To the Graduate Council:

I am submitting herewith a thesis written by Mary Leigh Miller entitled "Relationships Among Food Insufficiency, Dietary Status Index, and Food Group Intake in Women of Childbearing Age: Secondary Data Analysis of NHANES III." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

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We have read this thesis and
recommend its acceptance:

Accepted for the Council:

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RELATIONSHIPS AMONG FOOD INSUFFICIENCY, DIETARY STATUS INDEX, AND FOOD GROUP INTAKE IN HEALTHY WOMEN OF CHILDBEARING AGE: SECONDARY DATA ANALYSIS OF NHANES III

A Thesis

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Master of Science

Degree

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DEDICATION

This thesis is dedicated to my parents

Dr. Neil Austin Miller

and

Mrs. Sarah Frances Bond Miller

whose love and support have always been my greatest blessings

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Part I: Introduction and Literature Review

Introduction and Purpose

Dietary intake and nutrition status are recognized as significant influences of overall health in the general population (1-3). Therefore, assessment of these determinants has become a primary focus of national surveillance efforts (3). Because these efforts allow risk factors to be tracked and the prevalence of poor nutrition status to be evaluated, nutrition surveillance contributes to the establishment of appropriate agendas for policy-making (4). Monitoring mechanisms also allow for the assessment of nutritional status in particular populations or subgroups and for the development of interventions appropriate to those groups.

The US female population of childbearing age commands special attention as a cohort because of its unique physiological needs and singular ability to influence family/household dietary intake and nutrition status (5). This population has been identified as one of the most nutritionally at-risk demographic groups in the US (6-7). Because female-headed households experience a poverty rate three times greater than that of other families and because the nutrition status of the female head of household is a predictor of the future status of the entire family, this population merits the attention of surveillance endeavors (6-8). Successful monitoring and surveillance of women of childbearing age is meaningful because it may likely serve as the earliest possible indicator of compromised nutrition status of the family. Using the third National Health and Nutrition Examination Survey (9) as the database for secondary data analysis, this study

assessed the nutrition status of this population (defined as 19 - 50 year old females without a nutrition-related chronic disease) by examining relationships among food insufficiency, Dietary Status Index, and food group intake.

Food insufficiency, the quantitative aspect of the larger concept of food insecurity, provides one method for assessing nutrition status of women of childbearing age (10). This measure is based on an economically-driven lack of food; that is, financial constraints place limitations on the type and/or amount of foods included in the diet by affecting the purchasing power of women or their autonomy in food selection. A second measure useful in the examination of nutrition status of women is the Dietary Status Index (DSI) (11). The DSI estimates individual nutrition status by evaluating adherence to national dietary recommendations and reflects both nutrient adequacy and moderation (11). By expressing nutrient intake in respective measures of over- or under-consumption of particular nutrients for which national goals and recommendations have been established, DSI provides a useful description of the dietary quality of women of childbearing age. Finally, food group analysis allows for the identification of differences in food group intake among women at different levels of dietary status (DSI) and between those identified as food insufficient and sufficient. Together, these measures enable researchers to assess the nutrition status of women by examining dietary status as related to sufficiency, choices, and nutrient composition of the diet.

The purpose of this research was to study women of childbearing age at different levels of food sufficiency and to examine differences in relationships between food group

intake and DSI. Specifically, this study attempted to determine if intake of a particular food group relates to dietary status (DSI) differently when women experience food insufficiency compared to food sufficiency. Examination of such relationships serves as a foundation for appropriate, population-specific interventions, policy-making agendas, and further surveillance efforts which affect women of childbearing age and their families. The following text is a review of current literature on which the study was founded.

Literature Review

The following section presents findings from the current literature which provide a foundation for this study. Rationale for the selection of the sample population is presented through a progression of topics. First, as defined by prior research, the significance of women's nutrition status, food sufficiency, and food group intake on the larger US population is offered. Next, documented characteristics and observed trends regarding economic security, nutrition status, and food group intake of women of childbearing age are included followed by an explanation of measures related to nutritional quality. To conclude, a historical perspective of nutrition monitoring in the United States is presented.

Women as a Population with Special Needs

Diet and nutrition status are recognized widely for their significant association with overall health in individuals (1-2). Prevention or delayed progression of certain chronic diseases, maintenance of optimum immunological defense, and

promotion of fundamental physical processes are related to nutrition status and food intake (1-3). While these relationships have been observed throughout the general population, additional associations between nutrition and health exist for the maternal or potential childbearing cohort (6-7). The nutritional status of women of childbearing age commands special attention because of the cohort's unique physiological needs, potential to contribute to the health of their conceptus, and established position of influence over the long term nutrition status of family members (5-7,12).

Diet and nutrition status in women of childbearing potential are recognized as significant predictors of pregnancy outcome. The factors of maternal iron status, folate status, pre-pregnancy weight, and overall nutrition status prior to conception are related directly to a woman's ability to produce a healthy child (7). To promote optimum stores prior to pregnancy and to reduce the prevalence of iron deficiency anemia, the Food and Nutrition Board (13) established a Recommended Dietary Allowance for iron of 15 milligrams per day for pre-menopausal women (aged 11-50 years). The Recommended Dietary Allowances are defined as "the levels of intake of essential nutrients, which on the basis of scientific knowledge, are judged by the Food and Nutrition Board to be adequate to meet the known nutrient needs of practically all healthy persons" (14, p.15). To prevent neural tube defects, an additional intake of folacin (RDA of 400 mg/day) is recommended for pregnant women and for those attempting to become pregnant (13).

Overall energy intake in women of childbearing potential was observed by Stein et al (15) to be another important contributor to pregnancy outcome. Severe caloric restrictions during the first trimester were associated with an increase in spina bifida, hydrocephaly, perinatal mortality, and premature births. Given the increasing number of women participating in weight loss programs, coupled with the possibility that discovery of pregnancy may not occur until the end of the first trimester, this finding is significant. In a study of life-style factors affecting pregnancy outcome, Bendich (6) described the diets of female participants in weight loss programs to be consistently low in certain nutrients, when compared with the RDAs.

In their study of US females of childbearing age, Block and Abrams (12) observed that large portions of this cohort failed to consume the recommended amounts of selected nutrients and that women with incomes below 130% of the poverty level reported markedly lower intakes than the rest of the cohort. Over 50% of women aged 15 to 24 years with incomes below 130% of the poverty level reported consuming less than 70% of the RDAs for calcium, zinc, iron, vitamin B6, vitamin C, and vitamin A. While Block and Abrams did not identify these segments of the larger cohort as deficient in these nutrients, the results of their work suggest that some members of the cohort may be at individual risk for deficiencies. For its report, *Nutrition During Pregnancy* (7), the National Academy of Sciences reviewed studies of pregnant women from 1978 to 1989 and found that their usual dietary intakes of iron, zinc, calcium, magnesium, and vitamins B6, D, E and folate averaged less than the 1989 RDAs.

Maternal nutrition status also has been recognized for its predictive value in the assessment of household nutrition status (16-17). In their research of household food management strategies, Campbell and Desjardins (18) hypothesized that "mothers' diets deteriorate before their children's" (18, p.167). This theory was based on the following findings from their study: when food was in limited supply, children were given priority; when food was in limited supply, mothers would feed their children but not themselves; and mothers' diets seemed worse than their children's. The researchers concluded that the quality of the maternal diet (including food security) may be an early indication of a household food crisis and that poor child nutrition is a likely indicator that the maternal diet has suffered already. The researchers also observed that "significant attention needs to be given to mothers' food and health needs, in addition to the more common focus on children's food and health needs" (18, p.167).

Radimer, Olson, and Campbell (17), in their development of indicators for assessing hunger, reasoned that while differentiation among household hunger, women's hunger, and children's hunger was important for programmatic and policy making reasons, identification of maternal hunger could reasonably serve to indicate household hunger. According to the researchers, the development of hunger indicators has practical utility for nutrition monitoring and surveillance.

In a study of 96 single, homeless mothers and their 192 dependent children, Drake (16) found that subjects in all age groups were consuming less than 50% of the RDAs for iron, magnesium, zinc, and folic acid and that mothers in particular were consuming less

than 50% of the RDA for calcium. In addition, subjects reported dietary fat intakes in excess of established recommendations. Citing concern over low intakes of certain nutrients and excessive intakes of others, Drake observed a "need to examine and remedy nutrient intake deficiencies among single women who are heads of household in temporary housing situations" (16, p.312).

Precarious economic situations place female-headed households as one of the most nutritionally at-risk demographic groups in the United States (10). According to the US Department of Commerce (8), the poverty rate for all families in 1992 was 11.7%, while female-headed households experienced poverty at a rate of 34.9%. Likewise, 52.4% of all poor families had a female head of household. As research indicates that the nutrition status of the female head of household is reflective of the status of the entire family, monitoring women of childbearing age provides an important means of assessing nutrition status in the greater population. Successful monitoring and surveillance of this female population is meaningful because it may likely serve as the earliest possible indicator of impending compromised nutrition status in the family (16-17).

Observed Trends and Characteristics of US Women of Childbearing Age

Economic Factors. In studies of weekly food expenditures, economists have observed that single mothers spend a larger proportion of income on food than any other group while spending the smallest amount per person (19). This phenomenon reflects the economic model known as the Engle function (20), which states that the poorer a family, the greater the share of total expenditures (income) it must use to purchase food.

Conversely, as consumer income increases, the share of income spent on food decreases (assuming all other factors remain equal). Between 1960 and 1990, the percent of income spent on food fell for all but the lowest quintile of the US population, where it actually rose by 8% (19). In 1990 the highest quintile (mean income, $76,600) spent 9% of income on food while the lowest quintiles (mean incomes, $5,637 and $14,115) spent 42% and 22%, respectively. These two lowest quintiles represent persons living at or below the poverty level and are three times more likely to include female-headed households than male-headed households. Thus, the quantity and nutritional adequacy of food available for women is limited because they are more likely to be poor.

