the children had iron deficiency and 1% had iron deficiency anemia while 8% (77) of the female caregivers had iron deficiency and 9% (88) had iron deficiency anemia. There is a higher prevalence of iron deficiency and iron deficiency anemia among female caregivers than in the children. Fewer children had transferrin saturation, serum ferritin, erythrocyte protoporphyrin and hemoglobin measures below the cut-point than female caregivers.

Overall, 29% of female caregivers had low values for transferrin saturation, 15% serum ferritin, 17% protoporphyrin, and 18% hemoglobin, compared to the children with values below the cut-point; 11% transferring saturation, 5% serum ferritin, 7% protoporphyrin and 4% hemoglobin (Table 13). Less prevalence of iron deficiency and iron deficiency anemia among children than female caregivers may be as a result of high consumption of breakfast and RTEC by children than by female caregivers. The highest prevalence of iron deficiency anemia was observed among female caregivers ages 40 – 49 years old 13%, followed 7% in 20 – 29 years, and 5% 15-19 years.

Table 13. Iron status of children and female caregivers

Age (y)	Transferrin Saturation % below cutoff	Serum ferritn % below cutoff	Protoporphyrin Erythrocyte % below cutoff	Hemo-globin % below cutoff	Iron Def[1] %	Anemia[2] %	Target[3] 2010 Iron def
Children							
All					3.1	1	<1%
2- 4	11.4	7.6	7.3	6.6	4	1	
5- 9	19.8	2.3	6.3	1.3	2	0	
Female caregivers							
All	28.5	14.8	17.2	18.2	15	9	<7%
15-19	18.2	13	13	26.1	8	1.1	
20-29	29.3	16	15	16.1	14	7.1	
30-39	26.8	13.6	18.4	19	14	4	
40-49	33.3	16.1	19.5	21	17	13	

[1] Iron deficiency is defined as more than one abnormal value (below the cuoff value) of transferrin saturation, serum ferritin or erythrocyte.protoporphyrin
[2] Iron deficiency and low hemoglobin value
[3] Healthy People Objective 2010 for iron deficiency

Fourth Research Question:

How does the children's weight status related to their female caregivers' adiposity?

Children's weight status was measured by the triceps skinfold and weight-for-height (wt-for-ht) percentiles (NCHS Reference). 19% of children were overweight using triceps skinfolds of $\geq$ 85% (Table 15, appendix L). Using weight-for-height measurements (Table 16, appendix M), 24% of children were overweight (with $\geq$ 85% percentile as overweight). Children ages 2 – 4 years were less heavy than 16%, n=562, than the 5 – 9 year olds, 23%, n= 428. 23% of the girls were considered overweight by their triceps skinfold percentile, while only 15% of the boys had their triceps skinfold measurements $\geq$ 85% tile. There was a significant difference in the weight status of the children by their age group and gender and race-ethnicity and participation in WIC Program. Mexican American children (30%) were more overweight than black and white children, 20% and 24% respectively. 21% of WIC participant were overweight compared to 10% overweight non-WIC children. The higher the family size the lower the overweight prevalence. There were 17% overweight children in household with 5 and over family members, and 26 – 24 % overweight children in household with two to three family members.

The mean female caregivers' BMI was 27.7$\pm$6.8, which falls with the overweight category. 43% of female caregivers had BMI scores $\leq$ 24.9 % which is considered normal weight, 28% overweight female caregivers with BMI 24.9 – 29.9, and 29% obese with BMI $\geq$ 30 (Table 17, appendix N). 33% black female caregivers were obese compared to 30% Mexican American and 20% white. Female caregivers who did not participate in WIC Program were more overweight that the WIC participants. Female

BMI scores significantly differed by the female caregiver's age group, race-ethnicity, participation in WIC and by family size. Table 20 (appendix O) shows the female caregivers triceps skinfold classifications, < and >85%tile as per the reference values from the NCHS. Triceps skinfold > 85% was considered to be overweight.

Tables 8 and 9 are children's nutrient intake in tertiles by their female caregivers. Children with nutrient intake in the highest tertile had most female caregivers with intakes also in the highest tertile (third tertile). Children with intakes in the first tertile had most of their female caregiver also with intakes in the same tertile. This implied that the level of children's nutrient intake is related to that of their female caregivers. Children that were overweight were more likely to have caregivers who were overweight or obese (Tables 18 and 19). Female caregiver-child weight status showed a positive significant correlation with Pearson' (r) correlation coefficient of 0.12 – 0.33 (table 21, appendix P).

In summary, 990 female caregiver-child pairs from same household with income of $\leq$ 185% poverty level were used in these analyses. The results of the study showed a mild to moderate significant positive correlation between the children and female caregiver's nutrient intakes, breakfast and RTEC consumption, iron deficiency and weight status. Female caregivers with high energy intake from total fat, saturated fat, carbohydrates, low dietary fiber intake, and less consumption of breakfast and RTEC were likely to have children with high intake of total fat, saturated fat, carbohydrates, and low dietary fiber intakes and less breakfast and RTEC consumption. Children that had iron deficiency, iron deficiency anemia, or over weight were likely to have female caregivers with iron deficiency, iron deficiency anemia, overweight or obese.

Table 18. Children's weight-for height and triceps skinfold percentiles by their female Caregivers' BMI[1] scores

	Female caregivers' BMI			
	≤24.9	25 - 29.9	≤30	p
Weight-for-height Percentiles				
All				0.00
≤ 85%tile	49.1	26.5	24.4	
> 85%tile	27.4	31.1	41.5	
2 - 4 y				0.00
≤ 85%tile	51.1	22.5	26.0	
> 85%tile	29.3	30.9	39.8	
5 - 9 y				0.00
≤ 85%tile	46.0	31.6	22.4	
> 85%tile	25.8	31.2	43.0	
Triceps				
All				0.00
< 85%tile	47.0	26.8	26.2	
>85%tile	30.2	30.9	38.9	
2 - 4 y				0.00
< 85%tile	49.4	23.2	27.4	
>85%tile	33.3	29.9	36.8	
5 - 9 y				0.00
< 85%tile	44.0	31.3	24.6	
>85%tile	27.8	31.7	40.6	

[1]Body mass Index

p value by x^2

Table 19. Children's weight-for-height by their female caregivers' triceps skinfold percentiles.