Despite financial limitations, the poor have been shown to purchase food more efficiently than their more affluent counterparts (19-21). In a recent study (21) of Food Stamp participants, price was reported to be the most important consideration in food purchases. Extraneous factors, such as cyclic, monthly increases in supermarket prices that accompany food stamp disbursement, accounted for less efficient spending.

Nutrition status. Judicious spending does not, however, guarantee good nutritional status. In a 1986 study of women aged 19-50, Senauer, Asp, and Kinsey (20,22-24) found that greater numbers of women and their children living below 130% of the federal poverty level were receiving less than 70% of the RDA for many nutrients (compared to those above 130% of the poverty level). Overall, prevalence of health problems directly or indirectly related to nutrition was greater among poor women than other population groups. Across all age groups, the percent of overweight women was

found to be higher for those below the poverty level. Iron deficiency prevalence was high across all income levels, but was twice as high (10.2%) among those below the poverty level than those above (5.5%) (20,25).

Comparative data from the Nationwide Food Consumption Survey (1977-78) and the Continuing Survey of Food Intakes by Individuals (1985-86) revealed that, among women aged 19 to 50, the percent of calories from fat and protein decreased and carbohydrates increased, although not significantly by statistical measures (20,26-28). Analyses of NHANES II data by Block (29) found that women met recommended guidelines for cholesterol but not for total fat or saturated fat as a percent of calories. In fact, all age groups exceeded recommendations of $\leq$ 30% of total calories from fat and $<$ 10% of total calories from saturated fat, although the polyunsaturated/saturated fat ratio was approaching the recommendation. Mean caloric intake followed no visible trend with regard to increasing poverty to income ratio. That is, as women of both Caucasian and African-American descent moved away from poverty, no statistically significant change in calories was found. Across all age subgroups and income levels, African-American women consumed consistently fewer calories than their Caucasian counterparts, with the exception of the lowest income group in age subset 19-34. Regarding overall quality of diet, Popkin et al (30) found that diets of different socioeconomic groups in 1989-1991 were relatively similar and that historical disparities among racial and economic boundaries appeared to have narrowed.

Food Consumption. After examining the food consumption trends of US women aged 19-50 between the years of 1977 and 1985, Popkin et al (31) made the following observations: increasing numbers of women are consuming lower fat milks, lower fat and higher fiber cereals, lower fat poultry, higher fat cheeses, medium fat pork and beef, higher fat grain-based beef (mixed) dishes, and higher fat salty snacks. The largest percentage shift, 43.1%, was a decline in the number of women consuming higher fat beef and pork products. This shift was paralleled by an increase in the number of women consuming medium and lower fat pork, beef, and poultry products, which are examples of healthier food choices.

A significant contribution of Popkin's research was the identification of variables which most affect a woman's decision to include/exclude a food from the diet and those which most affect the quantity in which a food is included in the diet. Variables most strongly associated with a decision to include/exclude a food were: 1) education level of the female household head, 2) being on a special diet, 3) age, and 4) ethnicity. Variables showing some effect on this decision but on a fewer number of foods included: 1) income as a percentage of poverty level, 2) Food Stamp participation, 3) employment status of the female household head, 4) urban v. suburban residence, and 5) presence of a male head of household. Thus, these nine variables are relevant to food sufficiency, or the quantitative aspect of food security.

In the same study, influences on the quantity of a food included in the diet, rather than <u>if</u> a food would be included, were identified as: 1) income as a percentage of

poverty, 2) household size, 3) number of children under 18 in the household, and 4) whether the female is childless. These variables explained relatively more of the decision of how much rather than inclusion/exclusion of a particular item and therefore address the qualitative aspect of the diet. Appreciation of these variables as influences in dietary choices (inclusion/exclusion and degree of inclusion) affords researchers a more meaningful understanding of the various forces interacting on the food consumption practices of women.

Justification for Selection of Variables

In the US female childbearing population, a number of physical and socioeconomic variables are recognized as important to nutrition status and dietary intake (32-33). Presence of chronic disease, educational attainment, socioeconomic status, geographic region of residence, and participation in assistance programs have been identified as having possible relationships to nutrition and should be considered when assessing the nutrition status of females of childbearing age (32-33).

The relationship between diet and chronic disease is documented widely (1-3,34). Diseases with an explicit nutrition component include diabetes, heart disease, stroke, and some types of cancer (1-3,34). The confounding effect of nutrition-related chronic diseases requires consideration of such conditions in the inclusion or exclusion of individuals for assessment of nutrition status and dietary intake.

The Piedmont Health Survey (35) measured the relationship between educational attainment and active life expectancy in five South Carolina counties and illustrated the

impact of education level on health status. Reflecting quality of life rather than quantity, active life expectancy in individuals with at least 12 years of education was found to be 2.4 to 3.9 years greater than those with less than 12 years of formal education.

Income and socioeconomic status also are recognized as appropriate considerations and /or potential predictors of nutrition and health status (36-37). The Community Childhood Hunger Identification Project (38) found that, in families with children under the age of 12 years and incomes at or below the federal poverty level ($12,700 for a family of four in 1990), 32% were hungry and that this hunger was experienced for an average of seven days per month. These hungry households were reported to spend nearly one-third of their monthly income on food costs (only $0.68 per meal) and, on average, 54% of their monthly income on shelter (38). Exorbitant and unpredictable shelter costs also may diminish the money available to purchase food and often result in temporary food insecurity (39).

Regional variations in salaries, cost of living, availability and duration of employment opportunities, and participation in assistance programs are factors often associated with food insecurity and indirectly associated with dietary intake and nutrition status (39-40). While poor economic status often is associated with poor nutrition status, participation in assistance programs may serve to contradict this association. From the findings of his study, *The Impact of Food Stamps on the Dietary Adequacy of Poor Children*, Brown (41) reported that the quality of dietary intake and nutrition status was found to be greater when families eligible for the Food Stamp Program were receiving food stamps.

Consideration paid to the characteristics of socioeconomic status, program participation, and educational attainment provides a more comprehensive picture of nutrition status and dietary intake of US females of childbearing age.

Nutritional Quality Measures

Food Insufficiency. The findings of the Community Childhood Hunger Identification Project (38) revealed that 12% of all families with children under 12 years of age in the US experience hunger. Representing 5.5 million children, this percentage approximates the number of families experiencing hunger at a given point in time while another 28% of families are estimated to be at risk for hunger. Campbell and Desjardins' (18) theory that "mothers' diets deteriorate before their children's" (p.167) would suggest then that a substantial number of US females of childbearing age have inadequate diets and possibly poor nutritional status.

Measurement of any aspect of food security must be preceded by the identification of a clear operational definition of the concept to be studied (10). Conceptual distinctions between hunger, under-nutrition, food insecurity, and food insufficiency must be well delineated and should serve as primary consideration in the selection of appropriate scales for measurement. Recent efforts by the scientific community to develop a set of operational definitions have lead to the establishment of generally accepted terminology.

Food insufficiency, considered to be intrahousehold handling of food shortages, is equated directly with hunger (10). Reports of food insufficiency are based on perceptions of inadequate food intake and/or household food shortages and to those behaviors "that

involve handling food or food resources to make them last longer, including intrahousehold food restrictions" (10, p.69). Measurements of food insufficiency include self-reports or perceptions of food insufficiency by other household members, by reductions or changes in eating behavior due to food shortages, by perceptions of insufficient money for food, by reliance on a limited number of foods, and a lack of diversity in dietary intake. This definition does not include coping behaviors, or those response strategies used by household members attempting to increase their food supply by securing meals or money for food through socially unconventional means. Behaviors used to manage food shortages (restricting household food intake) are not considered coping behaviors because they occur within the "context of limited household stores" (10, p.69).

Extrahousehold behaviors that result from perceived food insufficiency include those actions taken to expand food and food resources. Examples of these behaviors include reliance on emergency food providers and/or extended family or friends for food (10). In short, intrahousehold food shortages from constrained resources is considered food insufficiency, while extrahousehold responses or strategies to expand food or food resources are termed coping behaviors. Together, intrahousehold handling of food shortages and extrahousehold strategies to increase food supply are combined to form the broader concept of food insecurity.

The study of intrahousehold strategies for handling food shortages due to a lack of money for food, called food insufficiency, provides insight into the household food management practices of females of childbearing age (10). By examining the manner in

which adult female members of households handle existing food resources in the home, it is possible to look closely at the practices of food rationing and to determine any differences in the rationing of food among family members, including the practice of skipping meals. Measurement of food insufficiency in women of childbearing age is possible through the identification of factors that are associated with insufficiency and determination of the presence of these factors in the self-reports of this population. Ultimately, assessment of food insufficiency in females of childbearing age provides meaningful insight into overall nutrition status (10).

Dietary Status Index. The relationship of nutrition status and dietary intake in US females of childbearing age can be measured through the Dietary Status Index (11,33). The DSI (11) was established by the United States Department of Agriculture on the principle that a healthy diet is one that is adequate in nutrients and without excess. The DSI measures the diet of a population by considering both adequacy and moderation. The index utilizes the Recommended Dietary Allowances (13) in its assessment of dietary adequacy and the National Research Council's (3) *Diet and Health* goals to measure moderation. The components of the DSI are the Dietary Adequacy Score and Dietary Moderation Score.

Adequacy, expressed as the Dietary Adequacy Score (DAS), reflects attainment of the RDAs for 15 nutrients on a 15 point scale. For each nutrient in which at least 100% of the RDA is achieved, one point is assigned. A higher score indicates greater dietary adequacy, whereas a lower score reflects poor achievement of the RDAs. The DAS is

scored on a scale of 100 possible points. To calculate this measure, total points for RDA attainment (maximum of 15) are multiplied by a factor of 6.66. The following 15 nutrients are assessed for attainment of RDA: protein, vitamin A, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B6, folate, vitamin B12, calcium, phosphorus, magnesium, iron, and zinc (11).

Moderation, expressed as Dietary Moderation Score (DMS), reflects dietary adherence to four of the *Diet and Health* goals, established by the National Research Council (3,11). DMS is calculated by the assignment of one point for adherence to each of the following guidelines: 1) limiting fat intake to less than or equal to 30% of total calories; 2) limiting saturated fat intake to less than or equal to 10% of total calories; 3) limiting sodium intake to less than or equal to 2400 milligrams per day; and 4) limiting dietary cholesterol to less than or equal to 300 milligrams per day (3). Because DMS is scored on a scale of 100, points for adherence to the four *Diet and Health* goals are multiplied by a factor of 25. After DAS and DMS are calculated, the scores are summed and divided by a factor of 2. This final calculation yields the Dietary Status Index.

Determination of DSI allows for the expression of dietary quality that accounts for adequacy and moderation (11,33). Simple to calculate with the appropriate intake data collection, the DSI enables assessment of dietary status with few limitations. Shortcomings of the DSI include the following (11,33):

1) DMS is not reflective of all *Diet and Health* goals, namely maintenance of a healthy weight;

2) only attainment of 100% of the RDAs is considered sufficient for point assignment (this factor fails to account for the issue of fat soluble vitamins which may remain in the body longer and lessen the necessity of meeting the RDA each day). For example, intake of 99% of the RDA for a given nutrient would not yield a point for adequacy even though true physiological adequacy for that nutrient is met;
3) all dietary measures are weighted equally (this issue neglects the possibility that certain nutrients may deliver greater benefit and therefore should be weighted heavier than others in computation of DAS); and,
4) finally, the DMS fails to reflect accurately the *Diet and Health* goals for saturated fat, sodium, and cholesterol by including the cut-off points in the criterion for moderation. For example, the *Diet and Health* goal for saturated fat is < 10% of calories and the moderation criteria is ≤ 10% of calories.

To calculate DSI, DMS, and DAS most accurately, nutrient data collected by a 24-hour dietary recall are recommended for revealing true dietary status of a group (11).

The DSI is not the only dietary quality measure established by the USDA. The Healthy Eating Index (HEI) measures diet quality by examining ten components (42-43). Components include conformity to USDA's Food Guide Pyramid (accounting for five components), total fat as a percentage of calories, saturated fat as a percentage of calories, total cholesterol intake, total sodium intake, and variety in a three day diet. Each component has a possible score of 10, with the total possible points for HEI as 100. A higher numerical score indicates a higher quality diet. Shortcomings of the HEI (which yield DSI as a more practical and accurate index) include difficulty in quantifying the variety component and controversial techniques for determining portion sizes for the milk and meat groups (43-44). For example, the HEI uses commodity equivalents rather than standard calcium and protein nutrient equivalents for determining milk portion sizes. As

an example of calcium-content based equivalents, one cup of milk equals two cups of cottage cheese. Based on the technique used by HEI, a serving for the milk group is based on milk solids found in one cup of milk rather than on calcium content. As observed by Chung et al (44), the practical effect of basing serving sizes on milk solids is to reduce a single serving of cottage cheese from 2 cups to 1 cup. Use of HEI may potentially overestimate calcium adequacy in the diet.

Food Group Analysis. Food group intake analysis also is documented as a valid method of assessing dietary intake (33,45-47). Previously utilized in studies by Knol (33) and Subar (45-46), food group analysis allows for the identification of food groups consumed by a population. Use of food group analysis requires selection of an appropriate method for classifying individual foods into groups (45-46). The six food groups depicted by the Food Guide Pyramid (48) were established for the purposes of education and distinguish between broad categories of foods. Food Guide Pyramid food groups include the following: bread, cereal, rice, and pasta group; vegetable group; fruit group; milk, yogurt, and cheese group; meat, poultry, fish, dry beans, eggs, and nuts group; and fats, oils, and sweets group. Recognizing a need for further distinctions among food groups, Subar et al (45-46) created a set of 59 food subgroups which are not mutually exclusive and are based on "nutritional, functional, and botanical similarities" (45, p.360) of foods. Examples of these subgroups include garden vegetables, fruits and juices, and fruits and vegetables.

Food group analysis allows researchers to identify and focus on the specific sources of nutrients found in the diet when nutrient levels are found to be either excessive or inadequate. In addition to identified nutrients, foods contain unknown components. Food group analysis accounts for this limitation by identifying food groups rather than their known nutrient components (45-47). This method of dietary intake assessment is most useful because it employs a language that is meaningful to the general population and allows for the development of population-based educational interventions.

Nutrition Monitoring in the United States

Assessment of nutrition status and dietary intake requires appropriate mechanisms for monitoring. Until 1987 the United States lacked a comprehensive mechanism for assessment of its population's nutrition status (49). In the absence of public law mandating such a system, the Honorable George E. Brown, Jr., House Representative of the 36th district of California, along with fellow members of the 99th Congress, proposed a legislative directive to place permanent responsibility for national nutrition monitoring in the hands of the federal government. While federal legislation had not dismissed the need for such a mechanism prior to 1987, legislative mandates leading to such initiatives as the Ten State Nutrition Survey (1967) and the National Health and Nutrition Examination Survey (1971) were vulnerable to budgetary resource cutbacks as determined by current administrations and the Office of Management and Budget (49). Three years later, with the realization that piecemeal efforts precluded Congress' ability to assess directly the adequacy or direction of such initiatives, the National Nutrition Monitoring

and Related Research Act of 1990 was passed by the 101st Congress (50). This new legislation attempted to create a framework within which nutrition monitoring efforts could be coordinated and technology advanced.

The following text contains the expanded manuscript form of this research study. Included in the manuscript are an introduction and statement of purpose, followed by a presentation of the methods, results, discussion, conclusion, and implications of the study.

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Part II: Expanded Manuscript

Introduction and Purpose

Dietary intake and nutrition status are recognized as significant influences of overall health in the general population (1-3). Therefore, assessment of these determinants has become a primary focus of national surveillance efforts (3). Because these efforts allow risk factors to be tracked and the prevalence of poor nutrition status to be evaluated, nutrition monitoring contributes to the establishment of appropriate agendas for policy-making (4). Monitoring mechanisms also allow for the assessment of nutritional status in particular populations or subgroups and for the development of interventions appropriate to those groups.

The US female population of childbearing age commands special attention as a cohort because of its unique physiological needs and singular ability to influence family/household dietary intake and nutrition status (5). This population has been identified as one of the most nutritionally at-risk demographic groups in the US (6-7). Because female-headed households experience a poverty rate three times greater than that of other families and because the nutrition status of the female head of household is a predictor of the future status of the entire family, this population merits the attention of nutrition surveillance endeavors (6-8). Successful monitoring and surveillance of women of childbearing age is meaningful because it may likely serve as the earliest possible indicator of compromised nutrition status of the family. Using the third National Health and Nutrition Examination Survey (9) as the database for secondary data analysis, this

study assessed the nutrition status of this population (defined as 19 - 50 year old females without a nutrition-related chronic disease) by examining relationships among food insufficiency, Dietary Status Index, and food group intake.

Food insufficiency, the quantitative aspect of the larger concept of food insecurity, provides one method for assessing nutrition status of women of childbearing age (10). This measure is based on an economically-driven lack of food; that is, financial constraints place limitations on the type and/or amount of foods included in the diet by affecting the purchasing power of women or their autonomy in food selection. A second measure useful in the examination of nutrition status of women is the Dietary Status Index (DSI) (11). The DSI estimates individual nutrition status by evaluating adherence to national dietary recommendations and reflects both nutrient adequacy and moderation. By expressing nutrient intake in respective measures of over- or under-consumption of particular nutrients for which national goals and recommendations have been established, DSI provides a useful description of the dietary quality of women of childbearing age. Finally, food group analysis allows for the identification of differences in food group intake among women at different levels of dietary status (DSI) and between those identified as food insufficient and food sufficient. Together, these measures enable researchers to assess the nutrition status of women by examining dietary status as related to sufficiency, choices, and nutrient composition of the diet.

The purpose of this research was to study women of childbearing age at different levels of food sufficiency and to examine differences in relationships between food group

intake and DSI. Specifically, this study attempted to determine if intake of a particular food group relates to dietary status (DSI) differently when women experience food insufficiency compared to food sufficiency. Examination of such relationships serves as a foundation for appropriate, population-specific interventions, policy-making agendas, and further surveillance efforts which concern women of childbearing age and their families.

Methods

Sample

NHANES III. The third National Health and Nutrition Examination Survey is a nationwide survey, designed to assess the health status of the entire US civilian, non-institutionalized population. The sample for NHANES III represents the population aged 2 months and older from all 50 states. Using a stratified multistage probability design, NHANES III was conducted in two phases from October 1988 through October 1994. The first phase was conducted from October 1988 through October 1991 with a total of 20,227 participants. The second phase was conducted from September 1991 through October 1994. Circling the United States each year for a total of six years, Phases I and II were held at 44 and 45 locations, respectively. Data from most subjects were collected through an extensive interview and physical examination taken in mobile examination centers. Subjects aged 60 or older who were bed- or wheelchair-bound were candidates for home examination. Descriptions of the development, operational logistics, and objectives of NHANES III have been documented elsewhere (12).

Sample Selection. The sample population for this study, women aged 19 to 50 years without a nutrition-related chronic disease and having a reliable interview, were identified through the assignment of appropriate selection variables. The following variables were used in the selection of subjects for the sample population: gender (female); age at interview (19 to 50); absence of congestive heart failure, stroke, cancer, diabetes, and heart attack; and quality of interview (reliable). This study used data from Phase I and identified 2,311 subjects meeting the criteria for inclusion in the sample population.