		Female caregiver's triceps percentiles		
		≤ 85%tile	>855tile	p
Weight-for-height Percentiles				
All				0.00
	≤ 85%tile	77.3	22.7	
	> 85%tile	64.3	35.7	
2 - 4 y				0.00
	≤ 85%tile	76.4	23.6	
	> 85%tile	65.4	34.6	
5 - 9 y				0.00
	≤ 85%tile	78.5	21.5	
	> 85%tile	63.3	36.7	
Triceps				
All				0.00
	< 85%tile	76.2	23.8	
	>85%tile	64.8	35.2	
2 - 4 y				0.00
	< 85%tile	75.5	24.5	
	>85%tile	67.4	32.6	
5 - 9 y				0.00
	< 85%tile	77.2	22.8	
	>85%tile	62.8	37.2	

[1]Body mass Index

p value by x^2

Chapter Five

Conclusion, Research and Policy Implications

Summary

This chapter consists of a summary of the background information on nutritional adequacy among low-income families, nutrition issues, dietary habits, and related nutrition health risks common among low-income women and children. It summarizes the statistical methods and study findings. In addition, the overall conclusions, research, and policy implications will be discussed.

The study of the relationship of female caregiver–child nutrient intake, iron-deficiency anemia, and obesity provides insights into how female caregivers may influence children's dietary habits and, possibly, their nutritional health. Undesirable dietary habits and lifestyles that include inadequate nutrient intake, excessive fat intake, and low physical activity may result into nutritionally related diseases such as iron-deficiency anemia, obesity, and cardiovascular diseases.

Low-income families have lower nutrient intake than recommended for proper growth and development. Federal food assistance programs provide food and cash assistance to low-income households to improve their dietary quality and reduce nutrition deficiency diseases. Caregivers' food choices may affect the children's dietary quality and habits. Studies have shown that dietary habits developed in childhood may persist into adulthood, and healthy dietary habits developed in childhood can prevent nutritional health risks both in childhood and adulthood.

Low-income children and women have a higher prevalence of iron deficiency and iron-deficiency anemia, and higher energy intake from total and saturated fat than the recommended allowance. Increased prevalence of obesity in low-income children and women is due to over-consumption of dietary fat and physical inactivity. The parent-child relationship of nutrient intake and health risks indicated the likelihood that the parental influence on children's dietary intake and eating patterns eventually affects the children's nutrition.

In this study, nutrient intake was assessed by the 24-hour dietary recall for both children and female caregivers and was compared to the recommended allowance to determine the adequacy intake level of each nutrient in the study. Breakfast and Ready-To-Eat Cereal (RTEC) consumption were used as indicators of dietary habit or behavior. Breakfast consumption and consumption of Ready-To-Eat Cereal are excellent sources of micronutrients that contribute significantly to the total daily nutrient adequacy of individuals. Iron deficiency and iron-deficiency anemia were determined by similar biomarkers used in NHANES II and III and by other researchers (Looker, 1997). Transferrin saturation, serum ferritin, and erythrocyte protoporphyrin were used to measure iron deficiency and hemoglobin values were used to determine iron-deficiency anemia. Children's weight status was determined by their triceps skinfold and weight-for-height measurements. The female caregivers BMI score (BMI score is defined as body weight in kilograms divided by the height squared, kg/ht^2) and triceps skinfold measures were the variables for female weight status.

Results on the relationship of female caregiver–child nutrient adequacy showed that female caregivers with high nutrient inadequacy were more likely to have children who consumed fewer nutrients than recommended guidelines and vise versa. Female caregivers with diets high in calories, total fat, saturated fat, and carbohydrates had children who were more likely to consume a similar diet. Children with low fiber, calcium, iron, vitamin A, and vitamin C intake had female caregivers with low intake of the same nutrients. This study revealed that there is a tendency of a variety of nutrients intake patterns to cluster within households or families.

Findings from the study indicated that there was a positive relationship between the children's breakfast and RTEC consumption and that of their female caregivers. Female caregivers who skipped breakfast and did not consume RTEC at breakfast were more likely to have children who frequently skipped breakfast and not consume RTEC. Children enrolled in WIC program consumed RTEC compared to their female caregivers. This difference may be explained by the fact that WIC program provides RTEC to the children but not to the women participating in the program. Higher consumption of breakfast in WIC children may also be due to the free supplemental foods that are provided by the programs, including milk, cereal, and eggs.

There was higher prevalence iron deficiency (8%) and iron-deficiency anemia (9%) among female caregivers than in children, 3% and 1% respectively. These results are consistent with other studies that showed a higher prevalence of iron deficiency and iron-deficiency anemia in women than in children (NMRR, USDA, 1995). There was a positive relationship between the iron-deficiency anemia and their female caregivers. The correlations between female caregivers' and children's iron deficiency were found to be significant and moderately correlated with R-value of .33. There was a higher prevalence of overweight among the children and their female caregivers. Twenty-four percent of the children were overweight and 28% of the female caregivers were overweight while 29% were obese. These results are similar to other studies (Whitaker et al. 1997). The relationship analyses showed that overweight female caregivers were likely to have children who were overweight, and obese female caregivers were also likely to have children who were obese. There was a similarity in the weight status of the children and their female caregiver. The children's weight status was significantly and positively correlated with that of their female caregivers.

The positive relationship between the children's and their female caregivers' weight status is consistent with a study done by Deutscher et al (1966). There is an increase in prevalence of overweight and obesity in both children and adults. Overweight and obesity have been associated with lack of physical activity and high-fat diets. A study by Fisher and Birch (1995) revealed that children's food preference of high-fat foods was associated with their parents' adiposity. They concluded that parents or mothers influence their children's high-fat food preference. Mothers determine the kinds of food they feed their children. By making high-fat foods available to their children, they enhance the children's preference for foods high in fat.