Selected data from the Household Adult Questionnaire, Household Family Questionnaire, and Mobile Examination Center (MEC) adult data file were analyzed for the purpose of this study (9,12). The Household Adult Questionnaire, administered to individuals 17 years of age and older, provided data on selected social characteristics and self-reported medical history, physical condition, and food frequency. The Household Family Questionnaire was administered to a responsible adult household member with the purpose of gathering information regarding ethnicity, occupational information, family income, education levels, health insurance coverage, and characteristics of the household. The MEC consisted of a questionnaire and physical exam given to subjects aged 17 years and older. The questionnaire included a 24-hour dietary recall and gathered information regarding vitamin and mineral usage, tobacco use, alcohol and drug use, and reproductive health history. Following assignment of the sample population, additional variables were selected to describe the population more specifically. The following descriptive variables were examined: race/ethnicity, census region, poverty index (computed on income),

household size, highest grade attended, and highest grade finished.

Nutritional Quality Measures

A 1987 University of California - Berkeley hunger symposium concluded that "of all the relevant Federal surveys, NHANES is probably the best equipped to look at the interrelationship between diet, food shortages, and health indicators" (13, p.14). Through the inclusion of food insufficiency questions, a 24-hour recall, and a food frequency questionnaire, NHANES III provides data useful for the assessment of food insufficiency, dietary status, and food group intake in the female population of childbearing age.

Food Insufficiency. Drawing from previously developed food insecurity surveys, namely the Community Childhood Hunger Identification Project (14), NHANES III contains a set of questions aimed at both household and individual food insufficiency. Household and individual food insufficiency questions and appropriate procedures for analysis of these data were developed by Briefel et al (15). Four food insufficiency questions were administered to a family respondent during the household interview and elicited information regarding whether there was enough, sometimes enough, or often not enough food to eat in the last month; the number of days in the last month that there was no food or money for food; and if the reason for this problem was a lack of money or another reason. In aggregate, the questions elicited information about the incidence of family food insufficiency, the severity and duration of the problem (for a one-month period), and intrahousehold mechanisms for handling food shortage problems. For this study, a household food insufficiency problem was identified when a respondent reported

that they "sometimes" or "often did not have enough to eat," during at least one day in the past month because of lack of money.

Food insufficiency was investigated at the individual level through a series of 7 questions administered during the medical examination (9-12). Subjects were asked to report the number of days in the past month that they had no food or money to buy food, if they had skipped a meal in the last month or in the last day (also the day for which the 24 hour recall would be taken), and how often they had skipped meals in the last month or day. For this study, individual food insufficiency was defined as at least one day in the past month with no food because of a lack of food or money to buy food. This lack of food must have been attributed to a lack of money rather than a lack of transportation or other possible factors.

According to the procedures developed for appropriate analysis of these data, this study identified women experiencing food insufficiency. Responses which indicated a) an absence of food or money to buy food, b) on at least one day in the past month, c) because of a lack of money, indicated a food insufficiency problem whether reported at the individual or household level. All three criterion (a,b,c) must have been met for the subject to be identified as food insufficient. Specifically, respondents indicating that they "sometimes" or "often" did not have enough to eat at least one day in the past month due to a lack of money were assigned a value of 2, indicating household food insufficiency. Individual food insufficiency was identified by indicating that on at least one day in the past month the individual had no food or money to buy food and that the reason for this

lack of food was due only to a lack of money. A value of 2 also was assigned to these individuals. To classify subjects as food insufficient, women with values of 2 for either the household or individual questions were assigned a final food insufficiency score of 2. This identification allowed the researchers to categorize respondents as "sufficient = 1" or "insufficient = 2." Variables and data used in this analysis were taken from both the Household Family Questionnaire and the MEC adult data files. The Appendix contains a list of questions and corresponding NHANES III variables used for determination of food insufficiency.

Dietary Status Index. The Dietary Status Index (DSI) is a measure that reflects both adequacy and moderation of nutrient intake (11). The 24-hour dietary recall served as the principal technique for collecting detailed quantitative nutrient intake for the sample population. The components of the DSI are the Dietary Adequacy Score (DAS) and the Dietary Moderation Score (DMS). The following formula, developed by Basiotis et al (11), was used to calculate DSI:

$$DSI = \frac{(DAS \times 6.66) + (DMS \times 25)}{2}$$

Dietary Status Index Formula

The Dietary Adequacy Score, the first component of the Dietary Status Index, estimates adequacy of individual nutrient intake. Achievement of the RDA for each nutrient was determined by comparing each subject's intake of 15 selected nutrients to the

1989 RDA table (Appendix), which reflects those values established by the Committee on Dietary Allowances (16). To control for outliers, data values which were greater than six standard deviations were identified as missing values. For each nutrient in which the RDA was achieved, one point was assigned, with each subject able to achieve a total of 15 possible points. The sum of these points then was multiplied by 6.66 to arrive at individual DAS scores. All variables for DAS calculation were taken from the 24 hour dietary recall data found in the Mobile Examination Center (MEC) adult file.

The Dietary Moderation Score (DMS), the second component of the DSI, is an expression of dietary adherence to four of the *Diet and Health* goals (3). DMS was calculated by assigning one point for adherence to each of the following guidelines:

1) limiting fat intake to ≤ 30% of total calories;

2) limiting saturated fat intake to ≤ 10% of total calories;

3) limiting dietary cholesterol to ≤ 300 milligrams per day; and,

4) limiting sodium intake to ≤ 2400 milligrams per day.

Total DMS points (maximum of 4) were multiplied by a factor of 25 to produce a final DMS scored on a 100-point scale. Final calculation of DSI was accomplished by applying DAS and DMS scores to the DSI formula (p. 36). The possible range of DSI values was 0 to 100. Numerical scores then were classified by tertile (low, middle, or high). Scores of 0 to 38.32 were assigned as Low DSI, 38.33 to 50.00 as Middle DSI, and scores >50.00 as High DSI. Variables and corresponding data for the calculation of DMS were taken from

the 24 hour dietary recall included in the Mobile Examination Center (MEC) adult data file. The Appendix provides a list of all variables related to DSI.

Food Group Intake. For the purpose of providing typical or qualitative data for the ranking of sample persons by their intake of food and/or food groups, a food frequency questionnaire was included in NHANES III (12). This method of dietary data collection requires that an individual respond to questions regarding the frequency with which certain foods are consumed during the past 30 days. The food frequency questionnaire was developed to be comparable to those used in past NHANES studies but was enlarged to capture more detailed information on intake of foods containing specific nutrients (12). The expanded food list for NHANES III included foods containing nutrients associated with the risk for cardiovascular disease, osteoporosis, and cancer. The food frequency was designed for use in the assessment of relationships between dietary patterns and dietary guidelines, in the comparison of nutrient intakes of dissimilar demographic groups, and in the assessment of relationships between factors impacting dietary intake (12).

For this study, NHANES III food frequency data were analyzed to determine statistically significant differences in the consumption of food groups represented by the Food Guide Pyramid (17). Assessment of these data allowed for the identification of those foods that were or were not consumed and the degree to which they were present or absent from the diet of the sample population. To analyze food groups, individual foods were assigned to one of six Food Guide Pyramid food groups (Table 1).

Table 1. Classification of NHANES III food frequency items by food group

Food Group	NHANES III Food Frequency Item
Bread	High fiber cereal, fortified cereal, other cereal, cooked cereal, white bread, dark bread, corn bread, flour tortilla, rice, salty snacks, spaghetti
Vegetable	Carrots, broccoli, brussel sprouts, white potatoes, sweet potatoes, tomatoes, spinach, salad, cabbage, chili peppers, peppers, other vegetables
Fruit	Orange juice, other juice, citrus fruits, melons, peaches, other fruit
Meat	Soup and stew, bacon, organ meats, beef, pork and ham, shrimp, fish, chicken, eggs, pizza, dried beans, peanuts
Milk	Chocolate milk, milk on cereal, yogurt, ice cream, cheese, cheese dishes
Other	Cakes, chocolate candy, tang, diet soda, soda, coffee, tea, beer, wine, liquor, margarine, butter, oil and vinegar

Following initial analysis of the values for daily food group servings, data were recoded to control for outliers. Values greater than 4 standard deviations were assigned as missing values. Each reported serving of a food was considered to be a medium serving. Therefore, a subject reporting a frequency of milk intake to be 45 was assumed to have consumed 45 medium servings of milk during the 30-day period. The reported number of servings for the reference period then was divided by 30 to calculate the number of servings per day. Differences in mean daily food group servings among DSI tertiles for food sufficient and food insufficient women were determined.

Statistical Analysis

Data were coded, verified, and analyzed using Statistical Analysis System (SAS) programming (18). DSI (as tertiles of low, middle, or high) and food insufficiency were treated as ordinal and nominal variables, respectively. Food group intake was treated as an interval variable. Significant interaction between DSI and food insufficiency was determined using a two-factor multivariate analysis of variance (MANOVA) (19). This analysis treated six food groups as dependent variables and DSI and food insufficiency as independent variables and was performed with Wilks' lambda. For all analyses, statistical significance was set at $p < .05$. Where a significant interaction was observed within univariate tests, main effects were not examined further. For non-significant interactions of DSI and food insufficiency, main effects within univariate analyses for each food group were examined.

Results

A general demographic profile of the sample population (n=2311), presented in Table 2, revealed a fairly equal distribution across the dominant US ethnic groups (35.3% non-Hispanic white, 28.9% non-Hispanic black, and 32.1% Mexican-American) and geographic regions (14.2% Northeast, 20.0% Midwest, 34.0% South, and 31.8% West). The mean age (± SD) for the population was 32.3 years (± 8.7) and the mean household size was 4.2 persons (± 2.4). Seventy-eight percent of the sample population had completed 11.8 years of formal education. Of the 2311 women meeting the criterion for inclusion in the sample population and having no missing variables, 244 (10.5%) were identified as being food insufficient.

Results were analyzed using a two-factor MANOVA, between groups design. Analysis revealed a significant multivariate interactive effect between food insufficiency and Dietary Status Index [Wilks' lambda = .04, F (12,4522) = 1.7687; $p < .05$]. This statistical significance indicated that the relationship between food group intake and DSI varied at different levels of food sufficiency. That is, the relationship between DSI and at least one food group was found to vary between food sufficient and food insufficient groups. To determine where the significant interaction between DSI and food sufficiency occurred, results from univariate tests were examined. Significant interactions were found for two food groups: meat ($p = .0274$) and bread ($p = .0141$). Main effects of these univariate tests were not examined further. Results from all univariate tests are found in

Table 2. Demographic characteristics by DSI tertile.

	Dietary Status Index			
	Low n (%)	Middle n (%)	High n (%)	Total n (%)
Sample size	794 (34.3)	929 (40.1)	688 (29.7)	2311 (100)
Ethnicity				
Non-Hispanic White	257 (32.4)	301 (36.6)	258 (37.5)	816 (35.3)
Non-Hispanic Black	281 (35.4)	243 (29.3)	145 (21.1)	669 (28.9)
Mexican-American	239 (30.1)	259 (31.2)	243 (35.3)	741 (32.1)
Other	17 (2.1)	26 (3.1)	42 (6.1)	85 (3.7)
Region				
Northeast	92 (11.6)	126 (15.2)	110 (16.0)	328 (14.2)
Midwest	180 (22.7)	146 (17.6)	137 (19.9)	463 (20.0)
South	319 (40.2)	288 (34.7)	178 (25.9)	785 (34.0)
West	203 (25.6)	269 (32.4)	263 (38.2)	735 (31.8)
Education				
Mean Highest Grade Attended (± SD)	11.7 (2.9)	12.0 (3.1)	11.7 (3.9)	11.8 (3.3)
% Finished Grade	77.7	79.2	79.5	78.8
Age				
Mean years (± SD)	32.4 (8.9)	32.3 (8.5)	33.5 (8.9)	32.3 (8.7)
Household Size				
Mean persons (± SD)	4.3 (2.4)	3.9 (2.2)	4.3 (8.9)	4.2 (2.4)
Poverty Index	8510.1	11153.2	8658.4	9502.4

Table 3.

Non-significant interactions were found for the remaining four food groups. Main effects of these non-significant interactions revealed that DSI differed in relation to the intake of vegetable, fruit, and milk groups and food insufficiency differed in relation to fruit intake. Overall, no statistically significant differences in DSI were found between the food insufficient and food sufficient groups.

Sample population means for daily nutrient intakes, food group servings, and DSI scores by tertile are presented in Table 4. Criterion used in determination of DAS and DMS are included for reference purposes. Mean DSI score (± SD) for the total sample was 45.25 (15.60). Across tertiles of low, middle, and high, DSI scores (± SD) were 28.72 (6.79), 46.15 (3.77), and 63.23 (10.40), respectively.

Discussion

The purpose of this study was to determine if the relationship between Dietary Status Index and food group intake varied at different levels of food sufficiency among women of childbearing age. Results of this study indicate that a significant interaction existed between DSI and food insufficiency for the bread and meat food groups. That is, among women identified as experiencing food insufficiency, higher DSI scores were associated with higher servings of meat and bread. The higher servings of meat among those identified as food insufficient may be explained in a number of ways. First, servings of food items from the meat group must not be confused with servings of meat, a typically

Table 3. Average daily food group servings by DSI and food insufficiency

		Low DSI		Middle DSI		High DSI	
		Food Insufficiency		Food Insufficiency		Food Insufficiency	
Food Group	Total $\bar{x}$ (SD) n=2310	NO $\bar{x}$ (SD) n=708	YES $\bar{x}$ (SD) n=86	NO $\bar{x}$ (SD) n=750	YES $\bar{x}$ (SD) n=78	NO $\bar{x}$ (SD) n=608	YES $\bar{x}$ (SD) n=80
Bread*	2.37 (1.36)	2.27 (1.46)	2.49 (1.55)	2.38 (1.58)	2.98 (1.65)	2.39 (1.32)	3.27 (2.23)
Vegetable	2.29 (1.35)	2.15 (1.25)	1.76 (1.04)	2.26 (1.30)	2.17 (1.39)	2.55 (1.45)	2.51 (1.70)
Fruit	1.51 (1.21)	1.34 (1.10)	1.09 (0.98)	1.52 (1.22)	1.12 (1.05)	1.85 (1.31)	1.40 (1.19)
Meat*	2.18 (1.08)	2.17 (1.12)	2.37 (1.25)	2.13 (0.98)	2.87 (1.50)	2.12 (1.01)	2.71 (1.55)
Milk	1.52 (1.10)	1.41 (1.10)	1.24 (0.91)	1.57 (1.08)	1.60 (1.10)	1.64 (1.15)	1.48 (1.14)
Other	3.95 (2.65)	4.06 (2.47)	3.95 (2.91)	4.03 (2.79)	3.97 (3.14)	3.81 (2.58)	3.88 (4.10)

* statistical significance at $p < 0.05$

Table 4. Mean daily nutrient and food group intakes by DSI tertile

Mean DAS, DMS, DSI Scores					
	Total $\bar{x}$ (SD)	Low DSI $\bar{x}$ (SD)	Middle DSI $\bar{x}$ (SD)	High DSI $\bar{x}$ (SD)	
Sample n	2102.00	794.00	620.00	688.00	
Calories	1861.06 (789.49)	1659.14 (614.25)	2108.30 (953.21)	1871.28 (741.34)	
DAS	41.16 (31.18)	29.17 (21.58)	29.49 (35.52)	57.02 (29.11)	
DMS	49.33 (24.67)	28.27 (21.50)	52.80 (39.07)	69.44 (27.13)	
DSI	45.25 (15.60)	28.72 (6.79)	46.15 (3.77)	63.23 (10.40)	
Mean Daily Nutrient Intake					Criterion (≥)
DAS Components					19-24 / 25-50
Protein (g)	68.78 (33.97)	59.51 (27.19)	79.37 (42.26)	69.95 (29.41)	46.0 / 50.0
Vitamin A (RE)	809.69 (1279.89)	521.27 (937.05)	924.71 (1681.01)	1038.90 (1135.5)	800.0 / 800.0
Vitamin E (α TE)	7.81 (7.96)	6.40 (4.50)	8.36 (6.73)	8.93 (11.21)	8.0 / 8.0
Vitamin C (mg)	97.39 (99.19)	59.64 (63.11)	106.29 (100.71)	132.94 (115.64)	60.0 / 60.0
Thiamin (mg)	1.37 (0.76)	1.09 (0.55)	1.53 (0.86)	1.56 (0.79)	1.1 / 1.1
Niacin (mg)	18.52 (9.99)	14.92 (7.33)	20.24 (11.28)	21.12 (10.20)	15.0 / 15.0
Riboflavin (mg)	1.59 (0.90)	1.28 (0.62)	1.81 (1.07)	1.75 (0.91)	1.3 / 1.3
Vitamin B6 (mg)	1.46 (0.88)	1.03 (0.50)	1.59 (0.97)	1.83 (0.94)	1.6 / 1.6
Folacin (mcgm)	225.30 (164.68)	146.93 (87.53)	239.15 (158.41)	303.27 (195.26)	180.0 / 180.0
Vitamin B_{12} (mcgm)	4.13 (6.70)	3.36 (5.51)	5.02 (8.97)	4.21 (5.33)	2.0 / 2.0
Calcium (mg)	713.00 (483.03)	564.42 (337.46)	843.19 (584.02)	767.15 (486.64)	1200 / 800.0
Phosphorus (mg)	1106.24 (537.00)	911.28 (383.63)	1274.21 (660.25)	1179.88 (494.4)	1200 / 800.0
Magnesium (mg)	240.10 (122.57)	178.98 (72.81)	265.48 (133.88)	287.75 (128.46)	280.0 / 280.0
Iron (mg)	12.18 (7.02)	9.12 (3.68)	13.11 (6.73)	14.86 (8.69)	15.0 / 15.0
Zinc (mg)	9.61 (6.16)	7.86 (4.22)	11.09 (7.33)	10.30 (6.41)	12.0 / 12.0
DMS Components					Criterion (≤)
Total Fat (% kcals)	35.0	40.0	37.0	28.9	30.0
Sat. Fat (% kcals)	12.0	13.7	13.0	9.4	10.0
Cholesterol (mg)	258.61 (200.06)	268.53 (188.13)	308.81 (238.68)	201.91 (156.86)	300.0
Sodium (mg)	2935.9 (1586.19)	2762.2 (1251.64)	3315.7 (1836.40)	2794.0 (1631.65)	2400.0

Mean Daily Food Group Servings (SD)								
Food Group	Total $\bar{x}$ (SD)		Low DSI $\bar{x}$ (SD)		Middle DSI $\bar{x}$ (SD)		High DSI $\bar{x}$ (SD)	
Bread	2.40	(1.52)	2.30	(1.47)	2.43	(1.59)	2.49	(1.48)
Vegetable	2.29	(1.35)	2.11	(1.24)	2.25	(1.32)	2.54	(1.48)
Fruit	1.51	(1.21)	1.31	(1.09)	1.48	(1.21)	1.80	(1.30)
Meat	2.19	(1.10)	2.19	(1.14)	2.20	(1.06)	2.19	(1.10)
Milk	1.53	(1.11)	1.39	(1.08)	1.57	(1.09)	1.62	(1.15)
Other	3.97	(2.71)	4.05	(2.52)	4.03	(2.82)	3.82	(2.80)

expensive food item. The meat group contains dried beans, soups and stews, eggs, and poultry, as well as pork and beef. Therefore, servings from the meat group may in fact reflect servings of foods such as dried beans (a typically inexpensive item) or eggs (a food item which may be perceived as a "staple" of the diet and eaten with great consistency). If servings from the meat group reflect actual servings of meat items, then these findings are consistent with earlier studies (20-21) reporting that low-income families devote just over one-third of their food expenditures on meat. Meat purchase has been observed as a practice or socialized behavior that confers feelings of ethnic tradition, responsibility/duty, success, or status (20-21). One survey of African-American food stamp recipients found that 40% of every food dollar was devoted to meat purchases (20). Rather than a phenomenon of postmodern conspicuous consumption, the purchase of meat was perceived as a means of providing for or taking care of the household (20-21). Although servings of fruits and vegetables were not significantly different among food insufficient and food sufficient groups (when examined with DSI interaction), the economic displacement of more nutrient-dense, lower fat foods must be considered as a logical outcome of this higher meat consumption. Because food insufficiency is driven by economic limitations, those identified as insufficient can be assumed to have been financially constrained at least periodically. Given a limited amount of money to spend for food purchases, explicit decisions to purchase meat are implicit decisions not to purchase other more nutrient-dense foods, such as vegetables or fruits.