Conclusions

Familial nutrient intake and health status resemblance was investigated in the current study by Pearson correlation coefficient. There was a positive association between the children's caloric, total fat, saturated fat, carbohydrates, calcium, fiber, iron, vitamin A and C intake. There was also a positive relationship between the children's iron-deficiency anemia and weight status with their female caregivers. The results from this study reflect the stringent discipline in nutrition and lifestyle pattern that extend into the younger generation. The homogeneity of culture within a family and similar nutritional food patterns are likely to be the attributing factor to positive relation of nutrient and health risk factors. These outcomes are similar to the Patterson et al study (1988) that demonstrated a moderate relationship in dietary fat, sodium, and calories. There was a positive relationship between the child-parents, sibling-sibling, and spouse-spouse dietary intake. The correlation between the mothers and children was stronger than between the fathers and children.

The relationship between the children's health risk factors measured by the iron-deficiency anemia and obesity is an indication of how aggregate dietary intake may affect the development of health risk factors with a family. In comparison with other sources of influence in diet, family is believed to be very important. A positive relationship of dietary behavior within a family is expected because families eat meals together and tend to have access to similar foods and influence each others' eating behavior. A study by Eastwood et al. (1982) found a positive correlation of parent-child nutrient intake of carbohydrates, fat, and calories with the correlation ranging from 0.15–0.30. Other studies have reported that family members' nutrient intake contribute to coronary heart diseases (CHD). Kleiges et al. (1990) report that parents' interaction with children closely correlated with the children's physical activity, eating behavior, and perhaps relative weight. Parents who encourage their children to eat correlated with how much children spent to eat and the relative weight of the children. Parents who encouraged physical activity correlated with the children's physical activity level and the children's relative weight.

Individuals who live together share common dietary intake and habits and possibly energy expenditure. Therefore, it is possible to expect similarities in weight status (Garn 1988). Genetic and environmental factors are known to affect the individual's weight status. Environmental influence, such as consumption of foods high in total fat and saturated fat, high caloric intake, and lack of physical activity, are associated with development of overweight and obesity. Environmental influence on a person's weight is stronger than genetic influence. Because environmental factors, such as dietary intake and the level of physical activity are modifiable, prevalence of obesity can be reduced by positive changes in dietary intake and lifestyle.

Research and Policy Implications

Research implications

Twenty-four-hour dietary information used in NHANES III survey is not a true representation of an individual's usual nutrient intake. Multiple food diaries along with food frequency and a history of food intakes may improve the accuracy of the nutrient intakes and the outcome of the studies. Also, self reported dietary intake information may be under or over-reported, it relies on memory and honesty of the individual compared to observational methods, Oliveria et al (1992). NHANES III data is valid and reliable for estimating dietary quality for the national population and for subgroups. For a large sample size, a one- day dietary recall and mean intake of the subjects are acceptable for making estimates of individual's intakes for the study. A self-reported food diaries is simple, requires less time and effort, and it is appropriated for illiterate subjects.

NHANES III Survey does not identify the mothers or caregivers of the children with complete and reliable dietary information. Future NHANES Surveys need to include the variable "mother of child(ren)" to increase the accuracy on mother-child relationship studies. Variables such as Level of education, number of food assistance program participation, and physical activity are some of the indicators that the may reveal more about the caregivers influence on their children's nutritional health status that were not included in this study.

The relationship of nutritional health status demonstrated by paired sample of female caregiver and child was a more direct and accurate relations compared to relationships made using group samples of children and female caregivers. Nutrient intake, biochemical and athropometric methods are some of the commonly used methods of accessing nutritional health of individuals; dietary pattern and food servings are recommended for future studies on parental and children nutritional health relationships. Studies on families' dietary behaviors or patterns may provide more insight for nutrition interventions that target a low-income families unit.

Policy implications

Reports from studies have shown that nutrition programs have a positive effect on the food quantity in low-income households, but there are mixed reports on the effect of the programs on nutrient intake of low-income families. The prevalence of nutrition inadequacy and poor diet among low-income groups may be an indication that those households that need to benefit from nutrition programs are not participating in the program or low-income families are participating in fewer assistance programs. Some reasons for non-participation in nutrition programs include poor accessibility to the program site due to lack of transportation, lengthy program application process and paperwork that discourages individuals, and lack of interest to enroll in the programs. Nutrition programs that target low-income families need to expand the programs, increase areas of coverage, and set up program sites closer to potential participants to improve accessibility to the programs. The nutritional interventions need to be made more attractive to low-income individuals in order to increase enrollment and participation in the programs. The application process should be simple and fast to encourage participation.

The federal government needs to increase the federal and state budget allocation for nutrition programs targeting low-income households; this will enable the programs to increase coverage and participation. Nutrition programs, such as WIC, have shown a positive effect on the nutritional status of low-income women and children; a reduction in iron-deficiency anemia among low-income women and children has been attributed to the efforts of the WIC program. Such programs require continuous support to enable the program to improve on its intervention strategies with the goal of eliminating nutrition-related problems among low-income groups.

Nutrition programs need to emphasize educating the participants on the association between nutrition and disease. Individuals' negative attitudes toward nutrition programs for low-income people as "a source of food and cash to low-income families" but not as a source of assistance that aims at improving their nutrient intake and prevention of nutrition-related diseases affects the impact of the program on the participants. The Food Stamp Program does not provide nutrition education to' participants along with the cash assistance offered. It is not known whether the cash assistance given to program members is used to purchase nutritious food for the family member; FSP must offer nutrition education to participants in order to improve their nutrient intake.

WIC program provides food vouchers for specific foods high in calcium, iron, vitamins, and minerals for women, infants, and children. The positive impact of WIC programs on the nutrient intake of participants is mainly due to the supplemental foods offered that are high in vitamins and minerals. FSP does not have restrictions or specification on what the cash voucher can be used to purchase. It is likely that some of these vouchers may be used to purchase non-food items or foods low in nutritional value, such as high-fat foods or high-sugar beverages. Nutrition programs should have restrictions on what foods may be purchased with the vouchers in order to make nutritious foods available in low-income households.