However, it should be noted that differences in mean DSI between food sufficient and food insufficient women were not found to be statistically significant, meaning that dietary adequacy and moderation were similar for both groups. With the exception of High DSI for both food sufficient and food insufficient women, mean percentages of calories from fat, and saturated fat exceeded *Diet and Health* goals for all tertiles and levels of food sufficiency. Likewise, no group mean for sodium intake met the criterion and only High and Low DSI (both food sufficient and insufficient) had mean cholesterol scores which satisfied the criterion for moderation. Thus, striking similarities (or the lack of obvious disparities) were observed for dietary adequacy and moderation for women experiencing food insufficiency and those identified as food sufficient.

These results seem to confirm the work of Popkin et al (22), with regard to variables that influence the inclusion of foods and those that influence the quantity of a food in the diet. According to Popkin, income as a percent of poverty level had a greater influence on the qualitative aspects of the diet, not on the inclusion or exclusion of a food from the diet. The results of this study support this hypothesis in the following way: financial limitations do not appear to affect the ability of food insufficient women of achieving a level of dietary quality (adequacy and moderation) similar to those without financial limitations on food purchases. The only difference, then, between food insufficient women and food sufficient women may be the reconciliation of internal conflicts with regard to health, diet, and learned behavior (21-23).

Obesity prevalence in women below the poverty level provides one example of this conflict. An obese African-American food stamp participant purchasing meat may forego her desires for a lower-fat food item, ignoring her own concerns about health because of the familial duty, tradition, or perceptions of success associated with buying meat. Conversely, a more affluent woman who does not associate buying meat with her ability to provide for her family may be more likely to attend to her concerns about obesity/health. In either case, the results of the study suggest that adequacy and moderation are not grossly affected by such conflicts. In the interest of public health, however, efforts should be taken to temper such conflicts which may perpetuate poor health outcomes.

A significant interaction between DSI and food insufficiency also was observed for the bread group. Again, lack of money cannot be attributed to differences in a woman's ability to achieve a level of adequacy and moderation similar to her more affluent peers. The most obvious explanation for this interaction is that women with limited financial resources may purchase more foods from this less expensive food group. Clearly, a given amount of money will buy a greater quantity of bread products than most other food items.

These findings support selected observed trends from Knol (24) in which low-income women with high DSI scores tended to have higher intakes from the bread group, compared to women with lower DSI scores. While these differences were not statistically significant, when components from the larger bread group were broken down into smaller subgroups, Knol found that salty snacks, a component of the larger bread group, were

highest for the High DSI tertile. Thus, especially high intakes of one component of the food group may inflate the overall servings from the larger group. In this event, high intakes of salty snacks should not be confused with high intakes of nutrient-dense complex carbohydrate items also in the bread group.

Results of the current study also revealed that intakes of fruit, milk, and vegetable groups were significantly different for DSI tertiles. For women with higher DSI scores regardless of food sufficiency or insufficiency, mean intakes of fruit, vegetables, and milk were found to be higher. This relationship between fruit intake and dietary status has been documented in previous work by both Knol (24) and Subar et al (25-26). As observed by Knol (24), when mean food group servings are highest for the High DSI tertile, food groups that have contributed to both adequacy and moderation are revealed. In fact, trends observed among DSI tertiles (Table 4) may be explained in the following way. Nutrient intake for the Low DSI tertile tended to meet neither adequacy nor moderation criterion. That is, they fell below adequacy levels and exceeded moderation levels. For Middle DSI, nutrient intake met more of adequacy criterion and some of the moderation criterion. Nutrient intake for High DSI can be characterized as having achieved more of the adequacy levels and satisfying some of the moderation components. Food insufficiency and intake from the fruit group also were significantly related. That is, mean servings of fruit among women experiencing food insufficiency were lower across all DSI tertiles when compared to food sufficient women. Given the high cost of fruit, it is reasonable to conclude that financial limitations may have affected the choice of women to

include adequate quantities of fruit in their diets. This finding, coupled by the observed relationship of meat intake with DSI and food insufficiency, suggests that limited economic resources were directed more often toward the meat group than the fruit group.

Finally, mean DSI score for the total sample (45.25 ± 15.60) may be compared to previous studies estimating DSI of female populations. In Knol's study of low income women with mean age of 49 (± 18.5) years, mean DSI score was 48.39 (± 17.50). As observed by Knol (24), the large number of women in the sample on special diets may have contributed to the relatively higher DSI score for the group, as compared to the DSI score of the current study. Comparison of mean DSI score of the current study with studies using similar age groups may be more meaningful. In an assessment of DSI in the female population aged 20 to 50, Basiotis et al (11) found a mean DSI score of 43.8. While this score was lower than that of the current study, additional findings from Basiotis' work reveal important implications for this study. When Basiotis compared DSI scores of those at or below 130% of the federal poverty level to those above 130% of the federal poverty level, the following significant differences were found: those at or below 130% the federal poverty level had a significantly lower mean score (43.9) than those above this level (46.8). While the current study found no statistical differences in DSI for those identified as food insufficient (which is driven by economic limitations), Basiotis' work suggests that dietary quality is, in fact, related to economic status.

Limitations of this study include an inability to identify subjects as pregnant, lactating or as supplement users. Variables which would allow for identification of these

characteristics were not included in the data set for Phase 1 of NHANES III but were included in the full data set released at the end of the full six year study. Failure to identify women as pregnant may have resulted in an overestimation of dietary adequacy that subsequently may have overestimated DSI scores. Specifically, pregnant women have higher RDAs for all DAS nutrients except vitamin A (compared to RDAs for both the 19-24 and 25-50 age groups) (16). Census Bureau statistics reveal that in the general population of women aged 19 to 50, approximately 10.9-11.4% of these women can be anticipated to be pregnant at a given point in time (27). Lactating women also have higher RDAs for selected nutrients which may not truly have been achieved. Because supplement users also were not identified in the available data set used for analysis, the overall nutrient intake of these women may have been underestimated. For the purposes of this study, however, DSI was assessed by nutrient intake through foods rather than a combination of foods and supplements. Further analysis of these data with the complete data sets will allow for identification of these groups and appropriate analysis to account for these conditions.

Closer analyses of smaller, more defined food groups would yield more accurate information regarding food group intakes. Development of appropriate nutrition education interventions would require examination of these six food groups as subgroups in order to identify which foods from the bread and meat groups were the greatest contributers to mean daily servings. Because intake from both of these groups can be associated with higher DSI scores among women experiencing food insufficiency,

economic and convenience factors are important considerations to include for further study.

Conclusions and Implications

Because NHANES III was designed explicitly to "demonstrate relationships between diet and health" (12, p.14) and to capture both quantitative and qualitative data reflecting the nutrition status of the US population, this data set lent itself as a most appropriate choice for secondary data analysis. The large total sample population used in NHANES III and the over-sample of minority populations allowed for the accurate analysis of both smaller subgroups and the larger cohort. In this study the selection of a population subset and the analysis of relevant variables from the database allowed for the investigation of relationships not previously studied in such broad scope.

Specifically, this study utilized NHANES III to examine food insufficiency, DSI, and food group intake in US females aged 19 to 50 years without a nutrition-related chronic disease. After determination of these measures of nutrition status, this study examined differences in the relationship between DSI and food group intake in food insufficient and food sufficient women of childbearing age. Statistical analysis revealed that the relationship between DSI and two food groups (bread and meat) differed for those experiencing food insufficiency. For these women, higher mean daily servings of bread and meat were associated with higher DSI scores. These results indicate that food insufficiency (driven by a lack of money) and quality of diet (DSI) are related to intake of

particular food groups. When examined together, this combination of variables has significant power to indicate the intake of the bread and meat food groups by food insufficient women.

Results from this study provide a basis for further examination of the data from NHANES III. Analysis of Food Guide Pyramid food groups as smaller subgroups would provide more specific information from which to build targeted educational interventions. These findings, coupled with additional analyses, also would build upon current knowledge regarding food intake patterns of women with limited financial resources to secure a safe and socially acceptable food supply (28-30). Most importantly, determination of relationships between food groups and dietary status provide direction for policy-makers concerned with assuring people of all socio-economic levels access to a healthful diet.

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Appendix

DAS Variables

The following NHANES III variable names and values were used to identify intake of nutrients by the sample population. Data were taken from the 24 hour dietary recall found in the Mobile Examination Center (MEC) adult file.