Studies on the parent-child relationship on nutrient intake and disease risks have indicated that parents/mother or caregivers may influence children's nutritional intake and dietary habits. Findings from my study also indicated a positive relationship between the female caregivers and their children's nutritional health status. There is also an indication that the caregivers' role has an impact on the children's nutrition and food habits. The positive relationship of the caregivers' and their children's nutritional status, and the role of caregivers on the children's and other family members' nutrient intake may have a positive effect on the nutrition program intervention. Nutrition programs should targeting women or caregivers but yet address the nutritional needs of an entire household, since members from same household have similar nutritional needs due to the common dietary patterns in a household. Nutrition education targeting healthy behavioral change using a household perspective may lead to higher achievements in prevention and reduction of nutrition health problems in low-income households.

Nutrition health problems among low-income groups is a multi-factorial problem. Social, financial, and physical factors are some of the factors contributing to nutrition health problems. A holistic approach may be an appropriate method to address the nutrition deficiencies and poor dietary habits in low-income groups. Collaborative efforts with other related fields such as public health, social services, medical, nutrition, extension, and policy maker are required to deal with nutrition problems and prevention of nutritional deficiencies and related disease in low-income households in the United States.

The primary goal of nutrition programs is to increase participants' nutrient intake to the recommended guidelines for good health and development. A change in an individual's nutrition practices or patterns requires elimination of barriers or forces against positive change that may hinder the process. This process is known as forces of continuity and change (Axinn, 1988, Lewin, 1950). Factors that may affect nutritional behavioral change include social, cultural, physical, financial or economic, political, and genetic. Environmental factors are modifiable; therefore, changes in these factors may result in positive changes in nutritional quality, hence reducing related health risks. The same factors can also become forces against positive change. For example, if nutrition intervention incorporates the cultural food practices of a low-income Hispanic group, there will be a positive change in their dietary intake and habits, but if cultural foods and beliefs are overlooked, there may be no impact on Hispanic families' food practices.

Social factors have a great influence on the nutritional intake of household members. Nutrition decision-making, family organization, parenting, and lifestyle are some of the social effects on the process of change. It is clear that household income affects nutritional quality of a household, and program budget financial allocation also determines the number of participants in the program and intervention strategy. Environmental factors can also be barriers to positive change in nutritional intake and healthy behaviors. For positive change to be achieved and sustained, the barriers to change need to be minimized, if not eliminated.

Nutritional health inadequacy is a complex problem that cannot be solved by one discipline in isolation; it requires a holistic, interdisciplinary approach on the part of public health care, nutritionists, social services, researchers, and policy makers (Schensul, 1995).

Nutritional inadequacy, excess fat intake, and poor dietary habits are likely to be a whole family's nutritional problems; nutrition interventions that target a family as a unit to increase nutrient intake may lead to a reduced prevalence of nutrition deficiencies and health risks in low-income households. Caregivers are key players in nutritional changes for children and other household members. The positive relationship between the children's and their female caregivers' nutrient status is an indication that female caregivers may influence children's nutrient intake and dietary habits. This may have a positive impact on the nutrition program interventions. More research is needed to determine the parents' or caregivers' influence on the family members' nutritional status.

APPENDICES

Appendix A

Working definitions of terms

Nutrition Assessment –A measure of indictors of dietary status and nutrition-related health status of individuals or population to identify possible occurrence, and nature of the deficiencies and nutrition-related diseases. The methods used in nutrition assessment include dietary, biochemical, clinical, and anthropometric methods. NHANES III survey used these four methods of assessments

Dietary measurement –A measure of nutrients in a diet that is consumed by children and their meal planners of income households. The foods consumed are classified into specific food groups, and a computer software program analyzes nutrient intake of each food.

CSFII / DHKS. Continuous Survey of Food Intake of Individuals (CSFII) and Dietary Health and Knowledge Survey (DHKS) of non-institutionalized persons of was established with an intention of providing dietary information of the US population, and eating patterns of certain groups that could be at nutritional risk.

National Health And Nutrition Examination (NHANES) III- Along with dietary assessment, NHANES III conducts biochemical, clinical, and athropometric measurements to assess the populations nutritional status. One day's 24-hour food recall was used to obtain dietary information.

The Special Supplemental Food Program for Women Infant and Children (WIC). One of the federal funded nutrition programs that were established in 1972 as result of stunted growth and anemia occurrences among low-income families that were reflected in the national nutrition survey. The task of WIC is to improve the nutritional status of women and children of households with income level below 130% of the federal poverty guidelines. The end-results of nutritional improvement are a reduction of low birth weights and mortality rates in this population. Besides nutrition education, WIC offers supplemental food package that meet certain nutritional and needs along with food vouchers for obtaining more specific food stuff to the participants to improve food availability in the household (Http/www.nawdconference.com, 10/09/1997).

Expanded Food and Nutrition Program (EFNEP). An education program administered by the Cooperative State Research and Education and Extension Services. The program intended to improve dietary adequacy by improving nutritional knowledge of the population at risk. Homemakers and children are the target groups for EFNEP program. Unlike other nutrition programs for low-income population, EFNEP does not give food supplements, vouchers, or foods stamps to the participants; the program offers nutrition education on proper utilization of food resources for optimum nutrition (USDA 1994).

Recommended Dietary Allowance (RDA)- A dietary standard that is used to evaluate the health standards of an individual. It is the level of nutrient intake that is used to meet the needs of known nutrient needs for a health person. RDA's are very vital in identifying a group of people that are at a nutrition-related health risk.

Mobile Examination Center (MEC): In NHANIES III survey, examination and interviews were conducted in a specially equipped and designed mobile examination center (MEC) that traveled to survey locations throughout the country. MEC consisted of a laboratory, examination rooms for physical, and dental and x-rays a computer room and other interview rooms.

A 24-hour dietary recalls. Each respondent was asked to remember and report all the food and beverage consumed in the proceeding 24 hours or in a day. This was done through interviews conducted by well-trained persons. The interviews were, conducted at the mobile examination centers (MEC), or at households for the participants who could not get to the MEC. The interviewers assisted the participants to remember the foods consumed by asking questions on their dietary intake.

Food Frequency Questionnaire (FFQ): The FFQ, a checklist of foods that assess the energy and nutrient intake to determine the frequency of consumption of foods of specific nutrient interest. FFQ was collected during the household interviews; information of these foods can be linked to with reported health conditions.

Age of the sample group. The selected sample group for study include of women of ages 15-49 and children ages 2-9 years low income same household. The women in the study include women of child-bearing age that assume the responsibility of providing care and prepare food for children and other family members.

Income level: The federal poverty guideline is 130% below the poverty level Low this level the income of the women is inadequate to provide for food and other social needs for themselves and the family members. This group has been identified as most at nutrition risk. Individuals who quality to enroll in the WIC program have an income level of or below 185% poverty index. Federal government funded nutrition programs (WIC, EFNEP NSLP, SBP, and Head Start) for low-income population improves nutritional quality of this population by providing food vouchers or food stamps, and nutrition knowledge.

Appendix B

Excluded from the study. Of 29,105 people who provided complete and reliable 24-hour dietary recall information, the following groups were excluded from the study:

- 2,755 children less that two years old
- 2,313 children ages 10-14 years
- 806 girls ages 15-19 years old that did not have at least one live birth
- 69 pregnant and/or lactating girls age 15-19 years old
- 367 pregnant and/or lactating women ages 20-49 years old
- males ages 15-49, and
- adults > 49 years of age.

Included in the study. The study sample included

- 6,167 children ages 2-9 years
- 126 teenage mothers ages 15-19 years, and
- 4,575 women ages 20-49 years old.

Each child selected had at least one female caregiver from the same household. A total of 3,74 children were left out because there were no female caregivers from the child's household in the sample.

Appendix C

Criteria used to select female caregiver in households with more that one women in the sample

1. Select all female age 20-49 years old and girls age 15-19 years old with at least one live birth.
2. Select a woman who is the possible mother of the child included in the study (using the child's age and the mother's age, and age at first and live birth).
3. If more than one woman (who may or may not be same age) is the possible mother of the same child(ren) in the sample, select the younger woman.
4. In cases were two or more women are possible mothers of different children in a household, match the child(ren) with the possible mother breaking the household into multi-family units.
5. If none of the women in the sample is the possible mother of the child(ren) in the sample, select the oldest woman with at least one live birth.

Appendix D

Table 2. Children's daily adequacy of total energy, percent energy from total fat, and saturated fat by the demographic characteristics

	Energy (%RDA)	% energy from: total fat	% energy from: saturated fat
	<70% RDA	≥30% fat	≥10%
Age (y)			

All	97.2 ± 35.4[1]	21.0	33.8 ±7.5	29.0	12.4 ± 3.7	24.0
2 - 4	100.3 ± 36.4	19.0	33.7 ± 7.7	28.0	12.6 ± 3.7	24.0
5 - 9	93.5 ± 33.9	23.0	33.8 ± 7.5	29.0	12.4 ± 3.6	25.0
p		0.00		0.84		0.66
Gender						
Boys	101.7 ± 36.6	18.0	33.6 ± 7.5	29.0	12.5 ± 3.6	25.0
Girls	92.5 ± 33.5	24.0	34.1 ± 7.5	28.0	12.5 ± 3.6	24.0
p		0.00		0.65		0.94
Race-Ethnicity						
White	99.2 ± 34.2	18.0	33.3 ± 7.4	32.0	12.4 ± 3.5	28.0
Black	97.1 ± 35.6	21.0	34.4 ± 7.5	26.0	12.3 ± 3.6	25.0
Mexican A	95.9 ± 36.3	23.0	33.8 ± 7.6	28.0	12.8 ± 3.7	21.0
Others[5]	96.1 ± 32.9	21.0	31.4 ± 7.3	39.0	12.4 ± 4.0	28.0
p		0.250		0.050		0.08
WIC[4]						
Yes	102.4 ± 36.4	15.0	34.6 ± 8.3	25.0	13.1 ± 3.9	20.0
No	96.4 ± 34.8	25.0	34.3 ± 6.7	25.0	12.3 ± 3.2	18.0
p		0.1		0.93		0.66
Family Size						
2	103.6 ± 38.3	15.0	34.9 ± 7.5	25.0	12.7 ± 3.7	22.0
3	94.0 ± 33.0	22.0	34.1 ± 7.4	27.0	12.6 ± 3.8	25.0
4	98.4 ± 35.5	20.0	33.2 ± 7.9	31.0	12.1 ± 3.7	28.0
5+	96.8 ± 35.8	21.0	34.0 ± 7.4	28.0	12.7 ± 3.6	22.0
p		0.48		0.37		0.19

[1]Mean ± S.D.

[2]Recommended Dietary Allowance

[4] Special Supplemental nutrition Programs for Women Infants and Children

[5] Hispanics and non Hispanics that are not white, black or Mexican Americans

p value by X^2 test

Appendix E

Table 3. Children's daily adequacy of carbohydrates, dietary fiber, and calcium by their demographic characteristics