The following NHANES III variables represent nutrient intake of the subjects:

NHANES III Variable Name	Nutrient (Measurement)
DRPNPROT	protein (grams)
DRPNVARE	vitamin A (retinol equivalents)
DRPNVE	vitamin E (alpha tocopherol equivalents)
DRPNVC	vitamin C (milligrams)
DRPNVB1	thiamin (milligrams)
DRPNVB2	riboflavin (milligrams)
DRRNIAC	niacin (milligrams)
DRPNVB6	vitamin B6 (milligrams)
DRPNFOLA	folacin (micrograms)
DRPNVB12	vitamin B12 (micrograms)
DRPNCALC	calcium (milligrams)
DRPNPHOS	phosphorus (milligrams)
DRPNMAGN	magnesium (milligrams)
DRPNIRON	iron (milligrams)
DRPNZINC	zinc (milligrams)

The following assigned variable names were used to compare sample population nutrient intakes (NHANES variables above) to the RDA values:

RPRO	protein
RVITA	vitamin A
RVITE	vitamin E
RVITC	vitamin C
RVITB1	thiamin
RVITB2	riboflavin
RNIAC	niacin
RVITB6	vitamin B6
RFOLA	folacin
RVITB12	vitamin B12
RCALC	calcium
RPHOS	phosphorus
RMAGN	magnesium
RIRON	iron
RZINC	zinc

RDA Table

The following RDA table was applied to NHANES III nutrient variables to determine sample population intake of nutrients compared to age-appropriate RDAs.

```
IF HSAGEI <= 0.5 THEN RPRO=13;
IF 0.5<HSAGEI<=1.0 THEN RPRO=14;
IF 1.0<HSAGEI<4.0 THEN RPRO=16;
IF 4.0<=HSAGEI<7.0 THEN RPRO=24;
IF 7.0<=HSAGEI<11.0 THEN RPRO=28;
IF HSSEX=1 AND 11.0<=HSAGEI<15.0 THEN RPRO=45;
IF HSSEX=1 AND 15.0<=HSAGEI<19.0 THEN RPRO=59;
IF HSSEX=1 AND 19.0<=HSAGEI<25.0 THEN RPRO=58;
IF HSSEX=1 AND HSAGEI>=25.0 THEN RPRO=63;
IF HSSEX=2 AND 11.0<=HSAGEI<15.0 THEN RPRO=46;
IF HSSEX=2 AND 15.0<=HSAGEI<19.0 THEN RPRO=44;
IF HSSEX=2 19.0<=HSAGEI<25.0 THEN RPRO=46;
IF HSSEX=2 AND HSAGEI>=25.0 THEN RPRO=50;
IF GEST=PG THEN RPRO=60;
IF GEST=BF1 THEN RPRO=65;
IF GEST=BF2 THEN RPRO=62;

IF HSAGEI <=1.0 THEN RVITA=375;
IF 1.0<HSAGEI<4.0 THEN RVITA=400;
IF 4.0<=HSAGEI<7.0 THEN RVITA=500;
IF 7.0<=HSAGEI<11.0 THEN RVITA=700;
IF HSSEX=1 AND HSAGEI >=11.0 THEN RVITA=1000;
IF HSSEX=2 AND HSAGEI>=11.0 THEN RVITA=800;
IF GEST=PG THEN RVITA=800;
IF GEST=BF1 THEN RVITA=1300;
IF GEST=BF2 THEN RVITA=1200;

IF HSAGEI <= 0.5 THEN RVITE=3;
IF 0.5<HSAGEI<=1.0 THEN RVITE=4;
IF 1.0<HSAGEI<4.0 THEN RVITE=6;
IF 4.0<=HSAGEI<11.0 THEN RVITE=7;
IF HSSEX=1 AND HSAGEI>=11.0 THEN RVITE=10;
IF HSSEX=2 AND HSAGEI>=11.0 THEN RVITE=8;
IF GEST=PG THEN RVITE=10;
IF GEST=BF1 THEN RVITE=12;
IF GEST=BF2 THEN RVITE=11;

IF HSAGEI <= 0.5 THEN RVITC=30;
IF 0.5<HSAGEI<=1.0 THEN RVITC=35;
IF 1.0<HSAGEI<4.0 THEN RVITC=40;
IF 4.0<=HSAGEI<11.0 THEN RVITC=45;
IF 11.0<=HSAGEI<15.0 THEN RVITC=50;
IF HSAGEI>=15.0 THEN RVITC=60;
IF GEST=PG THEN RVITC=70;
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IF GEST=B1 THEN RVITC=95;
IF GEST=B2 THEN RVITC=90;
IF HSAGEI <= 0.5 THEN RVITB1=0.3;
IF 0.5<HSAGEI<=1.0 THEN RVITB1=0.4;
IF 1.0<HSAGEI<4.0 THEN RVITB1=0.7;
IF 4.0<=HSAGEI<7.0 THEN RVITB1=0.9;
IF 7.0<=HSAGEI<11.0 THEN RVITB1=1.0;
IF HSSEX=1 AND 11.0<=HSAGEI<15.0 THEN RVITB1=1.3;
IF HSSEX=1 AND 15.0<=HSAGEI<51.0 THEN RVITB1=1.5;
IF HSSEX=1 AND HSAGEI>=51.0 THEN RVITB1=1.2;
IF HSSEX=2 AND 11.0<=HSAGEI<51.0 THEN RVITB1=1.1;
IF HSSEX=2 AND HSAGEI>=51.0 THEN RVITB1=1.0;
IF GEST=PG THEN RVITB1=1.5;
IF GEST=B1 OR GEST=B2 THEN RVITB1=1.6;

IF HSAGEI <= 0.5 THEN RVITB2=0.4;
IF 0.5<HSAGEI<=1.0 THEN RVITB2=0.5;
IF 1.0<HSAGEI<4.0 THEN RVITB2=0.8;
IF 4.0<=HSAGEI<7.0 THEN RVITB2=1.1;
IF 7.0<=HSAGEI<11.0 THEN RVITB2=1.2;
IF HSSEX=1 AND 11.0<=HSAGEI<15.0 THEN RVITB2=1.5;
IF HSSEX=1 AND 15.0<=HSAGEI<19.0 THEN RVITB2=1.8;
IF HSSEX=1 AND 19.0 <=HSAGEI<51.0 THEN RVITB2=1.7;
IF HSSEX=1 AND HSAGEI>=51.0 THEN RVITB2=1.4;
IF HSSEX=2 AND 11.0<=HSAGEI<51.0 THEN RVITB2=1.3;
IF HSSEX=2 AND HSAGEI>=51.0 THEN RVITB2=1.2;
IF GEST=PG THEN RVITB2=1.6;
IF GEST=B1 THEN RVITB2=1.8;
IF GEST=B2 THEN RVITB2=1.7;

IF HSAGEI <= 0.5 THEN RNIAC=5;
IF 0.5<HSAGEI<=1.0 THEN RNIAC=6;
IF 1.0<HSAGEI<4.0 THEN RNIAC=9;
IF 4.0<=HSAGEI<7.0 THEN RNIAC=12;
IF 7.0<=HSAGEI<11.0 THEN RNIAC=13;
IF HSSEX=1 AND 11.0<=HSAGEI<15.0 THEN RNIAC=17;
IF HSSEX=1 AND 15.0<=HSAGEI<19.0 THEN RNIAC=20;
IF HSSEX=1 AND 19.0 <=HSAGEI<51.0 THEN RNIAC=19;
IF HSSEX=1 AND HSAGEI>=51.0 THEN RNIAC=15;
IF HSSEX=2 AND 11.0<=HSAGEI<51.0 THEN RNIAC=15;
IF HSSEX=2 AND HSAGEI>=51.0 THEN RNIAC=13;
IF GEST=PG THEN RNIAC=17;
IF GEST=B1 OR GEST=B2 THEN RNIAC=20;

IF HSAGEI <= 0.5 THEN RVITB6=0.3;
IF 0.5<HSAGEI<=1.0 THEN RVITB6=0.6;
IF 1.0<HSAGEI<4.0 THEN RVITB6=1.0;
IF 4.0<=HSAGEI<7.0 THEN RVITB6=1.1;
IF 7.0<=HSAGEI<11.0 THEN RVITB6=1.4;
IF HSSEX=1 AND 11.0<=HSAGEI<15.0 THEN RVITB6=1.7;
IF HSSEX=1 AND HSAGEI>=15.0 THEN RVITB6=2.0;
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IF HSSEX=2 AND 11.0<=HSAGEI<15.0 THEN RVITB6=1.4;
IF HSSEX=2 AND 15.0<=HSAGEI<19.0 THEN RVITB6=1.5;
IF HSSEX=2 AND HSAGEI>=19.0 THEN RVITB6=1.6;
IF GEST=PG THEN RVITB6=2.2;
IF GEST=B1 OR GEST=B2 THEN RVITB6=2.1;

IF HSAGEI <= 0.5 THEN RFOLA=25;
IF 0.5<HSAGEI<=1.0 THEN RFOLA=35;
IF 1.0<HSAGEI<4.0 THEN RFOLA=50;
IF 4.0<=HSAGEI<7.0 THEN RFOLA=75;
IF 7.0<=HSAGEI<11.0 THEN RFOLA=100;
IF 11.0<=HSAGEI<15.0 THEN RFOLA=150;
IF HSSEX=1 AND HSAGEI>=15.0 THEN RFOLA=200;
IF HSSEX=2 AND HSAGEI>=15.0 THEN RFOLA=180;
IF GEST=PG THEN RFOLA=400;
IF GEST=B1 THEN RFOLA=280;
IF GEST=B2 THEN RFOLA=260;

IF HSAGEI <= 0.5 THEN RVITB12=0.3;
IF 0.5<HSAGEI<=1.0 THEN RVITB12=0.5;
IF 1.0<HSAGEI<4.0 THEN RVITB12=0.7;
IF 4.0<=HSAGEI<7.0 THEN RVITB12=1.0;
IF 7.0<=HSAGEI<11.0 THEN RVITB12=1.4;
IF HSAGEI>=11.0 THEN RVITB12=2.0;
IF GEST=PG THEN RVITB12=2.2;
IF GEST=B1 OR BEST=B2 THEN RVITB12=2.6;

IF HSAGEI <= 0.5 THEN RCALC=400;
IF 0.5<HSAGEI<=1.0 THEN RCALC=600;
IF 1.0<HSAGEI<11.0 THEN RCALC=800;
IF 11.0<=HSAGEI<25.0 THEN RCALC=1200;
IF HSAGEI>=25.0 THEN RCALC=800;
IF GEST=PG OR GEST=B1 OR GEST=B2 THEN RCALC=1200;

IF HSAGEI <= 0.5 THEN RPHOS=300;
IF 0.5<HSAGEI<=1.0 THEN RPHOS=500;
IF 1.0<HSAGEI<11.0 THEN RPHOS=800;
IF 11.0<=HSAGEI<25.0 THEN RPHOS=1200;
IF HSAGEI>=25.0 THEN RPHOS=800;
IF GEST=PG OR GEST=B1 OR GEST=B2 THEN RPHOS=1200;

IF HSAGEI <= 0.5 THEN RMAGN=40;
IF 0.5<HSAGEI<=1.0 THEN RMAGN=60;
IF 1.0<HSAGEI<4.0 THEN RMAGN=80;
IF 4.0<=HSAGEI<7.0 THEN RMAGN=120;
IF 7.0<=HSAGEI<11.0 THEN RMAGN=170;
IF HSSEX=1 AND 11.0<=HSAGEI<15.0 THEN RMAGN=270;
IF HSSEX=1 AND 15.0<=HSAGEI<19.0 THEN RMAGN=400;
IF HSSEX=1 AND HSAGEI >=19 THEN RMAGN=350;
IF HSSEX=2 AND 11.0<=HSAGEI<15.0 THEN RMAGN=280;
IF HSSEX=2 AND 15.0<=HSAGEI<19.0 THEN RMAGN=300;
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```
IF HSSEX=2 AND HSAGEI>=19.0 THEN RMAGN=280;
IF GEST=PG THEN RMAGN=320;
IF GEST=B1 THEN RMAGN=355;
IF GEST=B2 THEN RMAGN=340;

IF HSAGEI <= 0.5 THEN RIRON=6;
IF 0.5<HSAGEI<11.0 THEN RIRON=10;
IF HSSEX=1 AND 11.0<=HSAGEI<19.0 THEN RIRON=12;
IF HSSEX=1 AND HSAGEI>=19.0 THEN RIRON=10;
IF HSSEX=2 AND 11.0<=HSAGEI<51.0 THEN RIRON=15;
IF HSSEX=2 AND HSAGEI>=51.0 THEN RIRON=10;
IF GEST=PG THEN RIRON=30;
IF GEST=B1 OR GEST=B2 THEN RIRON=15;

IF HSAGEI<=1.0 THEN RZINC=5;
IF 1.0<HSAGEI<11.0 THEN RZINC=10;
IF HSSEX=1 AND HSAGEI>=11.0 THEN RZINC=15;
IF HSSEX=2 AND HSAGEI>=11.0  THEN RZINC=12;
IF GEST=PG THEN RZINC=15;
IF GEST=B1 THEN RZINC=19;
IF GEST=B2 THEN RZINC=16;
```

Determination of DAS, DMS, DSI Scores

Determination of Dietary Status Index (DSI) requires calculation of Dietary Adequacy Score (DAS) and Dietary Moderation Score (DMS). Data for both DAS and DMS were taken from the 24 hour dietary recall in the Mobile Examination Center adult file.

Dietary Adequacy Score (DAS)

DAS expresses the achievement of RDAs for 15 nutrients on a 15 point scale. For each nutrient in which at least 100% of the RDA is met, one point is assigned. The following formulas were used to calculate intake as percent of RDA. For each formula which indicates an intake of at least 100% of the RDA, one point was assigned.

Example: PPRO = 89% (no point assigned)
PPRO = 112% (one point assigned)

PPRO=(DRPNPROT/RPRO) x 100;
PVITA=(DRPNVARE/RVITA) x 100;
PVITE=(DRPNVE/RVITE) x 100;
PVITC=(DRPNVC/RVITC) x 100;
PVITB1=(DRPNVB1/RVITB1) x 100;
PVITB2=(DRPNVB2/RVITB2) x 100;
PNIAC=(DRPNIAC/RNIAC) x 100;
PVITB6=(DRPNVB6/RVITB6) x 100;
PFOLA=(DRPNFOLA/RFOLA) x 100;
PVITB12=(DRPNVB12/RVITB12) x 100;
PCALC=(DRPNCALC/RCALC) x 100;
PPHOS=(DRPNPHOS/RPHOS) x 100;
PMAGN=(DRPNMAGN/RMAGN) x 100;
PIRON=(DRPNIRON/RIRON) x 100;
PZINC=(DRPNZINC/RZINC) x 100;

Following comparison of individual intakes to RDAs, the total point value (maximum of 15) was determined. Because Dietary Adequacy Score is scored on a scale of 100 points, the total point values were multiplied by a factor of 6.66 to determine individual Dietary Adequacy Score.

Dietary Moderation Score (DMS)

DMS reflects dietary adherence to four of the *Diet and Health* goals. DMS is calculated by the assignment of one point for adherence to each of the following guidelines:

1) limiting saturated fat to ≤ 10% of total calories
2) limiting fat intake to ≤ 30% of total calories

3) limiting sodium intake to ≤ 2400 milligrams per day
4) limiting dietary cholesterol to ≤ 300 milligrams per day

The following NHANES III variables were used in the calculation of DMS:

DRPNKSF (% kilocalories from saturated fat)
DRPNKF (% kilocalories from total fat)
DRPNSODI (milligrams sodium)
DRPNCHOL (milligrams cholesterol)

To calculate DMS, one point was assigned for meeting each of these four criterion:

DRPNKSF <=10
DRPNKF <= 30
DRPNSODI <= 2400
DRPNCHOL <= 300

The total point value (maximum of 4 points) then was multiplied by a factor of 25 to determine DMS.

Dietary Status Index (DSI)

Following calculation of DAS and DMS, DSI was calculated using the following formula:

$$DSI = \frac{(DAS \times 6.66) + (DMS \times 25)}{2}$$

Determination of Food Insufficiency

The following NHANES variables were used in the determination of food insufficiency. All data were taken from the Household Family Questionnaire and the Mobile Examination Center adult file.

NHANES Variable Name	Information Elicited (Score)
Household and individual responses from Household Adult Questionnaire:	
HFF4	enough to eat (1), sometimes not enough to eat (2), or often not enough to eat (3)
HFF5	in past month, number of days with no food or money to buy food (n of days)
HFF6C	if HFF5 ≥1 day, not enough money, food stamps, or WIC vouchers to buy food or beverages given as reason (1)
Individual responses from MEC file:	
DRPQ5	number of days in past month with no food or money to buy food (n of days)
DRPQ6	if DRPQ5 ≥1 day, reason was a lack of money (1)

Food insufficiency was assessed by the following responses:

HFF4 = 2 or 3 and HFF5 ≥ 1 and HFF6 =1: Individual food insufficiency

DRPQ5 ≥ 1 and DRPQ6 = 1: Household Food Insufficiency

A subject found to be food insufficient by the individual or household criteria was identified as food insufficient.

Food Group Analysis

Analysis of food group intake was made using the following NHANES III variables. Data for these calculations was taken from the food frequency found in the Household Adult Questionnaire.

NHANES Variables	Food	Food Group
HAN5CS	high fiber cereal	BREAD
HAN5DS	fortified cereal	
HAN5ES	other cereal	
HAN5FS	cooked cereal	
HAN5GS	white bread	
HAN5HS	dark bread	
HAN5IS	corn bread	
HAN5JS	flour tortilla	
HAN5KS	rice	
HAN5LS	salty snacks	
HAN2BS	spaghetti	
HAN4AS	carrots	VEGETABLE
HAN4BS	broccoli	
HAN4CS	brussel sprouts	
HAN4DS	white potatoes	
HAN4ES	sweet potatoes	
HAN4FS	tomatoes	
HAN4GS	spinach	
HAN4HS	salad	
HAN4IS	cabbage	
HAN4JS	chili peppers	
HAN4KS	peppers	
HAN4LS	other vegetables	
HAN3AS	orange juice	FRUIT
HAN3BS	other juice	
HAN3CS	citrus fruits	
HAN3DS	melons	
HAN3ES	peaches	
HAN3FS	other fruit	
HAN2AS	soup and stew	MEAT
HAN2CS	bacon	
HAN2DS	organ meats	
HAN2ES	beef	
HAN2FS	pork and ham	
HAN2GS	shrimp	
HAN2HS	fish	
HAN2IS	chicken	
HAN2JS	eggs	
HAN1HS	pizza	
HAN5AS	dried beans	

HAN5BS	peanuts	
HAN1AS	chocolate milk	MILK
HAN1BS	milk on cereal	
HAN1ES	yogurt	
HAN1FS	ice cream	
HAN1GS	cheese	
HAN1IS	cheese dishes	
HAN6AS	cakes	OTHER
HAN6BS	chocolate candy	
HAN6CS	tang	
HAN6DS	diet soda	
HAN6ES	soda	
HAN6FS	coffee	
HAN6GS	tea	
HAN6HS	beer	
HAN6IS	wine	
HAN6JS	liquor	
HAN7AS	margarine	
HAN7BS	butter	
HAN7CS	oil and vinegar	

To find daily servings of each food group, the total number of servings per month (from the food frequency questionnaire) was divided by 30.

VITA

Leigh Miller was born in Memphis, Tennessee on March 8, 1972 to Dr. and Mrs. Neil A. Miller. She attended Briarcrest Christian School and graduated in 1990. She received her Bachelor of Science in Nutrition from the University of Tennessee at Knoxville in 1994 and entered the graduate program in Nutrition and dietetic internship at the University of Tennessee at Knoxville the following year. While earning her degree, she performed block field experiences at The Willough at Naples in Naples, Florida and at Food For Survival, The New York City Food Bank. Throughout her graduate program, she worked with community anti-hunger organizations and was an instructor for an undergraduate course in Nutrition. She became a Registered Dietitian and graduated from the University of Tennessee at Knoxville in December 1997 with Master of Science in Nutrition and Master of Public Health degrees. Her most cherished acquisition during graduate work was a dog named Grendel, a gift from her parents.