	Carbohydrates		Fiber		Calcium	
				<recommended		<70%
Age (y)		≥55%				
All	53.5 ± 9.3	43.0	11.1 ± 6.3	42.0	101.1 ± 57.2	27.0
2 - 4	53.6 ± 9.5	42.0	10.3 ± 9.0	35.0	94.2 ± 55.3	22.0
5 - 9	53.3 ± 9.2	43.0	12.1 ± 6.8	48.0	109.0 ± 58.4	33.0
p		0.79		0.00		0.00
Gender						
Boys	53.6 ± 9.4	42.0	11.6 ± 6.6	39.0	107.3 ± 59.9	25.0
Girls	53.3 ± 9.3	43.0	10.6 ± 6.0	45.0	94.8 ± 53.6	30.0
p		0.69		0.02		0.01
Race-Ethnicity						
White	54.7 ± 9.2	50.0	10.8 ± 6.0	43.0	110.8 ± 60.7	22.0
Black	53.1 ± 9.2	41.0	10.6 ± 5.5	45.0	89.6 ± 51.2	35.0
Mexican A	52.9 ± 9.5	39.0	11.9 ± 7.4	38.0	105.5 ± 58.7	24.0
Others[5]	54.3 ± 9.0	45.0	10.7 ± 5.6	37.0	109.1 ± 58.8	23.0
p		0.01		0.06		0.00
WIC[4]						
Yes	52.6 ± 9.7	33.0	10.4 ± 5.5	28.0	96.9 ± 56.1	21.0
No	52.2 ± 10	42.0	10.5 ± 5.9	34.0	79.4 ± 45.1	32.0
p		0.16		0.35		0.08
Family Size						
2	52.4 ± 9.1	37.0	11.6 ± 5.9	43.0	106.2 ± 58.0	30.0
3	53.3±9.4	43.0	10.4 ± 5.8	49.0	99.4 ± 62.4	28.0
4	54.3±9.6	45.0	11.4 ± 6.5	41.0	102.7 ± 57.3	28.0
5+	53.2 ± 9.1	42.0	11.2 ± 6.5	40.0	100.2 ± 54.8	27.0
p		0.44		0.03		0.89

[1]Mean ± S.D.

[2]Recommended Dietary Allowance

[4] Special Supplemental Nutrition Program for Women Infants and Children

[5] Hispanics and non Hispanics that are not white, black or Mexican Americans

Appendix F

Table 4 Children's daily adequacy of micronutrients by their demographic

	Iron	<70% RDA	Vitamin A	<70% RDA	Vitamin C	<70% RDA
Age (y)						
All	117.5 ± 67.3	22.0	151.2 ± 120.5	26.0	231.7 ± 185.5	16.0
2 - 4	109.3 ± 64.1	28.0	163.1 ± 137.1	23.0	230.5 ± 193.0	18.0
5 - 9	127.5 ± 69.6	15.0	137.6 ± 11.4	29.0	233.2 ± 176.6	15.0
p		0.00		0.04		0.051
Gender						
Boys	126.9 ± 74.7	18.0	163.9 ± 95.4	25.0	239.4 ± 198.4	16.0
Girls	108.1 ± 57.3	26.0	138.3 ±124.3	27.0	224.0 ± 171.2	17.0
p		0.00		0.18		0.7
Race-Ethnicity						
White	122.1 ± 62.9	20.0	153.7 ± 118.8	20.0	208.0 ± 163.6	17.0
Black	114.6 ± 74.1	19.0	140.9 ± 111.8	31.0	240.7 ± 179.7	16.0
Mexican A	114.5 ± 74.1	27.0	160.5 ± 127.8	25.0	238.7 ± 206.2	17.0
Others[5]	109.7 ± 49.0	23.0	149.5 ± 103.8	27.0	231.1 ± 160.2	18.0
p		0.00		0.00		0.88
WIC[4]						
All	113.0 ± 65.1	28.0	158.6 ± 128.7	26.0	247.0 ± 229.9	19.0
Yes	119.3 ± 70.5	25.0	169.3 ± 135.2	23.0	252.3 ± 114.6	15.0
No	98.9 ± 48.6	36.0	134.7 ± 110.2	32.0	235.0 ± 219.9	27.0
p		0.08		0.18		0.02
Family Size						
2	132.9 ± 78.5	12.0	161.1 ± 107.7	27.0	287.8 ± 195.9	15.0
3	110.5 ± 57.4	25.0	142.0 ± 126.1	25.0	230.4 ± 174.9	16.0
4	122.7 ± 73.1	20.0	152.7 ± 122.6	25.0	235.8 ±189.0	17.0
5+	115.4 ± 65.4	24.0	152.3 ± 134.2	27.0	223.1 ± 185.3	16.0
p		0.01		0.92		0.96

[1]Mean ± S.D.

[2]Recommended Dietary Allowance

[4] Special Supplemental Nutrition Program for Women Infants and Children (WIC)

[5] Hispanics and non Hispanics that are not white, black or Mexican Americans

p value by X^2 test

Appendix G

Table 5. Female caregivers' dietary adequacy of energy, total fat, and Saturated fat, by demographic subgroups.

	Energy (%)		% Energy from			
			total fat		saturated fat	
		<70% RDA[1]		≥30%		≥10% Sat. Fat
Age (y)						
All	85.9 ± 37.4[2]	36.0	34.1 ± 9.3	32.0	11.3 ± 3.9	38
15 - 19	95.5 ± 48.0	28.0	34.3 ± 10.	28.0	11.5 ± 3.8	24
20 - 29	88.7 ± 36.3	33.0	34.2 ± 9.1	32.0	11.4 ± 3.9	36
30 - 39	84.1 ± 36.8	37.0	34.0 ± 9.4	31.0	11.2 ± 3.9	39
40 - 49	83.2 ± 40.6	39.0	33.8 ± 9.6	32.0	11.2 ± 4.1	38
p		0.29		0.90		0.32
Race-Ethnicity						
White	95.5 ± 48.0	33.0	33.9 ± 7.4	32.0	11.7 ± 4.0	33
Black	88.7 ± 36.3	36.0	35.3 ± 9.3	26.0	11.4 ± 3.8	37
Mexican American	84.1 ± 36.8	38.0	33.3 ± 9.1	34.0	11.1 ± 3.9	40
Others[3]	83.2 ± 40.6	38.0	30.4 ± 9.4	53.0	9.8 ± 3.5	52
p		0.45		0.00		0.02
WIC[4]						
All	91.6 ± 35.4	30.0	34.5 ± 9.0	31.0	11.8 ± 3.3	37
Yes	96.4 ± 36.3	25.0	35.7 ± 8.3	25.0	12.5 ± 4.2	30
No	86.7 ± 34.4	34.0	33.3 ± 9.7	38.0	11.1 ± 4.3	42
p		0.19		0.11		0.17
Family Size						
2	80.8 ± 33.1	39.0	34.0 ± 9.5	31.0	11.2 ± 3.8	40
3	86.2 ± 35.4	34.0	34.8 ± 8.9	29.0	11.4 ± 3.8	36
4	85.1 ± 39.4	39.0	34.1 ± 9.7	32.0	11.1 ± 4.0	40
5+	86.8 ± 37.4	34.0	33.8 ± 9.2	32.0	11.4 ± 4.0	37.0
p		0.20		0.79		0.67

[1] Recommended Dietary Allowance

[2] Standard deviation

[3] Hispanics and non Hispanics that are not white, black or Mexican Americans

[4] Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
p value by X^2 test

Appendix H

Table 6. Female caregivers' dietary adequacy carbohydrates fiber and calcium by their demographic subgroups.

	carbohydrates	<55% cho	Fiber	< Reco	Calcium % RDA[1]	<70% RDA
Age (y)						
All	50.7± 11.1[2]	34	14.3 ± 9.7	87	80.5 ± 55.1	62
15 - 19	50.7 ± 9.7	28	11.4 ± 8.7	92	73.4 ± 48.5	68
20 - 29	51.0 ± 10.9	36	14.1 ± 9.7	87	62.0 ± 62.0	62
30 - 39	50.4 ± 11.1	33	14.3 ± 9.4	87	85.2 ± 58.4	63
40 - 49	50.6 ± 12.1	31	15.2 ± 10.3	86	86.9 ± 57.9	61
p		0.52		0.79		0.83
Race-Ethnicity						
White	50.8 ± 11.8	34	13.7 ± 8.4	90	92.4 ± 58.9	54
Black	49.3 ± 11.1	30	11.9 ± 8.4	94	67.5 ± 49.7	44
Mexican American	51.8 ± 10.5	37	17.3 ± 11.	78	87.0 ± 55.8	55
Others[3]	52.4 ± 14.1	36	13.8 ± 8.7	88	71.2 ± 45.6	67
p		0.05		0.00		0.00
WIC[4]						
All	51.0 ± 10.3	65	14.7 ± 10.5	88	76.4 ± 54.5	60
Yes	50.1± 9.4	68	15.9 ± 12.4	88	85.7 ± 57.4	49
No	51.8 ± 11.1	63	13.7 ± 8.4	89	68.0 ± 50.7	69
p		0.53		0.83		0.02
Family Size						
2	50.9 ± 12.7	64	11.6 ± 7.3	93	66.6 ± 50.9	72
3	49.0 ± 10.8	71	13.5 ± 8.3	89	76.1 ± 46.5	65
4	50.5 ± 11.6	67	13.9 ± 9.3	90	80.9 ± 57.5	61
5+	51.4 ± 10.8	65.0	15.1 ± 10.5	84	83.8 ± 56.9	61
p		0.22		0.00		0.13

[1]1989 Recommended Dietary Allowance

[2] Standard deviation

[3] Hispanics and non Hispanics that are not white, black or Mexican Americans

[4] Special Supplemental Food and Nutrition Program for Women, Infants, and Children (WIC)

p value is by X^2 test

Appendix I

Table 7. Female caregivers' dietary adequacy of micronutrients by sociodemographic characteristics.

	Iron % RDA[1]	<70% RDA	Vitamin A % RDA	<70% RDA	Vitamin C % RDA	<70% RDA Vit C
Age (y)						
All	82.6 ± 50.6[2]	48	98.0 ± 52.3	57	162.9 ± 62.4	35
15 - 19	81.2 ± 46.7	40	96.9 ± 59.2	48	155.1 ± 72.8	28
20 - 29	83.8 ± 51.2	48	87.2 ± 46.9	60	165.4 ± 90.8	33
30 - 39	81.8 ± 51.2	48	107.7 ± 50.7	57	162.3 ± 99.7	37
40 - 49	82.4 ± 47.1	50	95.4 ± 30.8	56	158.8 ± 115.8	36
p		0.83		0.50		0.43
Race-Ethnicity						
White	86.4 ± 49.7	45	102.1 ± 79.8	51	137.4 ± 114.3	39
Black	77.8 ± 48.6	54	89.6 ± 64.2	63	154.0 ± 116.7	38
Mexican Americans	84.3 ± 52.3	45	102.2 ± 62.0	57	185.3 ± 131.1	30
Others[3]	90.2 ± 56.9	42	112.1 ± 86.3	59	210.4 ± 111.7	33
p		0.00		0.00		0.01
WIC[4]						
All	91.2 ± 58.3	42	97.2 ± 40.6	62	195.3 ± 147.3	27
Yes	97.4 ± 58.5	32	121.6 ± 97.8	54	214.9 ± 101.8	26
No	85.6 ± 58.0	51	75.1 ± 57.2	71	177.7 ± 131.2	28
p		0.02		0.04		0.83
Family Size						
2	76.6 ± 52.3	59	71.2 ± 83.7	67	175.0 ± 116.7	37
3	84.9 ± 50.9	48	101.2 ± 89.0	55	154.6 ± 112.2	34
4	82.7 ± 52.8	50	89.9 ± 55.8	56	157.0 ± 145.6	36
5+	82.4 ± 48.9	46.0	104.9 ±79.7	59.0	168.7 ± 138.6	35.0
p		0.07		0.15		0.94

[1] 1989 Recommended Dietary Allowance

[2] Standard deviation

[3] Hispanics and non Hispanics that are not white, black or Mexican Americans

[4] Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

p value by X^2 test

Appendix J

Table 12. Specificity, sensitivity, negative predictive value (PV-) and positive predictive values (PV+) of correlation model for breakfast consumption.

Correlation Model

	Female caregiver	
	Breakfast consumer	
	No	Yes
Children		
Breakfast		
Consumer		
No	57	51
Yes	237	645
Total	294	696

Sensitivity [a] (57/57+237) *100 = 19.3%
Specificity [b] (45/645+51) *100 = 92.6%
PV- [c] (645/645+237) *100 = 73%
PV+ [d] (57/57+237) *100 = 19%

[a] Sensitivity is the fraction of children non-breakfast consumers that the correlation model predicts correctly.
[b] Specificity is a fraction of children breakfast consumers that the correlation model predicts correctly
[c] PV- is the fraction of negative results according to the correlation model that are truly negative
[d] PV+ is the fraction of positive results according to the correlation model that are truly positive

Appendix K

Table 14. Iron status of children and female caregivers

	Transferrin Saturation	Serum ferritn	Protoporphyrin Erythrocyte	Hemoglobin
Age (y)	cutoff	cuttoff	cutoff	cutoff
Children				
2- 4	<10	<10	>80	<11
5- 9	<14	<12	>70	<11
Female caregivers				
15-19	<15	<12	>70	<12
20-29	<15	<12	>70	<12
30-39	<15	<12	>70	<12
40-49	<15	<12	>70	<12

Appendix L

Table 15. Distribution of children's triceps and weight for height ≤ or >85%tiles[1] by age, gender, race-ethnicity, WIC [2] Participation, and family size

	n	Tricep skinfold percentiles ≤85%tile	>85%tile	p
				0.000
All	990	81.0	19.0	
2 - 4 y	562	84.2	15.8	
5 - 9 y	428	77.3	22.7	
Gender				0.000
All	990	81.0	19.0	
Boys	508	84.7	15.3	
Girls	482	77.2	22.8	
Race-Ethnicity				0.314
All	990	81.0	19.0	
White	134	82.2	17.8	
Black	410	82.4	17.6	
Mexican Americans	403	79.2	20.8	
Others	43	76.1	23.9	
WIC				0.035
All	667	82.6	17.4	
Yes	199	79.1	20.9	
No	468	90.4	9.6	
Family Size				0.004
All	990	81.0	19.0	
2	27	73.4	26.6	
3	138	75.5	24.5	
4	236	83.0	24.5	
5+	559	82.9	17.0	

[1] >85%tile wt-for-ht – overweight [2] Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
p value by X^2 test

Appendix M

Table 16. Distribution of children's weight-for-height $\leq$ or >85%tile[1] by age, Gender race-ethnicity, WIC[2] Participation, and family size

	n	Weight- for-height percentiles ≤85%tile	>85%tile	p
Children				0.00
All	990	75.6	24.4	
2 - 4 y	562	78.8	21.2	
5 - 9 y	428	72.0	28.0	
Gender				0.37
All	990	75.6	24.4	
Boys	508	76.5	23.5	
Girls	482	74.6	25.4	
Race-Ethnicity				0.00
White	134	77.8	22.2	
Black	410	79.6	20.4	
Mexican Americans	403	69.7	30.3	
Others	43	76.8	23.2	
WIC				0.06
Yes	199	78.9	21.1	
No	468	88.9	11.1	
Family Size				0.15
All	990	75.6	24.4	
2	27	68.1	31.9	
3	138	71.8	28.2	
4	236	78.3	21.7	
5+	559	76.3	23.7	

[1] >85%tile wt-for-ht – overweight

[2] Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)

p value by X^2 test

Appendix N

Table 17. Female caregivers mean ± SD[1] BMI[2,] and BMI classification by their age group, race-ethnicity, participation in WIC[3] and family size

	n	Mean ± SD	BMI ≤24.9	24.9 - 29.9	≥30	p
age						
All	990	27.7±6.8	43.2	27.6	28.6	0.000
15 - 19 y	22	24.8±6.3	64	20	16	
20 - 29 y	451	26.2±6.2	50.2	26.5	23.3	
30 39 y	401	27.7±6.9	42.1	26.5	31.4	
40 - 49 y	116	29.3±7.2	29.4	35.1	35.5	
Race-Ethnicity						0.000
White	144	25.3±6.3	61.6	18.9	19.6	
Black	411	28.3±7.7	39.1	28.1	32.9	
Mexican Amer	397	27.7±5.8	35.5	33.6	30.6	
Other[4]	38	26.1±6.0	51.1	24.2	24.2	
WIC						0.012
All	368	27.0±6.2	39.4	32.1	28.5	
Yes	116	26.7±4.3	32.3	44.6	23.1	
No	152	27.3±7.5	45.8	20.8	33.3	
Family Size						0.000
2	65	26.8±6.9	54.3	21.3	24.5	
3	231	26.9±7.1	50.6	22.1	27.3	
4	239	26.8±6.8	47.5	26.5	26.1	
5+	302	27.8±6.6	37.5	31.3	31.2	

[1]Standard Deviation

[2] Body Mass Index

[3] The Special Supplemental Food Program for women infant and children (WIC)

[4]All Hispanics and non Hispanics that are not white, black or Mexican Americans

Appendix O

Table 20. Female caregivers skinfold triceps percentile by their age group, race-ethnicity, participation in WIC[3] and family size

		Triceps Skinfolds		
	n	<85tile	>85%tile	p
Age				
All	990	74.1	25.9	0.48
15 - 19 y	22	76	24	
20 - 29 y	451	73.9	26.1	
30 39 y	401	72.9	27.1	
40 - 49 y	116	78.1	21.9	
Race-Ethnicity				0.000
White	144	78.8	21.2	
Black	411	68.4	31.6	
Mexican Amer	397	75.5	24.5	
Other[4]	38	84.8	15.2	
WIC[3]				0.861
All	368	70.1	29.9	
Yes	116	70.8	29.2	
No	152	69.4	30.6	
Family Size				0.484
2	65	70.2	29.8	
3	231	73.9	26.1	
4	239	76.4	23.6	
5+[5]	302	73.1	26.9	

[1]Standard Deviation

[2] Body Mass Index

[3] The Special Supplemental Food Program for women infant and children (WIC)

[4]All Hispanics and non Hispanics that are not white, black or Mexican Americans

Appendix P

Table 21. Female caregiver-child correlation for each nutrient, Breakfast consumption, iron and weight status

	r
Nutrients	
Energy	.23*
Total fat	.31*
Saturated fat	.23*
Carbohydrates	.29*
Calcium	.20*
Iron	.12*
Vitamin A	0.40*
Vitamin C	.23*
Iron variables	
Transiferrin saturation	.13*
Serum ferritin	.10*
Protoporphyrin	.23*
Hemoglobin	.33*
Weight status variables	
Triceps skinfold	0.33*
BMI	0.21*

* $p<0.01$

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